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CUMBERLAND PLAIN ASSESSMENT REPORT

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

How to navigate the Assessment Report

We recommend viewing the Cumberland Plain Assessment Report (the Assessment Report) using Adobe Acrobat Reader. To access and use Adobe Acrobat Reader follow the relevant steps of this process:

- Download and install Adobe Acrobat Reader by following this link https://get.adobe.com/reader/
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- Right click on the report and select 'Open with Adobe Acrobat Reader'
- Click the bookmark symbol on the left side of the Adobe interface - the headings for each report Part will appear
- Click on the > symbol next to the Part headings - the headings for each report Chapter will appear

Navigate through the report by clicking on the Part and Chapter headings.

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The Assessment Report presents a range of maps. Maps are either presented as an A4 image within chapters of the document, or as a layered PDF file which is to be opened outside of the Assessment Report. Layered PDFs allow for the viewer to manipulate the visibility of data in the maps for ease of use.

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Terms and acronyms used in the Cumberland Plain Assessment Report

Term	Acronym	Description
Accredited assessor		A BCAR can only be prepared by a person accredited under the accreditation scheme developed under Section 6.10 of the *Biodiversity Conservation Act 2016*.
Action		Activities that directly support the delivery of one or more commitments in the Plan. Actions may be amended using adaptive management throughout the life of the Plan.
Active restoration		When entering a Biodiversity Stewardship Agreement, a landholder can elect to undertake active restoration management actions which generate additional biodiversity credits. They include actions to restore or improve ecological features in a landscape, such as habitat enhancement, targeted supplementary planting to augment habitat and the control of high threat exotic vegetation. *See also required management actions*.
Adaptive management		A structured, iterative approach to help determine how management actions can be most effective in achieving the Plan's outcomes. It allows the implementation of the conservation program to respond to changing circumstances, and ensure the actions are delivering the commitments and meeting the outcomes.
Already protected land		Used to describe areas that are already protected from development for environmental reasons, including national parks, nature reserves, biodiversity stewardship sites and other protected lands.
Asset Protection Zone	APZ	A buffer zone between a bushfire hazard and buildings. It is managed to minimise fuel loads and reduce potential radiant heat levels, flames, localised smoke and ember attack. The appropriate APZ distance is based on vegetation type, slope and the nature of the development.
Avoided land		Land that has been avoided from development in the nominated areas through the conservation planning process undertaken as part of developing the Plan. This includes land: • Avoided for biodiversity. This is land that has high biodiversity values to be protected and that has been avoided from development within urban capable land • Avoided for other purposes. This is land that cannot be feasibly developed due to topography (area of steep slope within avoided lands) or is land that is mapped as a riparian corridor associated with a Strahler order 3 stream or above (or Strahler order 2 streams with mapped vegetation, adjacent to avoided lands or that contribute to landscape connectivity)
BioBanking agreements		Agreements administered under the repealed *Threatened Species Conservation Act 1995*. These agreements are now called Biodiversity Stewardship Agreements under the *Biodiversity Conservation Act 2016*.
BioBanking Assessment Method	BBAM	An assessment method made under the repealed *Threatened Species Conservation Act 1997* now replaced by the Biodiversity Assessment Methodology under the *Biodiversity Conservation Act 2016*.

Term	Acronym	Description
Biodiversity Assessment Method	BAM	An assessment method made under the *Biodiversity Conservation Act 2016* that is used to determine the impact of development and other activities on biodiversity values. The Biodiversity Assessment Method was used to prepare the BCAR component of this Assessment Report.
Biodiversity certification		A streamlined biodiversity assessment process for areas of land that are proposed for development provided for under the *Biodiversity Conservation Act 2016*. The process identifies areas that can be developed after they are certified and measures to offset the impacts of development. Where land is certified, development may proceed without the usual requirement for site by site assessment of biodiversity impacts.
Biodiversity Certification Assessment Report	BCAR	A report setting out the outcomes of an assessment of the impacts of a development on biodiversity values in accordance with the Biodiversity Assessment Method. It is required under the *Biodiversity Conservation Act 2016* and is submitted as part of an application for biodiversity certification.
Biodiversity Conservation Act 2016	BC Act	The primary biodiversity law in NSW. Establishes the Biodiversity Offset Scheme and provides for the biodiversity certification of land.
Biodiversity Conservation Regulation 2017	BC Regulation	Provides supporting regulatory detail under the *Biodiversity Conservation Act 2016.*
Biodiversity Conservation Trust	BCT	A statutory not-for-profit body established under Part 10 of the *Biodiversity Conservation Act 2016* to encourage and support landholders across NSW to participate in private land conservation.
Biodiversity Investment Opportunities Map	BIO Map	A map of core habitat areas and habitat corridors identified in western Sydney to guide investment in biodiversity conservation.
Biodiversity Offsets Scheme	BOS	A framework under the *Biodiversity Conservation Act 2016* to avoid, minimise and offset impacts on biodiversity from development and clearing, and to ensure land that is used to offset impacts is secured in-perpetuity with an appropriate level of funding to ensure management actions identified are implemented.
Biodiversity risk weighting	BRW	The Biodiversity Assessment Method uses a biodiversity risk weighting to evaluate the ecological risks of threatened entities from the biodiversity offsets scheme. The risk weighting is comprised of two components: • Sensitivity to loss – this considers the increased threat posed to an entity from offsetting the loss of habitat or population, and • Sensitivity to potential gain – this considers the ability of a species to respond to improvements in habitat condition at an offset site
Biodiversity Stewardship Agreement	BSA	A voluntary agreement between a landholder and the Biodiversity Conservation Trust to permanently protect and manage an area of their land to improve its biodiversity values. It enables landholders to generate an income through trading biodiversity credits. Credits are generated by the expected improvement in biodiversity under management at the site.

Term	Acronym	Description
Biodiversity values		Biodiversity values are defined in the *Biodiversity Conservation Act 2016* as including: *(a) vegetation integrity—being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state* *(b) habitat suitability—being the degree to which the habitat needs of threatened species are present at a particular site* Impacts of the development on biodiversity values are required to be considered under the Biodiversity Assessment Method
Biodiversity Values Map		The Biodiversity Values Map identifies land with high biodiversity value that is particularly sensitive to impacts from development and clearing. The map forms part of the Biodiversity Offsets Scheme Threshold which is one of the triggers for determining whether the Biodiversity Offset Scheme applies to a clearing or development proposal.
BioNet Atlas		NSW database managed by EES containing data on species records.
BioNet Vegetation Classification		NSW database managed by EES containing data on Plant Community Types. *See also Plant Community Types.*
Candidate species		A Species Credit Species requiring assessment in the BCAR under the Biodiversity Assessment Method
Category 1 matters		Matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* that need detailed assessment in the Strategic Assessment Report. These matters are reliant on the Strategic Assessment Area, have some potential to be impacted (directly, indirectly or cumulatively), and are addressed in detail in this report.
Category 2 matters		Matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* that do not need further assessment in the Strategic Assessment Report. These matters are not reliant on the Strategic Assessment Area, are subject to no or very low risk of impacts (directly, indirectly or cumulatively), and are not addressed further in this report.
Certified – urban capable land		Land identified for future urban and industrial development, infrastructure, and intensive plant agriculture within the nominated areas that is proposed for biodiversity certification under the *Biodiversity Conservation Act 2016* and strategic approval under the *Environment Protection and Biodiversity Conservation Act 1999.* This category of land identifies where future development is likely to occur, subject to other approvals. Also referred to as urban capable land in this Assessment Report
Class of action approval		Class of actions describe the projects covered by the approval that do not need individual referral, assessment or approval under the *Environment Protection and Biodiversity Conservation Act 1999* provided they are undertaken in accordance with the endorsed final strategic assessment. Classes of actions covered under the Plan are: • Urban and industrial development • Infrastructure • Intensive plant agriculture • Major transport corridors These are referred to as 'development types' in the Assessment Report

Term	Acronym	Description
Commonwealth Government Department of Agriculture, Water and the Environment	DAWE	The Commonwealth Government department primarily responsible for environment protection and conservation at a national level.
Commitment		A defined milestone under the Plan which will be met through the delivery of the actions. *See also Action*
Connectivity		Areas that connect different areas of habitat, facilitating movement of threatened and more common species across their distribution. The presence of connectivity on a site contributes to the biodiversity value of that site at the landscape scale. Connectivity can be identified at different scales depending on the target species and can include broad biodiversity corridors, a local corridor identified by a council, flyways for migratory species or a riparian corridor of a stream, wetland or estuary.
Conservation lands		Conservation lands are sites of high biodiversity value identified for protection under the Plan to offset the residual impacts of the development on biodiversity values. Conservation lands include locations where ecological restoration may also occur.
Conservation Priorities Method		A systematic and repeatable method developed as part of the Plan for determining and prioritising new conservation lands. The method was used to determine the Strategic Conservation Area.
Conservation program		A package of commitments and actions to offset the residual impacts of the development under the Plan on biodiversity values and to ensure that the Plan's outcomes are delivered.
Cumberland Interim Biogeographic Regionalisation for Australia subregion (or 'Cumberland subregion')	IBRA subregion	Developed by the Commonwealth Government as a key planning tool to identify land for conservation. It has since become a spatial mapping and information source on vegetation communities and ecosystems across Australia. The Cumberland IBRA subregion is the main focus of this Plan, with most of the Plan Area occurring within this subregion.
Cumberland Plain		A relatively flat, broad geographic basin located within the Cumberland IBRA subregion in the Sydney region, identified by dominant older shale and younger alluvial geology.
Cumberland Plain Assessment Report	Assessment Report	Refers to this report. The Assessment Report assesses the potential impacts of the proposed development under the Plan on biodiversity values and other matters regulated under the NSW and Commonwealth biodiversity laws. The report is a single report prepared to meet the statutory requirements for both: • A Biodiversity Certification Assessment Report prepared in accordance with the Biodiversity Assessment Method under the *Biodiversity Conservation Act 2016* • A Strategic Assessment Report prepared in accordance with the Terms of Reference provided under the Part 10 Strategic Assessment Section 146 Agreement between the Commonwealth Minister for the Environment and the State of NSW under the *Environment Protection and Biodiversity Conservation Act 1999*

Term	Acronym	Description
Cumberland Plain Conservation Plan	Plan	The subject of this report. The Plan is a strategic conservation plan developed to manage and offset the impacts on biodiversity from projected growth in Western Sydney. The Plan will deliver a conservation program to protect and enhance biodiversity at a landscape scale while balancing the future needs of the local community.
Cumulative impacts		Cumulative impacts are the combined impact of past, present and future human activities and natural processes.
Derived native grasslands	DNG	Derived native grassland is a native grassland remaining after the removal or dieback of previous woody canopy vegetation (shrubs or trees), to a point where woody vegetation has less than 10 per cent cover.
Development Control Plan	DCP	Provides detailed planning and design guidelines to support the planning controls in a Local Environmental Plan or State Environmental Planning Policy.
Digital Elevation Model	DEM	A gridded layer of elevation that represents a terrain's surface.
District Plan		An integrated land use, transport and infrastructure plan outlining the local priorities and actions for implementing the *Greater Sydney Region Plan, A Plan for Growing Sydney*. There are five District Plans for the Western City, Central City, Eastern City, North and South districts.
Ecological function		Ecological function is the potential of an ecosystem to deliver a service that is dependent on ecological processes and structures. It considers how species interact with and affect their environment and involves any process that can cause change or may be changed by external influences.
Ecological restoration		Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed through actively managing restoration. It is also sometimes called rehabilitation or revegetation. *See also Reconstruction.*
Ecological Sustainable Development	ESD	Defined as using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased. Additional definitions can be found under Section 6 of the *Protection of the Environment Administration Act 1991* and Section 3A of the *Environment Protection and Biodiversity Conservation Act 1999.*
Ecosystem Credit Species	ECS	A category of species defined under the Biodiversity Assessment Method.
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	EPBC Act	The Commonwealth Government's central piece of environmental legislation, which provides a framework to protect and manage Matters of National Environmental Significance.
Environmental Planning and Assessment Act 1979 (NSW)	EP&A Act	The primary planning legislation in NSW. Provides a legal framework for land use planning, how land is to be developed and managed and the creation of environmental plans. It is administered by the NSW Department of Planning, Industry and Environment.
Environmental Planning Instruments	EPI	The collective name for Local Environmental Plans and State Environmental Planning Policies.

Term	Acronym	Description
Excluded land		Land which has been excluded from the Plan and for which NSW strategic biodiversity certification and approval through the Commonwealth strategic assessment will not be sought. These lands include: • Existing protected land, including reserves and established offset sites • Commonwealth land, such as Orchard Hills Defence Establishment • Lands already assessed as part of another development approval (Bingara Gorge), lands progressing through an alternate development assessment (Mount Gilead and Menangle Park) • Lands already developed (existing urban areas and urban land zones)
Existing North West and South West Growth Areas		The new term for the North West and South West Growth Centres.
Extent of occurrence	EOO	The area contained within the shortest continuous imaginary boundary which can be drawn to encompass all known, inferred or projected sites of present occurrence of a species or ecological community, excluding cases well outside an entity's normal distribution.
Facilitated impacts		Impacts that result from further actions (including actions by third parties) which are made possible or facilitated by the action.
Finalised priority assessment list	FPAL	List of species, ecological communities, and key threatening processes that have been nominated and approved for assessment and consideration for listing by the Minister responsible for the *Environment Protection and Biodiversity Conservation Act 1999*.
Future Transport Strategy 2056		The Future Transport Strategy is a 40-year strategy which will guide NSW transport investment over the longer term. It is an update of the 2012 Long Term Transport Master Plan for NSW.
Greater Macarthur Growth Area	GMAC	One of the four nominated areas the NSW Government has identified as the key focus for urban development to 2056 in Western Sydney.
Greater Penrith to Eastern Creek Investigation Area	GPEC	One of the four nominated areas that NSW Government has identified as the key focus for urban development to 2056 in Western Sydney.
Greater Sydney Commission	GSC	A NSW Government agency leading strategic metropolitan planning for the Greater Sydney region. Their strategic plans serve to make Greater Sydney more productive, liveable and sustainable for future generations.
Greater Sydney Region Plan		A 20-year integrated land use, transport and infrastructure plan outlining the priorities and actions for Greater Sydney.
Important Koala habitat		The term used to describe primary, secondary and tertiary movement corridors for Koala. It is the area that is critical to the long-term viability of koalas (primary corridors) as well as the areas (if enhanced) that would support the population (secondary and tertiary corridors). *See also Koala movement corridors*

Term	Acronym	Description
Important population		Important populations are defined in the Commonwealth's *Significant Impact Guidelines (Policy Statement 1.1)* as: "*Any population of a vulnerable species which meets the definition of an important population in the Commonwealth's Significant Impact Guidelines (Policy Statement 1.1) as follows:* *'A population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:* • *key source populations either for breeding or dispersal* • *populations that are necessary for maintaining genetic diversity, and/or* • *populations that are near the limit of the species range*" For the purposes of the SAR, important populations are also defined as including any population of an endangered or critically endangered species. Under the *Environment Protection and Biodiversity Conservation Act 1999*, all populations of an endangered or critically endangered species are considered to be important for the survival and recovery of the species.
Indirect impacts		Include downstream, downwind, upstream and facilitated impacts (e.g. fertilisers washed into river systems, extraction of raw materials, and construction of a dam facilitates water use).
Knowledge Based Method	KBM	Method used to map species habitat within the nominated areas, including species polygons under the Biodiversity Assessment Method, where expert reports were not prepared. Method was based on assumed presence within relevant Plant Community Types, which was refined where appropriate based on habitat or geographic constraints and species surveys.
Koala movement corridors		Koala movement corridors are areas of habitat (often but not always linear) which facilitate the movement and dispersal of koalas between habitat patches which would otherwise be disconnected. Koala movement corridors facilitate Koala population dispersal, which protects against localised extinctions, as Koalas require large, connected areas of important habitat for feeding and breeding.
Land Category		The Plan categorises land within the nominated areas into: • Certified – urban capable land • Certified – major transport corridor • Excluded land • Avoided land • Major transport corridor (strategically assessed only) • Major transport corridor tunnel (strategically assessed only)
Land Use and Infrastructure Implementation Plan	LUIIP	A strategic plan that provides an overview of future land uses and the proposed sequence of development to ensure new jobs and homes are delivered in alignment with infrastructure.
Local Aboriginal Land Council	LALC	An autonomous body which is governed by Boards elected by local Aboriginal community members every two years. LALCs were established under the Aboriginal Land Rights Act 1983 as the elected representatives for Aboriginal people in NSW. The Plan Area includes three LALCs: Deerubbin, Tharawal and Gandangara.
Local Environmental Plan	LEP	An environment planning instrument that guides planning and development decisions within a local government area in NSW. This is achieved through zoning and development controls, which provide a framework for the way land can be used.

Term	Acronym	Description

Major transport corridors		The major transport corridors are part of the NSW Government's planning for the long-term transport needs of Western Sydney by identifying and protecting corridors of land that can be used to deliver road and rail infrastructure when needed in the future. The transport infrastructure will be constructed and delivered to 2056. The major transport corridors are subject to different statutory approvals under the Plan and are categorised in the Assessment Report to reflect this:
		• Major transport corridors within the nominated areas are subject to biodiversity certification under the *Biodiversity Conservation Act 2016* and approval under Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999*. These are referred to as: Certified - major transport corridor
		• Major transport corridors outside the nominated areas are subject to approval under Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999* only. These are referred to as:
		  o Major transport corridor (strategically assessed only)
		  o Major transport corridor tunnel (strategically assessed only)
		Note that a small part of the tunnel section of the major transport corridors occurs within a nominated area (GMAC), but this is not subject to biodiversity certification under the *Biodiversity Conservation Act 2016*

Management action		An action under a Biodiversity Stewardship Agreement required to improve the condition of native vegetation or species habitat. These could include activities such as native vegetation management (restoring native vegetation, retaining and managing regrowth, nutrient control), pest animal control, weed management, among others.
Matters of National Environmental Significance	MNES	Defined under the *Environment Protection and Biodiversity Conservation Act 1999* as: • Listed threatened species and communities • Migratory species • Wetlands of international importance (listed under Ramsar) • Commonwealth marine environment • World Heritage properties • National Heritage places • The Great Barrier Reef Marine Park • Nuclear actions • A water resource, in relation to coal seam gas development and large coal mining development
Monitoring, Evaluation and Reporting	MER	The process of tracking and reviewing projects over time to ensure outcomes are met. For the Plan, this term is referred to as the 'evaluation program' and will provide assurance that Plan's outcomes and commitments are being satisfied and clarity for delivery partners on how to appropriately measure and report in a coordinated manner.
Native vegetation		Native vegetation is any plant native to NSW prior to European settlement, defined in Part 5A of the *Local Land Services Act 2013*. It can also include any plant, living or dead, in mapped Category 2-vulnerable land and generally excludes marine vegetation. Native vegetation species when occurring together form native vegetation communities, which in NSW are called Plant Community Types. *See also Plant Community Types*

Term	Acronym	Description
Nominated area		A nominated area is an area in Western Sydney identified for future growth which seek approvals through the Plan under the *Biodiversity Conservation Act 2016* and *Environment Protection and Biodiversity Conservation Act 1999*. These areas include: • Wilton Growth Area • Greater Macarthur Growth Area • Western Sydney Aerotropolis • Greater Penrith to Eastern Creek Investigation Area
Non-offsettable grassland	NoG	Comprises grassland vegetation zones with a vegetation integrity score of <15 and does not require offsetting for the associated Plant Community Type under the Biodiversity Conservation Method.
NSW (Mitchell) Landscapes		Mitchell Landscapes were mapped in 2002 using a combination of landsystems in the west of NSW and geology and Digital Elevation Model (DEM) in the east of NSW. There have been a number of new versions since the original mapping. The most recent is version 3.1.
NSW Environment Energy and Science	EES	The NSW Government department responsible for environment protection and conservation of biodiversity amongst other things. Formerly known as Office of Environment and Heritage (OEH).
NSW Government Department of Planning, Industry and Environment	The Department	The NSW Government department responsible for effective and sustainable planning and the development of industry to support growth.
NSW Koala Strategy		Identifies a set of short-term actions as part of a longer-term goal to stabilise and increase koala populations in NSW.
NSW Office of Environment and Heritage	OEH	A former office of the NSW Government from 2011 to 2019. Now known as NSW Environment Energy and Science.
Office of the NSW Chief Scientist & Engineer.		An office of the NSW Government with four key functions: • Independent Advice to government on scientific issues • Research Support – the office manages the NSW Government's Research Attraction and Acceleration Program • Industry Development – the office brings academia, government and industry together to drive the commercialisation of research excellence • Science Outreach and Education – the office is committed to ensuring that both students and the general public are given the opportunity to engage with science and scientists
Offset location		An 'offset location' is a site where one or more populations and habitat of the species has been confirmed through surveys or an expert report as being present. Offset location sites may be reserves or BSA sites. For a biodiversity stewardship site, this means credits representing a reasonable proportion of habitat and/or number of individuals of a local population of the threatened species are purchased and retired against the Plan's offset targets.
Outcome		An outcome is a reported or measurable result of a desired goal. In the Plan, it is the intended environmental, economic or social impact or value of delivering the Plan's commitments.

Term	Acronym	Description
Outer Sydney Orbital	OSO	Outer Sydney Orbital (Stage 1) from Palmyra Avenue to the Hume Motorway and remaining Outer Sydney Orbital 1 provides for a future north south motorway and freight rail line.
Plan Area		The area covered by the Cumberland Plain Conservation Plan, which covers around 200,000 hectares and includes the Cumberland IBRA subregion and some minor areas of the adjacent Sydney Cataract and Wollemi IBRA subregions. It extends from 10 kilometres north of Windsor to Picton in the south, and from the Hawkesbury-Nepean River in the west to east near Liverpool. It includes sections of eight Local Government Areas – Wollondilly, Camden, Campbelltown, Liverpool, Fairfield, Penrith, Blacktown and Hawkesbury.
Plant Community Type	PCT	The community-level grouping used in NSW's planning and assessment tools and vegetation mapping programs. They are identified in the BioNet Vegetation Classification (VIS) database.
Precinct planning		Ensures that nominated areas are strategically planned and infrastructure is delivered in a coordinated manner. The program identifies the development intent and development capacity across an entire precinct, through the allocation of housing choices, built form, infrastructure, and environmental and open space desires.
Prescribed impact		Prescribed impacts are impacts on biodiversity values which are not related to, or are in addition to, native vegetation clearing and habitat loss. Prescribed impacts are required to be assessed under the Biodiversity Assessment Method.
Primary corridors		Movement corridors for Koala that are defined as 'connected areas of Koala habitat that are contiguous (gaps between trees less than 100 metres) and together contain greater than 380 ha of Koala habitat'.
Protected Koala habitat		Koala habitat that has been included in the Plan's strategic conservation area and/or the avoided land. It includes some areas of cleared land that may be restored to enhance koala corridors and habitat.
Protected matters search tool	PMST	A database that identifies whether MNES or other matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* are likely to occur within an area or vicinity.
Ramsar Wetlands		A list of Wetlands of International Importance identified in the Ramsar Convention, which is maintained by the Commonwealth.
Reconstruction		An ecological restoration approach where the appropriate biota needs to be entirely or almost entirely reintroduced as they cannot regenerate or recolonise within feasible timeframes, even after expert assisted regeneration interventions. *See also Ecological restoration*
Reserves		Reserves are conservation lands of high biodiversity value typically managed by NSW National Parks and Wildlife Services or councils. Reserves can include national parks, nature reserves, regional parks, council reserves and community reserves.

Term	Acronym	Description
Riparian		Riparian refers to lands that relate to waterways and parts of the landscape influenced by streams and flowing fresh water. The riparian buffer is defined in the Biodiversity Assessment Method as being within a certain distance from the top of the bank of a waterway of particular order.
Saving Our Species program	SOS	The Saving Our Species program is an initiative in which the NSW Government is investing $100 million over five years (from 2016 to 2021) to protect threatened species from extinction.
Secondary corridors		Movement corridors for Koala that are defined as: 'smaller movement corridors that either have 'pinch points' which become narrow to less 50 metres wide, or that are not connected at both ends to other koala habitat'.
State Environmental Planning Policy	SEPP	An environmental planning instrument that deals with matters of State or regional environmental planning significance.
Serious and irreversible impacts	SAII	A determination of whether an impact is serious and irreversible is made in accordance with the principles prescribed in section 6.7 of the *Biodiversity Conservation Regulation 2017*. Threatened species and ecological communities will be at risk of serious and irreversible impacts if they are in a rapid rate of decline, have a very small population size, are severely degraded or disrupted, have a very limited geographic distribution or are unlikely to respond to measures to improve habitat.
Special Infrastructure Contribution		Levy contributions from developers to fund the delivery of State and regional infrastructure required to support a growing population, such as roads, public transport, health facilities, emergency services, schools, and open space and provide for biodiversity management.
Species Credit Species	SCS	A category of species defined under the Biodiversity Assessment Method
Species Distribution Model	SDM	Statistical models used to estimate the relationship between species records at sites and the environmental and/or spatial characteristics of those sites. Once this relationship has been estimated, the SDM can be used to predict other locations in the landscape where the species is likely to occur. Species Distribution Modelling was undertaken for Commonwealth listed Category 1 species mainly outside the nominated areas, where adequate species records were available to develop a model.
Strategic assessment		Landscape-scale assessments undertaken under Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999*. Unlike project-by-project assessments, which look at individual actions, strategic assessments can consider a much broader set of actions over a much larger scale and timeframe, such as a plan, policy or program.
Strategic Assessment Agreement		The formal agreement between the Commonwealth Minister for Environment and the State of NSW to enter into the Strategic Assessment for the Cumberland Plain Conservation Plan. It is a mandatory requirement under the *Environment Protection and Biodiversity Conservation Act 1999*, and formally establishes the expectations of both parties.
Strategic Assessment Area		The area subject to assessment of impacts on biodiversity values in the Strategic Assessment Report under the *Environment Protection and Biodiversity Conservation Act 1999*. The Assessment Report defines the assessment area for the Strategic Assessment Report as the Plan Area.
Strategic Assessment Report	SAR	An assessment report done in accordance with the Terms of Reference for the strategic assessment provided under the Strategic Assessment Agreement. *See also Strategic Assessment Agreement.*

Term	Acronym	Description
Strategic biodiversity certification		A form of biodiversity certification available only to planning authorities such as the Department of Planning and Environment, to support significant regional development and planning processes.
Strategic Conservation Area	SCA	An area of high biodiversity value determined using the Conservation Priorities Method. It contains large remnants of native vegetation with good connectivity, or areas with the potential to enhance connectivity in the Plan Area. The Strategic Conservation Area will be used to identify potential conservation lands for further investigation.
Strategic Conservation Planning		A landscape-scale approach to assessing and protecting biodiversity upfront in planning for large-scale development. Allows for streamlined delivery of housing and infrastructure while protecting regionally important land for conservation and publicly accessible green space.
Strategic Environmental Assessment	SEA	Prepared as part of the process of identification and protection of the major transport corridors that provides for an assessment of the environmental, economic and social impacts of reserving the corridor. SEAs are non-statutory documents that assist in planning and decision making. They are subject to public consultation and include justification for a preferred corridor alignment and provide information on the assessment of alternative corridor alignments.
Structured decision-making		The Department applied a structured decision-making process during early development of the Plan to define a high-level biodiversity outcome for the Cumberland subregion that set the context and direction for the development of the Plan. The process was one of the first steps in a comprehensive conservation planning process for the Plan.
Structure Plan		A strategic plan providing a spatial representation of high-level land uses, environmental assets and transport infrastructure within a nominated area. It includes overarching planning principles, distribution of land uses, the phasing of precincts and identification of a high-level transport framework, the Blue–Green Grid and other key infrastructure.
Sub-Plan A		Sub-Plan A of the Cumberland Plain Conservation Plan: Conservation Program and Implementation
Sub-Plan B		Sub-Plan B of the Cumberland Plain Conservation Plan: Koalas
Subject Land		The area subject to assessment of impacts on biodiversity values in the Biodiversity Certification Assessment Report under the Biodiversity Assessment Method. The Assessment Report defines the assessment area for the Biodiversity Certification Assessment Report as the nominated areas.
Terms of Reference	ToR	Terms of Reference are a requirement under the *Environment Protection and Biodiversity Conservation Act 1999* for undertaking a strategic assessment and are prepared in accordance with the Strategic Assessment Agreement. The Terms of Reference outline the requirements for the Strategic Assessment Report, including how impacts to matters of national environmental significance should be assessed and how outcomes of the Plan are evaluated.
Tertiary corridors		Movement corridors for Koala that are defined as: 'smaller corridor areas that are not connected at the landscape level'

Term	Acronym	Description
Threatened Biodiversity Data Collection	TBDC	A database maintained in the NSW BioNet Atlas consisting of profiles for threatened species, populations and ecological communities that occur in NSW and used as part of the Biodiversity Assessment Method.
Threatened Ecological Community	TEC	An ecological community may be listed as vulnerable, endangered or critically endangered under the *Biodiversity Conservation Act 2016* and/or *Environment Protection and Biodiversity Conservation Act 1999* depending on the level of threat and risk of its collapse.
Urban capable land		Land identified for future urban and industrial development, infrastructure, and intensive plant agriculture within the nominated areas that is proposed for biodiversity certification under the *Biodiversity Conservation Act 2016* and strategic approval under the *Environment Protection and Biodiversity Conservation Act 1999*. This category of land identifies where future development is likely to occur, subject to other approvals. Also referred to as certified land in this Assessment Report
Vegetation integrity score	VI score	A measure of vegetation condition used under the Biodiversity Assessment Method. Represents a combination of different scores for vegetation composition, structure and function.
Vegetation zones		A vegetation zone is an area of native vegetation that is the same Plant Community Type and has a similar broad condition state.
Western City District Plan		The Western City District Plan provides a 20-year plan to manage growth and achieve liveability, productivity and sustainability into the future for Western Sydney. It is one of the Greater Sydney Commission's five district plans and provides a link between local and regional planning
Western Sydney		A major region of Sydney comprised of 12 local government areas: Blacktown, Canterbury-Bankstown, Camden, Campbelltown, Cumberland, Fairfield, Hawkesbury, Liverpool, Parramatta, Penrith and Wollondilly.
Western Sydney Aerotropolis	WSA	One of the four nominated areas that the NSW Government has identified as the key focus for urban development to 2056 in Western Sydney.
Western Sydney City Deal		The City Deal is a 20-year agreement to deliver a transformation of Sydney's outer west. The Commonwealth and NSW Governments, together with eight local governments of Western Sydney, signed the Western Sydney City Deal on 4 March 2018.
Wilton Growth Area	Wilton	One of the four nominated areas that the NSW Government has identified as the key focus for urban development to 2056 in Western Sydney.
Working group		Working groups will be established under the Plan to determine priorities and support delivery of the Plan's commitments to meet outcomes for a specific area of focus. They will comprise relevant stakeholders and experts as required. Three working groups are proposed to be established under the Plan: compliance, koalas, and pest and animal control.

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OPENLINES
Environmental consulting

2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 1: OVERVIEW

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	N/A
CONTENT:	Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Mitchell Ross, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines)
REVIEWED BY:	
OPEN LINES:	Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor (BAAS18134)
VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

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1 Introduction

The NSW Government has identified four areas for urban growth and other development ('nominated areas') and a series of major transport corridors within and outside the nominated areas to support the future growth of Western Sydney until 2056. These initiatives are identified under two key planning strategies:

- *A Metropolis of Three Cities - The Greater Sydney Region Plan* (GSC, 2017)
- *Future Transport 2056* (Transport for NSW, 2018)

The nominated areas program represents the strategic prioritisation and delivery of new development as part of the long-term growth of Greater Sydney provided under the Greater Sydney Region Plan. The nominated areas are the key focus for development until 2056 and will be the centres of economic activity in Western Sydney.

The major transport corridors are part of the NSW Government's planning for the long-term transport needs of Western Sydney by identifying and protecting corridors of land that can be used to deliver road and rail infrastructure when needed in the future. The transport infrastructure will be constructed and delivered over the next few decades.

The nominated areas program is administered by the NSW Department of Planning, Industry and Environment (the Department). The major transport corridors program is administered by Transport for NSW.

The Department is progressing the approvals required for the development. As part of the biodiversity approvals required, the Department is preparing the Cumberland Plain Conservation Plan (the Plan) to provide long-term certainty for biodiversity and development in Western Sydney. The Plan sets out:

- Proposed development under the Plan
- A conservation program to achieve the Plan's objective and outcomes and offset the impacts of development on biodiversity values
- How the Plan will be implemented

The Plan will support two separate statutory approvals processes under State and Commonwealth laws required to address the impacts of the proposed development on biodiversity values, in accordance with:

- Strategic biodiversity certification under Part 8 of the *Biodiversity Conservation Act 2016* (BC Act)
- Strategic assessment under Part 10 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

This Cumberland Plain Assessment Report (Assessment Report) assesses the potential impacts of the proposed development under the Plan on biodiversity values regulated under the BC Act and EPBC Act.

The strategic biodiversity certification and strategic assessment processes aim to reduce the costs and timeframes associated with regulation of the proposed development under the two Acts, and more effectively manage the biodiversity impacts of planned growth and improve biodiversity outcomes in the long term by:

- Removing duplication between NSW and Commonwealth biodiversity laws
- Replacing site by site assessments and approvals for individual projects that would generally be needed under both the BC Act and EPBC Act for the proposed development with a single and strategic approval approach

1.1 DESCRIPTION OF THE PLAN

The Plan supports the delivery of infrastructure, housing and jobs for Western Sydney in a planned and strategic way that also protects and maintains key biodiversity values of the Cumberland Plain.

The Plan includes a conservation program of commitments and actions that seeks to improve ecological resilience and protect biodiversity in the Cumberland Plain and provide an enduring conservation legacy for Western Sydney.

The Plan comprises an overall Plan and two Sub-Plans. These documents cover three key elements:

- Development – this covers the urban and industrial, infrastructure, intensive plant agriculture, and major transport corridors under the Plan, including the scope and location of the development

- Conservation – this covers the conservation program and a set of commitments to achieve the Plan's objective and to offset the impacts of the development on biodiversity values
- Implementation framework – this covers how the Plan will be implemented

The Plan is described in detail in Part 2.

1.2 PLAN TIMING

The Plan will be implemented over the period to 2056 and the Department is seeking that the approvals for the Plan have effect until this date. This timing aligns with implementation of the *Greater Sydney Region Plan: A Metropolis of Three Cities* (GSC, 2018) and the *Future Transport Strategy 2056* (Transport for NSW, 2018).

1.3 THE PLAN AREA

The Plan Area is shown in Figure 1-1.

The Plan Area is primarily within the Interim Biogeographic Regionalisation for Australia (IBRA) Cumberland subregion of the Sydney Basin Bioregion. It also includes some minor areas of the adjacent Sydney Cataract and Wollemi subregions. The area covered is approximately 200,000 hectares (see Figure 1-1).

The Cumberland subregion is a broad geographic feature bounded by the elevated lands of the Hornsby Plateau in the north, the base of the Blue Mountains to the west, the Woronora plateau in the south, and the Sydney CBD to the east.

The Plan Area for this project lies generally within the Western part of the subregion and extends from about 10 km north of Windsor south to Tahmoor (south of Picton), and from approximately Silverdale eastwards to Liverpool, and includes all or part of eight Local Government Areas (LGAs), being:

- Camden Council
- City of Blacktown
- City of Campbelltown
- City of Fairfield
- City of Hawkesbury
- City of Liverpool
- City of Penrith
- Wollondilly Shire

1.4 PURPOSE OF THIS REPORT

The Assessment Report assesses the potential impacts of the proposed development under the Plan on biodiversity values and other matters regulated under the BC Act and EPBC Act. The Assessment Report is a single report prepared to meet the statutory requirements for both:

- A Biodiversity Certification Assessment Report (BCAR) prepared in accordance with the Biodiversity Assessment Method (BAM) made under the BC Act
- A Strategic Assessment Report (SAR) prepared in accordance with the Terms of Reference (ToR) for the SAR provided under the Part 10 Strategic Assessment Section 146 Agreement between the Commonwealth Minister for the Environment and the State of NSW under the EPBC Act (see Supporting Document A)

1.4.1 ASSESSMENT AREAS FOR THE BCAR AND SAR

The assessment areas differ for the BCAR and SAR components of the Assessment Report:

- For the BCAR, the assessment area is called the Subject Land and covers the nominated areas
- For the SAR, the assessment area is called the Strategic Assessment Area and covers the area of the Plan

1.4.2 PURPOSE OF BCAR COMPONENT OF THE REPORT

The purpose of the BCAR component of this Assessment Report is to provide an assessment of the proposed development taken under the Plan in accordance with stages 1 and 2 of the BAM, including:

- Identifying and assessing the biodiversity values of the area covered by the proposed development
- Quantifying the impacts on biodiversity values of the proposed development
- Describing the commitments and actions to offset the impacts of the development, including the number and classes of biodiversity credits that would be required to be retired if the offset rules under the Biodiversity Conservation Regulation 2017 (BC Regulation) applied

As the proposed development has been determined by the NSW Environment Minister to be considered for approval under a 'strategic biodiversity certification', the offset rules under the BC Regulation do not apply and the Minister can determine any measure to be a conservation measure (see Section 2.1).

The BCAR component of this Assessment Report will be considered by the NSW Minister for the Environment in deciding to confer strategic biodiversity certification for the proposed development under the BC Act.

1.4.3 PURPOSE OF SAR COMPONENT OF THE REPORT

The purpose of the SAR component of this Assessment Report is to address the ToR and assess the impacts of the proposed development taken under the Plan on all matters protected by Part 3 of the EPBC Act (protected matters).

The SAR component of this Assessment Report will be considered by the Commonwealth Environment Minister in deciding to endorse the Plan under the EPBC Act. If the Plan is endorsed by the Minister, the Minister may subsequently consider approval of the proposed development in accordance with the endorsed Plan.

1.5 SCOPE OF THE DEVELOPMENT

The scope of the proposed development broadly comprises:

- Urban and industrial development within urban capable land in the nominated areas
- Infrastructure within urban capable land in the nominated areas, as well as 'essential' infrastructure in limited cases within avoided lands in the nominated areas
- Intensive plant agriculture within the Agribusiness Precinct in the Western Sydney Aerotropolis (WSA)
- Major transport corridors within and outside the nominated areas

Figure 1-1 shows the location of the four nominated areas and the major transport corridors.

The nominated areas comprise:

- Greater Macarthur Growth Area (GMAC)
- Greater Penrith to Eastern Creek Investigation Area (GPEC)
- Western Sydney Aerotropolis (WSA) (excluding where there is overlap with the existing South West Growth Area)
- Wilton Growth Area (Wilton)

The major transport corridors comprise major road or rail projects within identified corridors. The corridors are located within three of the nominated areas – GPEC, WSA and GMAC (but not Wilton) as well as outside the nominated areas. Parts of some of the corridors comprise sections of tunnels, where disturbance to the land surface will be minimised.

As described in Section 1.6, the major transport corridors are subject to different statutory approvals under the Plan and are categorised in this Assessment Report to reflect this:

- Major transport corridors within the nominated areas are subject to biodiversity certification under the BC Act and approval under Part 10 of the EPBC Act. These are referred to as 'Major transport corridors (certified)'
- Major transport corridors outside the nominated areas are subject to approval under Part 10 of the EPBC Act only. These are referred to as:
    - 'Major transport corridors – non-certified (strategically assessed)'

- ‘Major transport corridors tunnel – non-certified (strategically assessed)’

Note that a small part of the tunnel section of the major transport corridors occurs within a nominated area (GMAC), but this is not subject to biodiversity certification under the BC Act

Not all parts of the nominated areas are proposed for development. The proposed development will occur within specified urban capable lands within each nominated area. These are shown in Figure 1-1.

Further details of the proposed development, including the different major transport corridors and their approval category under the Plan, are provided in Part 2.

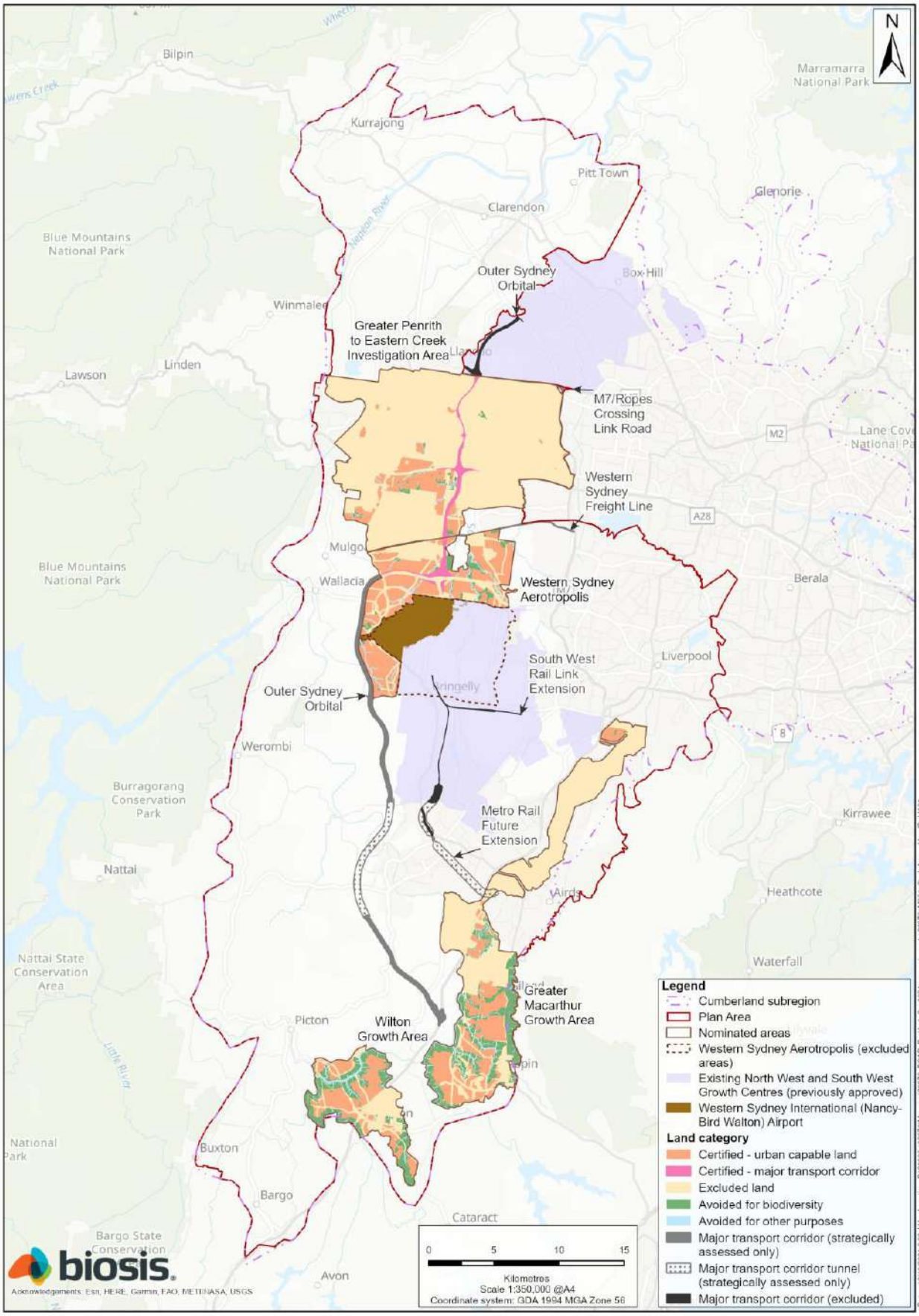

Figure 1-1: The Plan Area and location of nominated areas and major transport corridors

1.6 APPROVALS BEING SOUGHT

The Department is seeking two separate statutory approvals for the impacts of the development on biodiversity values:

- Strategic biodiversity certification under Part 8 of the BC Act
- Approval under Part 10 of the EPBC Act

Table 1-1 shows what development is subject to assessment and approval under the BC Act and EPBC Act.

Table 1-1: Development being assessed for approval under the BC Act and the EPBC Act#

Development	Biodiversity certification under BC Act	Approval under Part 10 of EPBC Act
The following development within the nominated areas: • Urban and industrial development • Infrastructure • Intensive plant agriculture • Major transport corridors – certified	✓	✓
The following development outside the nominated areas: • Major transport corridors – non-certified (strategically assessed)* • Major transport corridors tunnel – non-certified (strategically assessed)^	-	✓

Note that a formal modification to the strategic biodiversity certification will be undertaken to seek NSW biodiversity approvals on behalf of Deerubbin Local Aboriginal Land Council. This is included as an action (Action 6) under Commitment 1 of the Plan.

* Biodiversity certification may be sought for the transport corridors outside the nominated areas at a later date, and may be included as a modification or series of modifications to this biodiversity certification

^ A small part of the tunnel section of the major transport corridors occurs within a nominated area (GMAC), but this is not subject to biodiversity certification under the BC Act

Table 1-2 identifies the boundaries of the approval areas under the BC Act and EPBC Act and the effect of the approvals should they be granted.

Table 1-2: General boundaries of the approval areas under the BC Act and EPBC Act and effect of the approvals

	General boundaries of approval area	Effect of the approval
Biodiversity certification under BC Act	Land within the boundaries of the urban capable land and major transport corridors within the nominated areas shown in Figure 1-1 Land that is avoided or excluded (see Chapter 14) is not included in the land proposed to be biodiversity certified	Development can proceed in these areas without further approval under the BC Act Development must be undertaken in accordance with any conditions of the biodiversity certification under the BC Act Any other necessary approvals must also be obtained for the development, including development consent under the *Environment Planning and Assessment Act 1979* (EP&A Act)
Approval under Part 10 of EPBC Act	Land within the boundaries of the urban capable land and major transport corridors within and outside the nominated areas shown in Figure 1-1, as well as 'essential' infrastructure within avoided lands in the nominated areas	Development can proceed in these areas without further approval under the EPBC Act Development must be undertaken in accordance with the Plan and any conditions of the Part 10 approval under the EPBC Act

1.7 WHO PREPARED THIS REPORT

The Department commissioned a project team to prepare the Assessment Report and undertake data collection on biodiversity values within the Plan Area. The project team preparing this Assessment Report is comprised of:

- Open Lines – Responsible for preparing this Assessment Report, particularly the SAR component of the report
- DAJ Environmental – Part of the Open Lines team responsible for preparing this Assessment Report
- Biosis – Responsible for:
    - Preparing the BCAR component of this Assessment Report
    - Leading the collection of data to meet the requirements of the BAM and ToR
    - Developing the native vegetation, Threatened Ecological Communities (TEC) and species maps
    - Undertaking all BAM calculations to determine:
        - Amount of native vegetation, TECs and species habitat avoided and impacted
        - Number and class of biodiversity credits that would be required to be retired
- Ecoplanning – Provided support to Biosis in collecting field data to meet the requirements of the BAM and ToR

1.7.1 ACCREDITED ASSESSOR

A BCAR can only be prepared by a person accredited under the accreditation scheme developed under Section 6.10 of the BC Act. Throughout this report, an accredited person is referred to as 'the assessor'.

The BCAR component of this Assessment Report has been prepared by Jane Raithby-Veall from Biosis. Jane is a BAM accredited assessor (BAAS18134) taking the lead assessor role for the project. In preparing the BCAR, Jane has:

- Led the development of the BCAR to ensure that it meets the requirements of the BAM
- Reviewed and approved all of the data that is part of the BAM process
- Reviewed and approved all components of the BCAR

Given the size and complexity of the project, Jane was supported by a range of people in preparing the BCAR component of this Assessment Report. They include:

- Accredited BAM assessors/ecologists and GIS operators within Biosis
- Accredited BAM assessors/ecologists within Ecoplanning
- Impact assessment specialists within Open Lines and DAJ Environmental
- Technical staff within the Department's Conservation and Sustainability Branch

1.8 IMPLICATIONS OF 2019/2020 BUSHFIRES

NSW experienced extensive bushfires throughout the spring and summer of 2019-20. As of 3rd February 2020, the fires had burnt 5.37 million hectares of land (approximately 7 per cent of NSW). This includes (DPIE, 2020b):

- 37 per cent of the national park estate, including 81 per cent of the Greater Blue Mountains World Heritage Area
- 42 per cent of state forests
- 52% of heathland, 50% of wet sclerophyll and 37% of rainforest vegetation formations in NSW
- 25% of the most suitable koala habitat in eastern NSW (moderate, high and very high suitable habitat), particularly areas on the north coast, central and southern tablelands, central coast and the south coast

The full impact of the fires will not be understood for some time (EES, 2020).

Given the significance of these events, an initial assessment of the implications of the bushfires for the Plan and this Assessment Report was undertaken and is provided at Supporting Document G.

1.9 PUBLIC EXHIBITION OF THE PLAN AND ASSESSMENT REPORT

Public exhibition of the Plan and Assessment Report occurred over a period of 10 weeks from 26 August to 2 November 2020 to provide an opportunity for the community to provide feedback on the documents through formal submissions.

A total of 508 individual submissions were received from a range of stakeholders. All submissions were reviewed by the Department and consulting team and considered in preparing the final Plan and Assessment Report.

Responses to the feedback received during public exhibition as well as from early engagement on the Plan (see Part 2) were compiled into a report (see Supporting Document H). The report summarises the feedback on key themes that was received and explains how the Department has considered and responded to this feedback.

Key themes or issues raised in submissions during public exhibition that are particularly relevant to the Assessment Report and responses to these issues are summarised in Table 1-3.

Table 1-3: Key issues raised in submissions and responses to issues raised

Key theme or issue	Response to issue
E2 environmental conservation zone and the location of avoided land was based on inaccurate native vegetation mapping	Some landholders provided native vegetation mapping or ecological reports to support their submission. The information was reviewed by the accredited assessor and resulted in some minor changes to vegetation communities. This along with all reports and data provided through public exhibition was considered in updating the native vegetation and land category maps (see Chapter 11)
Impacts to Cumberland Plain Woodland are too high and remaining areas of the community should be preserved	The Assessment Report was updated to provide further information on avoidance of impacts (see Chapter 14) and residual direct impacts to Cumberland Plain Woodland (see Chapter 31) The Department will work with the Biodiversity Conservation Trust encouraging landholders to establish new biodiversity stewardship agreements in areas such as Razorback. The Razorback Area is contains significant areas of Cumberland Plain Woodland in addition to other TECs targeted for offsets under the Plan
Major transport corridors will affect existing conservation areas	The Assessment Report has evaluated the impacts of the major transport corridors on TECs and species, and the conservation program includes offsets for impacts within the corridors. A range of mitigation measures has been developed specifically to manage impacts from the construction of transport infrastructure. Transport for NSW are working to minimise impacts to existing reserves such as Wianamatta Regional Park and are proposing an elevated viaduct to pass over the reserve to reduce impacts to biodiversity values
Cumulative and indirect impacts are not adequately considered	The Assessment Report was reviewed and updated to provide further information on cumulative impacts and indirect impacts. This included considering additional major projects that could result in cumulative impacts (see Chapter 38) and providing more information about the risk of indirect impacts to specific species and TECs and the processes to implement mitigation measures (see Chapter 15)
The Plan does not go far enough to protect koala movement corridors as recommended by the Office of the NSW Chief Scientist & Engineer	The Department met with the expert panel that prepared the Advice on the protection of the Campbelltown Koala Population (Office of the NSW Chief Scientist & Engineer, 2020) to gain their insights and ensure the Plan was consistent with their recommendations The Assessment Report was reviewed and updated to reflect changes to the Plan relating to Koala (see Chapter 30) The Department is working with NSW National Parks and Wildlife Service to begin gazettal of the first stage of the Koala reserve by the end of 2023 and partnering with Transport for NSW to begin work on the fauna crossing of Appin Road to ensure safe koala movement

2 Regulatory context

This Chapter provides an overview of the key steps in the legislative processes for:

- Strategic biodiversity certification under Part 8 of the BC Act
- Strategic assessment under Part 10 of the EPBC Act

The key steps in the regulatory processes are shown in Figure 2-1.

These two processes are similar but differ in some respects. Both remove the need to further consider impacts to biodiversity values through site by site assessment and approval of individual developments.

A key difference between the two processes is that the EPBC Act process approves specific development (actions or classes of actions) undertaken in accordance with an endorsed policy, plan or program, while the BC Act process approves development within a specific area of land.

2.1 BIODIVERSITY CONSERVATION ACT 2016

2.1.1 BIODIVERSITY CERTIFICATION

Under Part 8 of the BC Act, individuals and planning authorities can seek strategic biodiversity certification from the NSW Minister for the Environment over areas of land. The biodiversity certification process requires that biodiversity values are assessed and areas of high biodiversity value are protected for conservation. Development can proceed in nominated areas with any remaining impacts on biodiversity offset through conservation measures.

Development on land that is biodiversity certified does not need further approval from planning authorities for impacts on biodiversity under the EP&A Act. In particular:

- The environmental assessment requirements for the approval of State Significant Infrastructure under Part 5.1 of the EP&A Act do not require an assessment of the impact on biodiversity
- An assessment of the likely impact on biodiversity of development is not required under Part 4 of the EP&A Act
- A consent authority is not required to take into consideration the likely impact on biodiversity when determining a development application under Part 4 of the EP&A Act
- An activity under Part 5 of the EP&A Act is taken to be an activity that is not likely to significantly affect any threatened species or ecological community under the BC Act, or its habitat
- A determining authority under Part 5 of the EP&A Act is not required to consider impacts on biodiversity

Impacts to biodiversity values on the land proposed for biodiversity certification, as well as the biodiversity benefits of the conservation program, are assessed through a BCAR. The BCAR is prepared by an accredited person in accordance with the BAM. The BCAR must be released for public comment prior to the Minister conferring biodiversity certification.

The Environment Minister may confer biodiversity certification if satisfied that the 'approved draft conservation measures' under the biodiversity certification adequately address the likely impacts on biodiversity values of the biodiversity certification, having regard to the BCAR. If the Minister is of the opinion that the biodiversity certification is likely to have serious and irreversible impacts on biodiversity values, the Minister must take those impacts into consideration and determine whether there are any additional measures that can minimise those impacts.

In determining the approved draft conservation measures under the biodiversity certification (including the number of credits that may be required to be retired), the Minister must have regard to the BCAR, but is not bound by it.

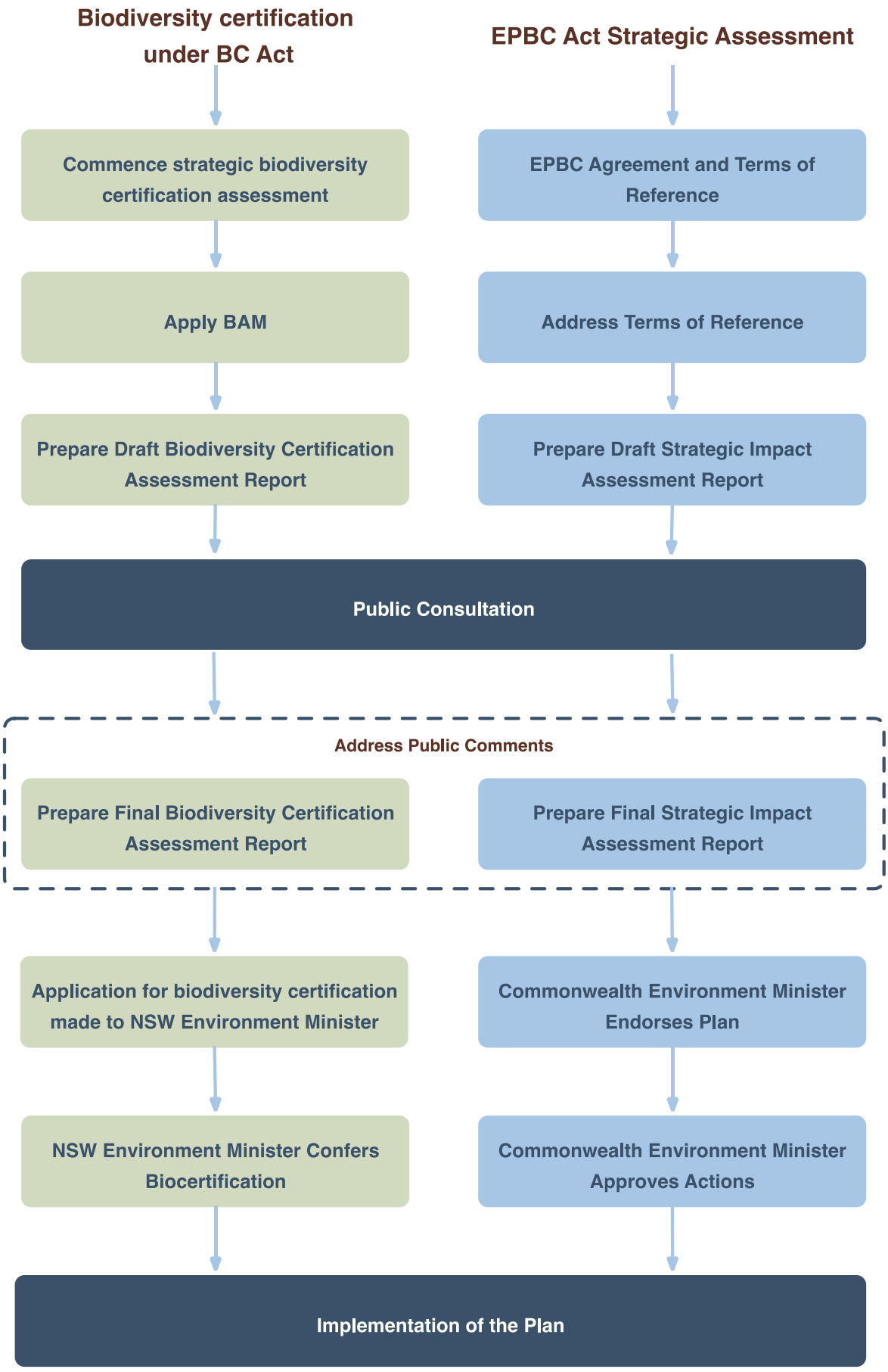

Figure 2-1: Key steps in the regulatory processes

2.1.2 STRATEGIC BIODIVERSITY CERTIFICATION

Planning authorities can apply to the Environment Minister to declare an application for biodiversity certification to be a 'strategic application'. Strategic biodiversity certification supports significant regional development and planning processes and provides an opportunity for impacts on biodiversity to be addressed at the landscape scale. In recognition of this, a wider range of conservation and other measures are available to proponents for strategic biodiversity certification to offset impacts on biodiversity values than for standard certification.

A strategic biodiversity certification may propose a mix of conservation measures that includes credits to be retired, as well as:

- Reservation of land under the *National Parks and Wildlife Act 1974* (NPW Act)
- Adoption of development controls (or State infrastructure contributions) under the EP&A Act that conserve or enhance the natural environment
- Any other measures declared by the regulations to be approved conservation measures
- Any other measure that the Minister determines to be a conservation measure

Under a strategic application for biodiversity certification, the BC Act does not require that the 'value' of the commitments be calculated in terms of credits and provides broad discretion around defining commitments. Commitments under strategic certification are not constrained by the offset rules (clause 6.2(5)(b) BC Regulation) and the NSW Environment Minister can determine any measure to be a commitment (section 8.3(2)(b) BC Act).

EES has prepared the *Conservation measures in strategic applications for biodiversity certification: Guidance for planning authorities* (DPIE, 2020a). The guidelines are intended to assist planning authorities preparing applications for strategic biodiversity certification to:

- Design conservation measures
- Demonstrate that conservation measures adequately address the likely impacts on biodiversity values of the biodiversity certification of the land

The guidelines provide principles for designing conservation measures that will be used by EES to evaluate a strategic application for biodiversity certification and advise the Environment Minister about the adequacy of conservation measures and the likely impacts on biodiversity values. These principles are summarised and addressed in Chapter 41.

When declaring that an application for strategic biodiversity certification is a strategic application, the Minister is to take into account criteria in Clause 8.3 of the BC Regulation. The criteria are:

1. The size of the area of the land
2. Any regional or district strategic plan under the EP&A Act that applies to the area in which the land is situated
3. Advice provided by the Minister for Planning regarding the proposed biodiversity certification
4. The economic, social or environmental outcomes that the proposed strategic biodiversity certification could facilitate

The Environment Minister declared on 16 January 2019 that this project is a strategic biodiversity certification.

At the time of the declaration BAM 2017 was in force, with BAM 2020 coming into effect on 22 October 2020. Under transitional arrangements, the *Biodiversity Conservation Regulation 2017* (Reg 6.31) allows the Assessment Report to be prepared under the previous biodiversity method (BAM 2017) for a designated period, stating:

"in the case of a biodiversity certification assessment report for a strategic biodiversity certification application--12 months or such longer period as the Minister approves in a particular case"

Consistent with the transitional arrangements, this Assessment Report has been prepared under BAM 2017. The Environment Minister (through a delegated authority) has approved an extension to the transitional arrangements for this project for a further 6 months, until 22 April 2022.

2.2 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The EPBC Act is Australia's key piece of legislation to protect and manage Australia's nationally and internationally important flora, fauna, ecological communities, and heritage places. The objectives of the EPBC Act include:

- Providing for the protection of the environment (especially matters of national environmental significance)
- Conserving Australian biodiversity
- Providing a streamlined national environmental assessment and approvals process
- Promoting Ecological Sustainable Development (ESD) through the conservation and ecologically sustainable use of natural resources.

Under Part 10 of the EPBC Act, the Commonwealth Minister for the Environment can agree to undertake a strategic assessment of the impacts of a policy, plan or program on matters protected under the EPBC Act.

The Agreement to undertake the strategic assessment was signed by the NSW Minister for Environment and Commonwealth Minister for the Environment on 12 November 2018 (see Supporting Document A).

The agreement must provide for a ToR to guide the preparation of an Assessment Report on the impacts of the policy, plan or program. The Assessment Report must be released for public comment. The ToR outlines what the Assessment Report must contain to allow the Commonwealth Minister to endorse the Plan.

Actions undertaken in accordance with a policy, plan or program endorsed by the Environment Minister do not require further assessment and approval for impacts on protected matters under the EPBC Act.

The Environment Minister may endorse a policy, plan or program if satisfied that the Cumberland Plain Assessment Report adequately addresses the impacts on protected matters to which the agreement relates (s 146(2)(f)) and that any recommended modifications to the policy, plan or program by the Minister have been made (s 146 (2f(ii))).

The agreement between the Commonwealth Environment Minister and the State of NSW for this project (see Supporting Document A) provides that, in determining whether or not to endorse the Plan, the Minister may consider the extent to which the commitments for the protection and management of protected matters are enforceable and achievable over the life of the Plan.

The agreement also provides that, in determining whether this Assessment Report adequately addresses the impacts, the Commonwealth Environment Minister must have regard to the extent to which the Plan meets the objectives of the EPBC Act, including how the Plan:

- Protects the environment, especially protected matters under Part 3 of the EPBC Act
- Promotes ESD through the conservation and ecologically sustainable use of natural resources
- Promotes the conservation of biodiversity
- Provides for the protection and conservation of heritage
- Promotes a cooperative approach to the protection and management of the environment
- Assists in the co-operative implementation of Australia's international environmental responsibilities

Following endorsement of the Plan, the Environment Minister may approve the taking of actions in accordance with the endorsed policy, plan or program subject to a range of general considerations (s 146F) and constraints on decision making (s 146G-M), including to not act inconsistently with a recovery plan or threat abatement plan for a protected matter (s 146K).

2.3 OTHER APPROVALS REQUIRED FOR THE PROPOSED DEVELOPMENT

A range of other planning and environmental approvals may be required for the proposed development, including:

- Planning approvals under the EP&A Act
- Aboriginal cultural heritage approvals under the *National Parks and Wildlife Act 1974*
- Built heritage approvals under the *Heritage Act 1977*
- Noise, water, air pollution approvals under the *Protection of the Environment Operations Act 1997*
- Water management approvals under the *Water Management Act 2000*

- Approvals for impacts to threatened fish and other matters listed under the *Fisheries Management Act 1994*

The proposed development will be implemented through a range of existing legislative and planning frameworks, particularly the EP&A Act. Implementation arrangements are described in Part 2.

3 Overview of environment within the Plan Area

This Chapter provides a brief overview of the environment within the Plan Area, including historical land-uses. A more detailed description of the environment within the Plan Area in accordance with Section 3.1 of the ToR, including the extent and quality of native vegetation and threatening processes, is provided in Chapter 28.

3.1 HISTORICAL LAND-USES

The Cumberland subregion has been greatly affected by historical and ongoing land-uses and land management practices. This is mainly due to topographic and geological characteristics that meant the subregion could support much greater agricultural and urban development than the surrounding sandstone areas.

Before European settlement, the subregion supported diverse native vegetation, including extensive grassy open forests, ironbark and turpentine forests, dry rainforests and floodplain forest, and wetland communities. Mammals such as echidnas, quolls, phascogales, bandicoots, koalas, gliders, and bettongs would have been common, along with many woodland birds such as the Hooded Robin, Brown Treecreeper, Speckled Warbler and Diamond Firetail (DECCW, 2011).

Hundreds of records of Aboriginal sites have been found across the Cumberland subregion, suggesting the subregion was an important area for Aboriginal people materially, socially and spiritually (DECCW, 2011). Records suggest Aboriginal occupation of the Sydney region occurred for at least 20,000 years, and possibly 40,000 years (Nanson, Young et al., 1987; Stockdon, 2009; Stockton & Holland, 1974). There is evidence of extensive use of fire by Aboriginal people to manage the landscape, including to establish mosaics of native vegetation to facilitate hunting (Gammage, 2011).

European agricultural land practices were established by settlers in 1792, and by the middle of the 19th century most of the Cumberland subregion was either being grazed or cultivated (Tozer, 2003). Significant clearing for urban development, including residential, commercial and industrial land-uses, followed.

3.2 BIODIVERSITY VALUES

The biodiversity values of many parts of the Plan Area, particularly within the Cumberland subregion, have been lost or degraded as a result of both historical and ongoing patterns of land-use and land management practices.

The existing native vegetation communities in the Plan Area are shown in Figure 3-1. Existing native vegetation comprises 39 Plant Community Types (PCTs). Remaining areas are often of high conservation value. Much remaining native vegetation comprises TECs or habitat for species listed under the BC Act and EPBC Act.

Remaining native vegetation is also highly fragmented. In 2010, an estimated 2,446 individual remnants remained in the Cumberland subregion, ranging from less than one hectare to 3,598 hectares (DECCW, 2010). The eighty one largest patches (greater than 50 hectares) represent 51 per cent of the remaining native vegetation community extent (DECCW, 2011). While some flora and fauna species will persist in small native vegetation patches with active management, evidence is that larger patches have a better prospect for long-term survival (DECCW, 2011).

Evidence indicates that biodiversity loss significantly increases once habitat fragmentation by clearing exceeds 70 per cent of the landscape. This threshold has already been passed in the Cumberland subregion (DECCW, 2011). Only approximately 13 per cent of the pre-1970 extent of native vegetation in the subregion remains intact, with an additional 12 per cent occurring as heavily degraded communities (e.g. scattered trees) in disturbed areas (DECCW, 2011).

The vast majority (greater than 75 per cent) of the remaining native vegetation within the Cumberland Plain is privately owned. At 2011, approximately 8 per cent of native vegetation was protected in existing formal reserves (DECCW, 2011).

3.3 KEY THREATS

A principal threat to the biodiversity values of the Cumberland subregion is the further loss and fragmentation of habitat from clearing for urban development and agricultural land uses (DECCW, 2011), including illegal clearing.

Historial clearing has led to increasingly isolated and small remnants of native vegetation that are more susceptible to degradation, and provide less habitat values and support fewer species (DECCW, 2011).

The *Cumberland Plain Recovery Plan* (DECCW, 2011) identifies several other key threats, including:

- Weed invasion particularly by African olive, African lovegrass, and bridal creeper
- Altered fire regimes, particularly too frequent fire caused by arson
- Runoff of high-nutrient and turbid water from urban and agricultural areas

The ecological communities of the Cumberland Plain are particularly vulnerable to weed invasion due to their grassy understorey, relatively fertile soils, and past agricultural uses. Weeds such as African olive (*Olea europaea* subsp. *cuspidata*), African lovegrass (*Eragrostis curvula*) and bridal creeper (*Asparagus asparagoides*) are well established, which displaces native plants and affects the regeneration of communities (DECCW, 2011).

Stormwater carrying high nutrient and sediment loads from impermeable surfaces such as roads may runoff into areas of native vegetation, which can encourage weed invasion in addition to the soil erosion issues.

Other threats identified in the Recovery Plan (DECCW, 2011) include:

- Impacts from recreational use of areas of native vegetation
- Grazing and mowing
- Altered hydrology
- Sedimentation and erosion
- Salinity
- Impacts of climate change

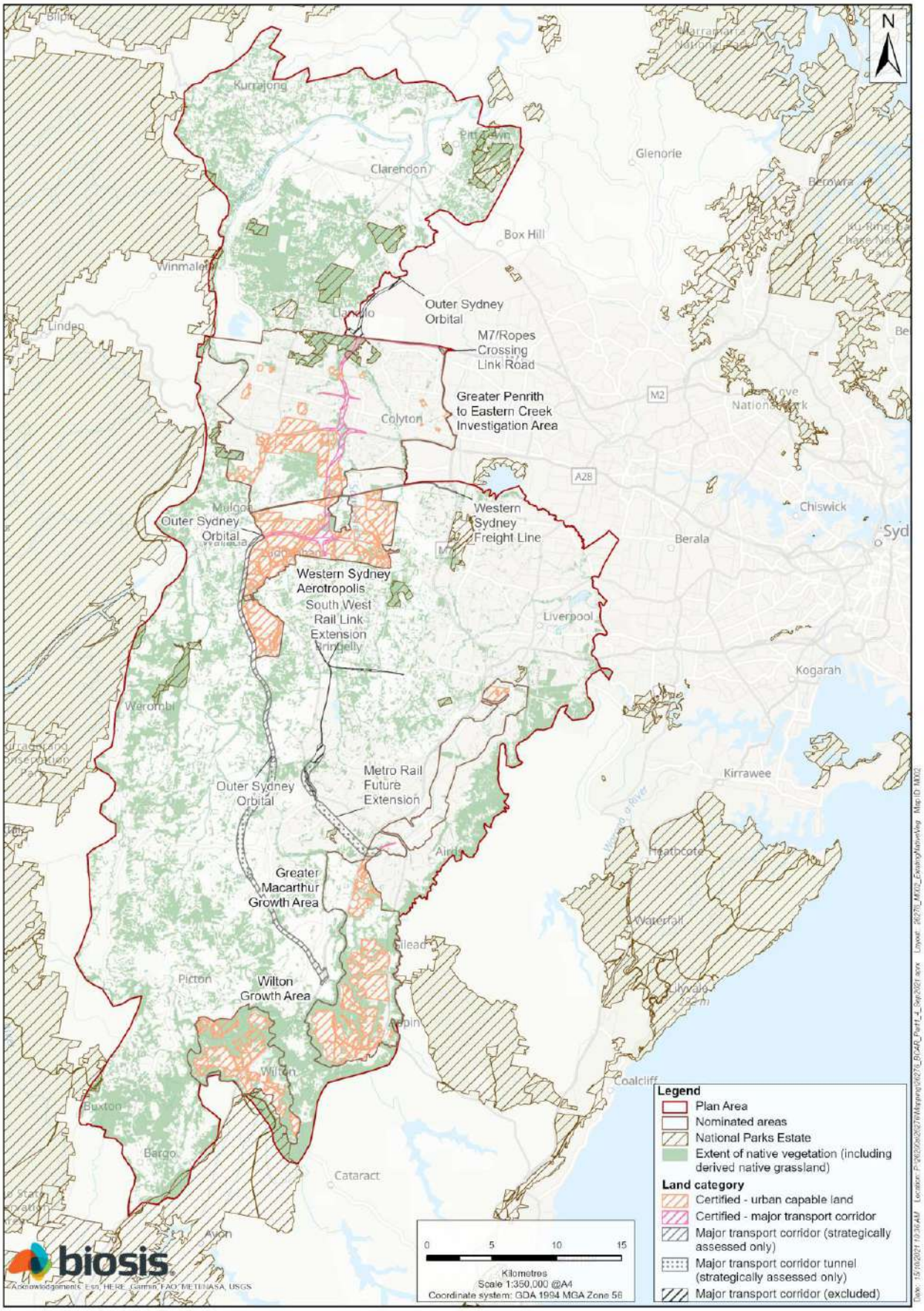

Figure 3-1: Existing native vegetation communities in the Plan Area

4 How to read this Assessment Report

BOX 1: HOW TO NAVIGATE THIS ASSESSMENT REPORT

We recommend viewing the Assessment Report using Adobe Acrobat Reader.

Adobe Acrobat Reader

- Download and install Adobe Acrobat Reader by following this link https://get.adobe.com/reader/
- Download the report and save to your computer
- Right click on the report and select 'Open with Adobe Acrobat Reader'
- Click the bookmark symbol on the left side of the Adobe interface - the headings for each report Part will appear
- Click on the > symbol next to the Part headings - the headings for each report Chapter will appear
- Navigate through the report by clicking on the Part and Chapter headings

4.1 COMPONENTS OF THE REPORT

This Assessment Report comprises both a BCAR prepared in accordance with the BAM under the BC Act and a SAR prepared in accordance with the ToR under the Part 10 Strategic Assessment Agreement of the EPBC Act.

The BCAR is mostly covered in Part 5, and the SAR part is mostly covered in Part 6. Where the requirements for preparing a BCAR and SAR are the same or similar, these requirements have been addressed jointly in a single part of this Assessment Report to avoid repetition and confusion.

Table 4-1 shows each main component of this Assessment Report and whether it forms part of the BCAR or SAR or both.

Table 4-1: Parts of this Assessment Report that comprise the BCAR or SAR or both

Report part	Description	BCAR	SAR
Part 1: Overview	Provides a general introduction to the project, this Assessment Report, and the regulatory context. Includes details of the accredited assessor (as per BC Regulation clause 6.9 (f))	✓	✓
Part 2: Description of the Cumberland Plain Conservation Plan	Describes the Plan, including its development and conservation elements, and how it will be implemented	✓	✓
Part 3: Assessment approach	Provides details of the assessment approach, including methods for identifying relevant biodiversity values that need assessing in this Assessment Report and the methods for mapping native vegetation, TECs and species habitat	✓	✓
Part 4: Minimising impacts	Provides details of the processes and actions taken to avoid and minimise impacts, an assessment of indirect impacts, and how the Plan will approach adaptive management	✓	✓
Part 5A: BCAR Stage 1 (biodiversity assessment)	Covers the requirements of Stage 1 of the BAM (existing biodiversity values) not already covered in Parts 1, 3, and 4	✓	-
Part 5B: BCAR Stage 2 (impact assessment)	Covers the requirements of Stage 2 of the BAM (assessment of impacts) not already covered in Parts 1, 3, and 4	✓	-

Report part	Description	BCAR	SAR
Part 6A: Strategic Assessment Report	Covers the requirements of the ToR relating to identifying existing biodiversity values and assessing the impacts of the Plan on protected matters not already covered in Parts 3 and 4	-	✓
Part 6B: Strategic Assessment Report			
Part 7: Evaluation of the Plan	Evaluates the adequacy of the conservation commitments and actions (as per BC Act section 8.7 and EES draft *Guidelines for planning authorities for proposing conservation measures in strategic applications for biodiversity certification* (DPIE, 2020a) and sections 4.6, 4.7, 5 and 6 of the ToR	✓	✓

4.2 HOW THIS REPORT ADDRESSES REGULATORY REQUIREMENTS

4.2.1 REQUIREMENTS FOR PREPARING A BCAR

The key requirements for preparing a BCAR under the BC Act are set out under:

- Part 8 of the BC Act
- Section 6.9 of the BC Regulation
- Appendix 10 of the BAM

Table 4-2 provides the key requirements for preparing a BCAR and identifies where each of these requirements are addressed in this Assessment Report, and specifically the BCAR component of this Assessment Report.

Table 4-2: Where requirements for preparing a BCAR are addressed in this Assessment Report

Minimum information requirements for a BCAR (taken from Appendix 10 of the BAM)	Maps and data requirements	Chapter of Assessment Report
Stage 1 biodiversity assessment		
Introduction		
Introduction to the biodiversity assessment: • Identification of urban capable lands • General description of development • Sources of information used in the assessment	• Site map • Location map	Chapter 7 Chapter 13 Chapter 18
Landscape context		
Identification of landscape features at the development site: • Bioregions and subregions, NSW landscape region and area • Native vegetation extent in the buffer area • Cleared areas • Rivers and streams classified according to Strahler stream order • Wetlands within, adjacent to and downstream of the site • Connectivity features • Areas of geological significance and soil hazard features • Site context components	• Site and Location maps showing landscape features	Chapter 18

Minimum information requirements for a BCAR (taken from Appendix 10 of the BAM)	Maps and data requirements	Chapter of Assessment Report
Native vegetation		
Identify native vegetation extent within the development site, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery	• Native vegetation extent, including cleared areas	Chapter 19
Describe PCTs within the development site: • Vegetation class and type • Area (ha) for each vegetation type • Species relied upon for identification of vegetation type and relative abundance • Justification of evidence used to identify a PCT • TEC status • Per cent cleared value of PCT	• Native vegetation extent map • PCTs map • Plot locations relative to PCTs map • TECs map • Plot field data • Plot field data sheets	Chapter 19 Chapter 20
Vegetation integrity assessment of the development site: • Mapping vegetation zones • Patch size • Assessing vegetation integrity using benchmark data • Survey effort (number of plots) • Determining the vegetation integrity score	• Table of current vegetation integrity scores for each vegetation zone in development site • Patch size of intact native vegetation	Chapter 11 Chapter 19
Where use of local data is proposed: • Identify relevant vegetation type • Identify source of information for local benchmark data • Justify use of local data in preference to database values		N/A
Threatened species and habitat		
Identify ecosystem credit species associated with PCTs on development site, including: • List of species • Justification for exclusion of any ecosystem credit species	• Table of habitats/habitat components and sensitivity classes • Table of biodiversity risk weighting for species on site	Chapter 11 Chapter 21

Minimum information requirements for a BCAR (taken from Appendix 10 of the BAM)	Maps and data requirements	Chapter of Assessment Report
Identify species credit species on development site, including: • List of candidate species • Justification for inclusions and exclusions of species credit species based on habitat features • Indication of presence based on targeted survey or expert report • Details of targeted survey technique, effort, timing and weather • Species polygons • Biodiversity risk weighting for the species • Threatened species survey	• Table of list of species credit species and presence status on site as determined by targeted survey, expert report or assumed presence • Species credit species polygons map • Table of species and habitat feature/ components and abundance on site • Table of biodiversity risk weighting for species on site	Chapter 11, including Attachment A Chapter 21
Where use of local data is proposed: • Identify relevant species • Identify aspect of species data • Identify source of information for local data • Justify use of local data in preference to database values		N/A
Where expert reports are used in place of targeted survey: • Identify the relevant species • Justify the use of an expert report • Indicate and justify the likelihood of presence of the species and information considered in making this assessment • Estimate the number of individuals or area of habitat for the development site, and how the estimate was made • Identify the expert and their expert credentials	• Expert reports	Chapter 11 Chapter 21 Supporting Document C
Stage 2 Impact Assessment – Biodiversity values		
Avoid and minimise impacts		
Demonstration of efforts to avoid and minimise impact on biodiversity values in accordance with Chapter 8	• Table of measures to be implemented to avoid and minimise the impacts, including action, outcome, timing and responsibility • Urban capable land and major transport corridor map	Chapter 14

Minimum information requirements for a BCAR (taken from Appendix 10 of the BAM)	Maps and data requirements	Chapter of Assessment Report
Assessment of direct and indirect impacts unable to be avoided at the development site, including type, frequency, intensity, duration and consequence of impact	• Maps demonstrating indirect impact zones where applicable	Chapter 15 Chapter 23
Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain	N/A	Chapter 16
Impact summary		
Identification and an assessment of the impacts which are potential serious and irreversible impacts	• Map showing location of serious and irreversible impacts • Table of SAII considerations	Chapter 25
Identification of impacts requiring offset	• Map of impacts requiring offset	Chapter 26
Identification of impacts not requiring offset	• Map of impacts not requiring offset	Chapter 26
Identification of areas not requiring assessment	• Map of areas not requiring assessment	Chapter 26
Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including: • Future vegetation integrity score for each vegetation zone at the development site • Change in vegetation integrity score • Number of required ecosystem credits for the impact of development on each vegetation zone at a development site • Number of required species credits for each threatened species that is impacted on by development	• Table of PCTs requiring offset and the number of ecosystem credits required • Table of threatened species requiring offset and the number of species credits required • Submitted proposal in the Credit Calculator	Chapter 26
Biodiversity credit report		
Credit classes for ecosystem credits and species credits at the development site	• Table of credit class matching credit profile	Supporting Document E

4.2.2 REQUIREMENTS FOR PREPARING A SAR

The requirements for preparing a SAR are set out under the ToR under the Part 10 Strategic Assessment Agreement.

Table 4-3 provides the key requirements for preparing a SAR and identifies where each of these requirements are addressed in this Assessment Report, and specifically the SAR component of this Assessment Report.

Table 4-3: Where requirements for preparing a SAR are addressed in this Assessment Report

Section	ToR requirement	Chapter of Assessment Report
1. Purpose of the Strategic Impact Assessment Report	1.1 The purpose of the Report is to assess the impacts of actions taken under the Cumberland Plain Conservation Plan (Plan) on all matters protected by Part 3 of the EPBC Act ('protected matters')	Chapter 1
2. Description of the Plan being assessed	2.1 The Report must describe the Plan	Part 2
	2.1.1 The Report must provide a summary outlining its overall purpose, key elements, spatial extent, and timeframes, including how long the Plan will be in effect	Chapter 1 Part 2
	2.1.2 The Report must provide details about the key elements, including: a. The conservation commitments and outcomes to be delivered for protected matters b. The actions likely to be taken under the Plan over the short, medium and long term c. The legal and administrative frameworks to implement the Plan and the persons and authorities responsible for implementation, including: i. How the Plan has been developed and its legal standing under New South Wales law. ii. The relationship of the Plan to other relevant polices, plans, guidelines, commitments, regulations and legislation including existing approvals under Commonwealth legislation for the Western Sydney Airport and the Western Sydney Growth Centres. iii. Management, approval and funding arrangements for implementing the Plan.	Chapter 5 Chapters 7 - 9
	2.1.3 The Report must describe the need and justification for the Plan including the environmental, social and economic drivers for its development	Chapter 6
	2.1.4 The Report must describe the decision-making framework used in considering alternatives and developing conservation outcomes of the Plan. It should identify where alternative options that have been evaluated to reach the final Plan have been published	Chapter 6
	2.1.5 The Report must describe how the principles of ESD (as set out in section 3A of the EPBC Act) are considered and promoted in the development of the Plan	Chapter 40
3. Description of the protected matters impacted by the Plan	3.1 The Report must describe the nature of the environment within the Strategic Assessment Area, and other areas outside the Strategic Assessment Area that may be impacted by actions taken under the Plan. This must include (at a minimum):	Chapters 28 to 31
	3.1.1 A description of historical and current land use.	Chapter 28
	3.1.2 The extent and quality of native vegetation present including detailed mapping of ecological communities and habitat for threatened species listed under the EPBC Act	Chapter 28 Chapters 29 to 31
	3.1.3 The nature of the environment, including ecosystem processes and threatening processes	Chapter 28

Section	ToR requirement	Chapter of Assessment Report
	3.1.4 A description of the landscape context for key environmental matters, including connectivity, habitat fragmentation and ecological processes	Chapter 28 Chapters 29 to 31
	3.1.5 A spatial map of areas that are already protected for environmental purposes, including Biobanking and Biodiversity Stewardship sites	Chapter 28
	3.2 The Report must identify and describe each protected matter that may be impacted directly, indirectly and cumulatively by actions taken under the Plan, including (at a minimum):	Chapter 28 Chapters 29 to 35
	3.2.1 Key sites, and where relevant, key habitats for protected matters	
	3.2.2 Important populations of protected matters, including the consideration of the importance of both small and large areas of habitat, and their position within the landscape	
	3.2.3 Areas likely to be important for maintaining ecological processes (for example, habitat connectivity) for protected matters	
	3.2.4 Condition of protected matters, including where relevant, seasonal and annual variability, and their likelihood to alter over time	
	3.2.5 Key threatening processes	
4. Assessment of the impact of the Plan on protected matters	4.1 The Report must describe and assess the likely impacts of actions taken under the Plan on all protected matters	Chapters 29 to 35
	4.2 The Report must describe the method used to understand likely impacts on all protected matters of actions taken under the Plan. The level of the assessment will be proportionate to the level of likely risk to each protected matter. The method must:	Part 3 Part 6 (Chapters 29.2, 30.2, 31.2, 32.1.2, 32.2.2, 33.6, 34.1, 35.2)
	4.2.1 Be appropriate for assessment at a strategic scale	
	4.2.2 Rely on the best available information	
	4.2.3 Discuss uncertainty, including reference to the technical data and information relied upon	Chapter 13
	4.2 The Report must identify the data used in the assessment, any limitations it may have, where (or if) the data is available and where it can be accessed, including publicly accessed	Chapter 13
	4.3 Describe and assess separately the likely impacts (if any) of actions taken under the Plan on the environment on Commonwealth land (as defined in section 528 of the EPBC Act)	Chapter 35
	4.4 The Report may also consider protected matters that are potentially eligible for listing as a result of inclusion in a final priority assessment listing held by the Commonwealth, or a recommendation to the Commonwealth Minister for listing by the Threatened Species Scientific Committee prior to the Report being submitted	Chapters 29 to 31
	4.5 The Report must include an analysis of the likely adverse impacts of actions of the Plan on protected matters. This must include (at a minimum) consideration of:	Chapters 29 to 35
	4.5.1 Information on the following: a. Number and size of populations/important populations. b. Extent (in hectares) of suitable habitat.	

Section	ToR requirement	Chapter of Assessment Report
	c. Extent (in hectares) and condition of protected matters. d. Landscape connectivity and ecological processes. e. Heritage listing and values	
	4.5.2 How impacts on protected matters will be avoided through land use planning and other measures, and what mitigation measures will be implemented to reduce impacts, including a description of the mitigation measures and how unavoidable impacts will be offset	Chapter 14 Chapters 29 to 35
	4.5.3 Potential indirect and cumulative impacts	Chapter 15 Chapters 29 to 35 Chapter 38
	4.6 The Report must include an analysis of the conservation benefits (beneficial impacts) of the Plan, including:	Chapter 8 Chapter 41
	4.6.1 How protected matters will be conserved, protected and managed within the Strategic Assessment Area and other areas related to the Plan	
	4.6.2 The adequacy of the commitments and actions under the Plan in protecting and managing protected matters, including the effectiveness of implementation and funding arrangements and who will be responsible for delivering on commitments	Chapter 9 Chapters 29 to 35 Chapter 41
	4.6.3 How proposed commitments and actions involving environmental offsets meet the principles of the *Environment Protection and Biodiversity Conservation Act, Environmental Offsets Policy*, 2012 (DSEWPC, 2012)	Chapter 41
	4.6.4 How landscape connectivity has been maintained and improved, which may include opportunities for strategic ecological restoration of key corridors and areas adjacent to sites with high biodiversity values	Chapters 29 to 35 Chapter 41
	4.6.5 How adaptation to reasonable climate change scenarios has been considered	Chapter 41
	4.7 The Report must consider the extent to which the impacts on protected matters of actions taken under the Plan meet legislative obligations under the EPBC Act, including but not limited to:	Part 6a and 6b
	4.7.1 Consistency with Australia's international obligations, including the Ramsar Convention	Chapter 33
	4.7.2 Consistency with recovery plans (section 146K of the EPBC Act)	Chapters 29 to 31
	4.7.3 Regard to objectives, conservation actions and other relevant information in conservation advices (section 146K of the EPBC Act)	Chapters 29 to 31
	4.7.4 Consistency with World Heritage management plans (sections 316 and 321 of the EPBC Act) and National Heritage place management plans (sections 324S and 324X of the EPBC Act)	Chapter 34
	4.7 The Report may also consider other Commonwealth policy guidelines on protected matters	Chapters 29 to 35
	4.8 The Report must include justification for key methods used in the assessment, including summaries of independent peer review processes and where the review/s are available to the public	Chapter 10 Chapter 11

Section	ToR requirement	Chapter of Assessment Report
5. Evaluation of the overall outcomes of the Plan	5.1 The Report must evaluate the overall commitments and outcomes for protected matters taking into account likely impacts on protected matters from actions taken under the Plan	Chapter 41
	5.2 The evaluation must include:	
	5.2.1 The extent to which protected matters are represented in areas to be protected or managed under the Plan or in existing protected areas in the bioregion/subregion	
	5.2.2 The extent to which the areas to be protected or managed under the Plan or existing protected areas in the bioregion/subregion will ensure the long-term viability of each protected matter	
	5.2.3 Whether there will be serious and irreversible impacts on any protected matter	
	5.2.4 An assessment of how the Plan meets the endorsement criteria set out in the Agreement at clause 8	
	5.3 The evaluation may also include consideration of:	
	5.3.1 The extent to which the commitments and actions under the Plan facilitate adaptation of biodiversity to climate change and address any significant vulnerabilities of protected matters under reasonable climate change scenarios	
	5.3.2 The likely effectiveness of the commitments and actions under the Plan in protecting and managing protected matters and risks and uncertainties	
6. Addressing uncertainty and adaptive management	6.1 The Report must identify key uncertainties and risks associated with implementing the Plan, responses to these and proposed adaptations to changing circumstances. Key uncertainties may include:	Chapter 9 Chapter 16
	6.1.1 Knowledge gaps in scientific understanding and responding to new knowledge	
	6.1.2 Assumptions made in assessing potential impacts and benefits	
	6.1.3 How changes to State and Commonwealth legislation, policies, plans and advice is to be accounted for in the management of the areas impacted by the Plan	
	6.1.4 Effectiveness or capacity to ensure the Plan is implemented	Chapter 16 Chapter 41
	6.2 The Report must describe and assess the adequacy of the procedures proposed in the Plan to ensure an adaptive approach to implementation of the Plan. This must include:	Chapter 16 Chapter 41
	6.2.1 How the results of monitoring will be used to understand the effectiveness of conservation outcomes for protected matters and improve implementation	
	6.2.2 How new information relating to protected matters and biodiversity, including legislative changes, may be assessed and accounted for in implementation of the Plan	
7. Monitoring and Reporting and Auditing	7.1 The Report must describe and assess the adequacy of the monitoring programs, regular review, public reporting and independent auditing processes proposed in the Plan to:	Chapter 9 Chapter 16

Section	ToR requirement	Chapter of Assessment Report
	7.1.1 Ensure conservation commitments and outcomes for protected matters contained in the Plan are delivered	Chapter 41
	7.1.2 Enable implementation of the Plan to adapt where monitoring demonstrates delivery of the conservation actions are not leading to the predicted conservation outcomes	
	7.1.3 Enable implementation of the Plan to adapt to changed circumstances, where there are risks to protected matters	
	7.2 The Report must identify and analyse the likely circumstances and procedures that may result in the review or modification of implementation plans proposed to deliver on commitments and outcomes for each protected matter as described in the Plan, or abandonment of the Plan	Chapter 9 Chapter 41
8. Information sources	8.1 The Report must identify the sources of information and data relied upon including the reliability and currency of the data	Chapter 13

Part 1 References

DECCW (2010) *Report on the methodology for identifying priority conservation lands on the Cumberland Plain* Department of Environment, Climate Change and Water NSW.

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2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 2: DESCRIPTION OF THE CUMBERLAND PLAIN CONSERVATION PLAN

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	Darren James (DAJ Environmental)
CONTENT:	Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Mitchell Ross, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines) Darren James (DAJ Environmental)
REVIEWED BY:	
OPEN LINES:	Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor (BAAS18134)
VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 2 Contents

Part 2 List of Figures

Part 2 List of Tables

This Part describes the Cumberland Plain Conservation Plan (Plan), including:

- An introduction to the Plan (see Chapter 5)
- Planning context and need for the Plan (see Chapter 6)
- Development under the Plan (see Chapter 7)
- Conservation program of the Plan (see Chapter 8)
- Implementation framework for the Plan (see Chapter 9)

5 Introduction

This Chapter provides an introduction to the Plan, including:

- Purpose of the Plan
- Vision and objectives of the Plan
- Key elements of the Plan
- Structure of the Plan
- How the Plan was developed

5.1 PURPOSE OF THE PLAN

The purpose of the Plan is to support the planned and strategic delivery of infrastructure, housing and jobs for Western Sydney while protecting and maintaining important biodiversity areas.

The Plan is part of the NSW Government's commitment to delivering the Western Parkland City, consistent with the Greater Sydney Commission's strategic vision described in the Greater Sydney Region Plan: A Metropolis of Three Cities and Western City District Plan. This includes providing the biodiversity approvals for development in Western Sydney's four nominated areas and major transport corridors.

The Plan has been developed to meet the requirements for:

- Strategic biodiversity certification under the NSW *Biodiversity Conservation Act 2016* (BC Act)
- Strategic assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

5.2 VISION AND OBJECTIVES OF THE PLAN

The Plan provides a high-level vision and objective and defines a set of outcomes and commitments that aim to achieve the Plan's objective and meet regulatory requirements under the BC Act and EPBC Act.

The NSW Government's vision for the Plan is to "support Western Sydney's biodiversity and growth".

The objective of the Plan is:

> *"To deliver biodiversity outcomes and support the ecological function of the Cumberland Plain, improve liveability and facilitate urban development in Western Sydney"*

5.3 KEY ELEMENTS OF THE PLAN

The Plan includes three key elements:

- Development – this covers the urban and industrial, infrastructure, intensive plant agriculture, and transport development under the Plan, including the scope and location of the development
- Conservation – this covers the conservation program and set of commitments and actions to achieve the Plan's objective and offset the impacts of the development on biodiversity values
- Implementation framework – this covers how the Plan will be implemented

The key elements of the Plan are described in detail in Chapters 7, 8 and 9 respectively.

5.4 STRUCTURE OF THE PLAN

The Plan comprises an overall Plan and two Sub-Plans.

The overall Plan describes how the development will occur and how impacts to biodiversity values and other protected matters will be addressed through the Plan's conservation program and implementation framework, including a set of commitments to address the impacts.

The Sub-Plans contain more details on how the overall Plan will be implemented, including sets of actions for each commitment that set out how the commitment will be delivered. The Sub-Plans are:

- Sub-plan A: Conservation Program and Implementation – this details the conservation program and its implementation, including the evaluation program
- Sub-plan B: Koalas – this details how the significant koala population in Western Sydney will be protected under the Plan and how the Plan will support other government initiatives to protect koala

The Plan includes a range of commitments and actions that seeks to improve ecological resilience and protect biodiversity and that will deliver the Plan's vision and objectives. These are provided in Attachment A.

5.5 HOW THE PLAN WAS DEVELOPED

5.5.1 PROGRAM LOGIC UNDERPINNING THE PLAN

The Plan was prepared on the basis of a program logic. The program logic describes how the vision, objective, outcomes, commitments and actions of the Plan link together:

- Outcomes – These are the environmental, social, and economic outcomes of the Plan
- Commitments – These set out how the outcomes are going to be delivered
- Actions – These describe what will be done to deliver the commitments

The program logic underpinning the Plan is shown in Figure 5-1.

Figure 5-1: Program logic underpinning the Plan

5.5.2 COMMUNITY CONSULTATION ON THE PLAN

Since late 2017, the Department has engaged with key stakeholders to help develop the Plan. This included local councils, landholders, industry groups, environmental groups, Local Aboriginal Land Councils (LALCs), Aboriginal groups, and members of the community. Engagement has included:

- Establishing a People's Panel in 2018 comprising of 18 community members, with at least two representatives from each of the LGAs in the Strategic Assessment Area. The Panel participated in a series of workshops on the Plan
- Establishing of a Community Reference Group comprising non-government organisations, academic and key industry stakeholders in the biodiversity conservation sector. The group included representatives from:
    - Australian Institute of Landscape Architects
    - Conservation Volunteers Australia
    - Cumberland Land Conservancy
    - Deerubbin Local Aboriginal Land Council
    - Ecological Society of Australia
    - Greening Australia
    - Landcare NSW, Mulgoa Valley Landcare Group
    - National Parks Association of NSW
    - National Trust
    - Nature Conservation Council of NSW
    - Total Environmental Centre
    - Western Sydney University, Hawkesbury Institute for the Environment
- Targeted engagement with the Aboriginal community. The Department began engaging with LALCs and the Aboriginal community about the Plan in 2018. The feedback through this engagement has supported actions in the Plan and a decision to develop and fund a 10-year Aboriginal Engagement and Implementation Strategy
- Six months of early engagement on the Plan with the Western Sydney community and key stakeholders between July and December 2019. This was done to inform stakeholders and seek preliminary feedback to support development of the Plan before was released for public exhibition
- Public exhibition of the Plan for 10 weeks from 26 August to 2 November 2020. This gave the community an opportunity to provide feedback on the draft Plan through formal submissions. A report on the community engagement process is provided as Supporting Document H

6 Planning context and need for the Plan

6.1 INTRODUCTION

The Plan has been prepared as part of a broader and complex long-term planning process for Western Sydney that aims to address a range of key planning challenges facing Greater Sydney, such as population growth and housing affordability.

This Chapter sets out:

- Key planning challenges for Western Sydney
- Planning context for Western Sydney
- Need and justification for the Plan
- Alternatives to the Plan

6.2 PLANNING CHALLENGES FOR GREATER SYDNEY

Greater Sydney is subject to several key planning challenges, including relating to:

- Population growth and housing needs, including housing affordability and choice
- Job opportunities
- Access to transport
- Protecting the natural environment and amenity

6.2.1 POPULATION GROWTH AND HOUSING NEEDS

Sydney's continued rapid growth presents a substantial challenge to urban planners. Sydney is predicted to grow by an additional 1.7 million people by 2036 (GSC, 2018a). Residents already face significant barriers to home ownership because of issues around housing affordability. In 2018, Sydney was the third least affordable major housing market for middle incomes globally, with median house prices over 11 times the median household income (Cox & Pavletich, 2019).

To accommodate this growing population, 725,000 new homes will be needed, including approximately 210,000 homes in the Western Parkland City at the centre of the Western Sydney Aerotropolis.

6.2.2 JOB OPPORTUNITIES

Sydney is predicted to have an additional 817,000 jobs by 2036. Currently there is an imbalance in the distribution of workplaces within the city, with a significant number of jobs being located within the CBD of Eastern Sydney. The concentration of jobs in one location increases the costs associated with obtaining and operating commercial premises and increases barriers to setting up or expanding business operations in Sydney (GSC, 2018a).

6.2.3 ACCESS TO TRANSPORT

The suburban layout of Sydney encourages car use over alternative transport options, such as public transport or cycling. The concentration of jobs in Eastern Sydney also means that many residents in Western Sydney are subject to long commutes. Increased travel times and heavy reliance on cars for commuting decreases the quality of life of residents by decreasing accessibility to employment and services and increasing the costs of commuting. This impacts air quality and decreases opportunities to participate in social and recreational activities (GSC, 2018a).

6.2.4 NATURAL ENVIRONMENT AND AMENITY

The natural environment and built heritage of Western Sydney provides important social, cultural, aesthetic, economic, historic, and environmental values within the Sydney region. The environment of Western Sydney is under significant pressure from historical and proposed new land uses (see Chapter 3 in Part 1) and balancing the protection of the environment and heritage with other urban development objectives is a significant planning challenge.

6.3 PLANNING CONTEXT FOR WESTERN SYDNEY

The NSW Government has prepared several strategies and plans to address the key planning challenges facing Greater Sydney in a coordinated and strategic manner. The key strategies and plans that form part of this planning framework, and their relationship to each other and the Plan, are discussed below.

6.3.1 WESTERN SYDNEY CITY DEAL

The Western Sydney City Deal is the single largest planning, investment and delivery partnership in the history of Australia, and involves the Australian and NSW Governments and eight local Councils in Western Sydney (GSC, 2018b). The Deal supports additional jobs, housing, and liveability improvements in Western Sydney.

Under the City Deal, the NSW Government has committed to publish 5-year and 20-year housing targets for each local government area to deliver 185,000 new homes needed in the next 20 years.

The City Deal supports the delivery of the Western City District Plan that covers the nominated areas, and includes a commitment to conduct a strategic assessment under the EPBC Act to protect the environment and streamline environmental approvals for development in Western Sydney (DIRDC & DPC, 2018).

The Plan supports that commitment by providing a mechanism to undertake this strategic assessment.

6.3.2 GREATER SYDNEY REGION PLAN

The Greater Sydney Region Plan is a 40-year vision for a global metropolis of three cities incorporating land use planning, transport planning and infrastructure planning. The Region Plan sets out a plan to manage urban growth by establishing a 'metropolis of three cities': Western Parkland City, Central River City, and Eastern Harbour City.

The Region Plan supports the delivery of the Western Parkland City by facilitating the nominated areas and major transport corridors. The Region Plan also includes an action (number 72) to deliver strategic conservation planning and develop a conservation plan for Western Sydney. The Cumberland Plain Conservation Plan delivers on that action.

The Region Plan is guided by 10 overarching directions and 40 objectives for liveability and sustainability, productivity and infrastructure in Greater Sydney and includes a target that all homes will be within 30 minutes access to jobs, schools, and health care (GSC, 2018a). Two core directions address sustainability:

- A cool and green parkland city in the Wianamatta (South Creek) corridor (Objective 26)
- Biodiversity is protected, urban bushland and remnant vegetation is enhanced (Objective 27)

The Region Plan is supported by a series of five 20-year District Plans. These District Plans provide greater detail regarding planning, development, and conservation objectives for each district of Sydney.

By supporting the delivery of the Western Parkland City, the Cumberland Plain Conservation Plan will contribute to the wider objective to develop Sydney as a 'polycentric city' and therefore help address many key planning challenges outlined in Section 6.2. Monocentric cities that experience growth can suffer from increasing business costs, increased housing and living costs, increased labour costs and reduced labour supply, and social segregation, congestion, air quality problems, heat island effects and spatial polarisation (GSC, 2018a). Major cities are responding to planning challenges associated with city growth through promoting the development of polycentric city structures (GSC, 2018a).

6.3.3 WESTERN SYDNEY DISTRICT PLAN

The relevant District Plan for the area covered by the Cumberland Plain Conservation Plan is the Western City District Plan. The Western City District Plan aligns with the Greater Sydney Region Plan and provides more details regarding targeted planning objectives for the District, with associated actions to be undertaken to achieve the outlined objectives.

The Cumberland Plain Conservation Plan supports the implementation of Western City District Plan's planning priorities for:

- Creating a Parkland City urban structure and identity, with Wianamatta (South Creek) corridor as a defining spatial element (Priority W13)
- Protecting and enhancing bushland and biodiversity (Priority W14)
- Protecting and enhancing scenic and cultural landscapes (Priority W16)

6.3.4 FUTURE TRANSPORT STRATEGY 2056

The Future Transport Strategy 2056 is an overarching strategy to achieve a series of objectives for the NSW transport network (Transport for NSW, 2018). The Transport Strategy will be implemented by a suite of plans, including the Greater Sydney Services and Infrastructure Plan (Transport for NSW, 2018).

The Future Transport Strategy 2056 supports the development of Sydney as a polycentric city by developing an integrated network of transport corridors to support connectivity and liveability within Sydney.

The Transport Strategy identifies a range of transport initiatives for investigation, including the Outer Sydney Orbital identified under this Plan (Transport for NSW, 2018).

The Plan supports the delivery of these transport initiatives in Western Sydney.

6.4 NEED AND JUSTIFICATION FOR THE PLAN

This Section addresses section 2.1(3) of the ToR, which requires the Assessment Report to '…describe the need and justification for the Plan including the environmental, social and economic drivers for its development'.

The Plan is needed for the following four key reasons:

- Supports the delivery of the nominated areas program and major transport corridors
- Supports the delivery of key planning strategies and plans
- Provides a mechanism to address conservation challenges for the Cumberland subregion
- Supports NSW Government priorities

6.4.1 SUPPORTS THE DELIVERY OF THE NOMINATED AREAS PROGRAM AND MAJOR TRANSPORT CORRIDORS

The Plan supports the delivery of the NSW Government nominated areas program and the development of major transport infrastructure to meet the long-term transport needs of Western Sydney.

The nominated areas program represents the strategic prioritisation and delivery of new development as part of the long-term growth of Greater Sydney and to meet key social and economic objectives identified under the Greater Sydney Region Plan. The program will consolidate future development needs across Western Sydney by establishing four new nominated areas. The nominated areas are the key focus for urban development over the coming decades and will be the centres of economic and social activity in Western Sydney.

Future Transport 2056 identifies a series of major transport corridors for the coming decades. For Western Sydney, major transport infrastructure is planned to be delivered to respond to the economic and social needs of Western Sydney over the next 40 years. The Plan includes key Western Sydney (major) transport corridors to facilitate infrastructure projects that will generate economic activity and support employment opportunities in the region.

6.4.2 SUPPORTS DELIVERY OF KEY PLANNING STRATEGIES AND PLANS

The Plan supports the delivery of key planning strategies and plans for Western Sydney, as well as the Western City Deal. By supporting the delivery of these, the Plan is directly helping to address key environmental, social, and economic planning challenges facing Greater Sydney outlined in Section 6.2.

The key plans and strategies that the Plan is supporting, and how the Plan supports their delivery, are outlined in Section 6.3. In summary, the Plan is needed to support implementation of:

- Western Sydney City Deal – by providing the mechanism to conduct a strategic assessment under the EPBC Act to protect the environment and streamline environmental approvals for development in Western Sydney
- Greater Sydney Region Plan, by supporting the delivery of the:
    - Western Parkland City
    - Key objectives of the Region Plan, including:
        - A cool and green parkland city in the Wianamatta (South Creek) corridor (Objective 26)
        - Biodiversity is protected, urban bushland and remnant vegetation is enhanced (Objective 27)

- Western City District Plan, by supporting the delivery of planning priorities:
  - Creating a Parkland City urban structure and identity (Priority W13)
  - Protecting and enhancing bushland and biodiversity (Priority W14)
  - Protecting and enhancing scenic and cultural landscapes (Priority W16)
- NSW Koala Strategy in Western Sydney

6.4.3 PROVIDES A MECHANISM TO ADDRESS CONSERVATION CHALLENGES FOR CUMBERLAND SUBREGION

Conservation planning in the Cumberland subregion is challenging and complex. Biodiversity in the subregion has suffered significant disturbance, and the subregion is one of the most threatened regions in NSW (DEC, 2005). Many ecological communities and species are listed as threatened under both NSW and Commonwealth legislation. Areas of remaining native vegetation are often of high conservation value. At the same time, the population of Sydney is growing, housing affordability is a priority and the cost of land across the region is very high.

These issues make it challenging to identify options that satisfy regulatory and community expectations around biodiversity conservation while also addressing the need for cost effective development.

Strategic assessment processes provide significant opportunities to address the key conservation challenges in the Cumberland subregion while facilitating cost effective development.

Strategic assessments can have the following benefits:

- Streamline the assessment and approval process and reduce duplication between regulatory requirements
- Enable effort to be focused on the highest biodiversity value areas of the landscape
- Address ecological function and landscape-scale ecological processes, such as habitat connectivity
- Manage threats at a landscape scale that can maximise benefits to multiple species
- Be designed and implemented strategically, such as by consolidating offsets into large and more viable patches
- Be implemented ahead of impacts occurring from development, to help reverse any trend of decline

6.4.4 SUPPORTS NSW GOVERNMENT PRIORITIES

The Plan supports NSW Government priorities and in particular, the Premier's Priorities. The Plan supports the delivery of two Premier's Priorities:

- Greening our city—increase tree canopy and green cover across Greater Sydney by planting 1 million trees by 2022
- Greener public spaces—increase the proportion of homes in urban areas within 10 minutes' walk of quality green, open and public space by 10% by 2023

The Plan contributes to these priorities by establishing and protecting large areas of new conservation land within Western Sydney, including new public reserves, and introducing development controls to protect biodiversity and other environmental features in urban development areas that will support increasing canopy and green cover.

6.5 ALTERNATIVES TO THE PLAN

This section addresses section 2.1(4) of the ToR, which requires the Assessment Report to '…describe the decision-making framework used in considering alternatives and developing conservation outcomes of the Plan.

Alternatives to the Plan can be discussed in terms of:

- Alternative approaches to urban development
- Alternative conservation outcomes
- Alternative locations of the urban capable lands and major transport corridors

The ToR requires the Assessment Report to '…identify where alternative options that have been evaluated to reach the final Plan have been published'. A key early step in considering alternative conservation outcomes was a structured decision-making process. There is no published report on this process, however, the process and its results are summarised in section 6.5.2. The various strategic planning processes and plans that considered and lead to the proposed locations for the urban capable land and major transport corridors are referenced in section 6.5.3.

6.5.1 ALTERNATIVE APPROACHES TO URBAN DEVELOPMENT

The nominated areas program involves the identification of large areas for greenfield development in high-level strategic planning documents. The nominated areas represent a planned approach to land release for which the NSW Government takes a lead role in setting objectives, planning, and co-ordinating the delivery of development.

Developing nominated areas provides the most effective approach to address the key planning challenges facing Sydney as it provides for a considered and strategic approach to the location of urban and transport infrastructure. A planned approach to land release through nominated areas also allows for:

- Co-ordinated precinct structure planning and better integration of land use and transport to maximise social and economic benefits, including employment areas, schools, hospitals, transport precincts, and open space
- More effective investment by infrastructure agencies when planning for services
- Better co-ordination and alignment between the objectives of different government agencies
- Better direction for the development industry about where future development will occur and greater certainty for landowners about the future use of their land
- A co-ordinated approach to development contributions to help fund the delivery of key infrastructure
- A more efficient use of government resources in responding to development proposals

The alternative to developing nominated areas is a larger number of smaller urban precincts that are separately identified and planned by different planning authorities across a broader region. This approach does not provide the benefits that come with the co-ordinated planning and consolidated development within nominated areas.

6.5.2 ALTERNATIVE CONSERVATION OUTCOMES

The Department applied a structured decision-making process during early development of the Plan to define a high-level biodiversity outcome for the Cumberland subregion that set the context and direction for the development of the Plan. The structured decision-making was one of the first steps in a comprehensive conservation planning process for the Plan. Other planning processes included a process to avoid impacts to biodiversity values (see Chapter 14) and a method to identify high value conservation lands within the Cumberland subregion for offsets that best support an ecologically-functioning, connected landscape (called the Conservation Priorities Method – see Sub-Plan A).

The structured decision-making process provided a systematic method to identify and compare a range of conservation options available to the NSW Government, taking into account social, economic, and environmental considerations.

The structured decision-making process involved five steps:

1. Understanding the decision/s that need to be made
2. Identifying what is important when making those decision/s
3. Developing a range of alternatives to compare
4. Understanding the performance of different alternatives
5. Comparing options and selecting a preferred alternative

The key decision relevant to the structured decision-making work was:

> *"What is the optimal biodiversity outcome for Western Sydney that will enable planned and existing development (including both in and beyond the nominated areas in the Cumberland Plain) to proceed in an affordable and sustainable way?"*

The structured decision-making process was based around four decision making criteria and six performance measures across environmental, social, and economic themes. The criteria were:

- Maximise conservation of biodiversity
- Minimise the costs of delivering the biodiversity outcome
- Ensure the biodiversity outcome is feasible
- Maximise public amenity

The process looked at four different models to provide funding for the biodiversity outcome, examined twenty alternative biodiversity outcomes, modelled the performance of each alternative, and compared the twenty alternatives under various scenarios to reach conclusions about the optimal approach.

The process found that the best approach to achieving the optimal biodiversity outcome with the available funding is to apply a broad mix of commitments and actions to maximise the biodiversity values that are protected, maximise certainty of delivery and alleviate the pressure on offset supply and demand.

The best mix of approaches includes:

- Securing one or more new national parks in the Plan Area
- Investing in biodiversity stewardship in the best remaining vegetation in the Plan Area
- Restoring key parts of the landscape within the Plan Area
- Providing dedicated funding for a set of actions to protect Koalas
- Investing a smaller proportion of the funding on biodiversity stewardship outside the Plan Area, within the allowable variation rules under the BC Regulation

This mix of approaches is reflected in the conservation program for the Plan (see Chapter 8).

6.5.3 ALTERNATIVE LOCATIONS OF URBAN CAPABLE LANDS AND MAJOR TRANSPORT CORRIDORS

PROCESSES TO LOCATE THE URBAN CAPABLE LAND

The urban capable land was identified in three phases:

- Strategic planning to locate the nominated areas
- Initial development of footprints through Land Use and Infrastructure Implementation Plans
- Iterative refinement of the footprints through development of the Plan and assessment of impacts

The initial development and refinement of the urban capable land footprints is described in Chapter 14.

Strategic planning to locate the nominated areas

The broad location of the nominated areas was determined through various strategic planning strategies and investigations over many years. Two key planning strategies that informed the location of the nominated areas were:

- *A Plan for Growing Sydney* (DPE, 2014) – this identified the general location of Wilton Growth Area (Wilton) and Greater Macarthur Growth Area (GMAC) and the Badgerys Creek Airport precinct, which was subsequently refined further by the Department to become WSA
- *A Metropolis of Three Cities* (GFC, 2017) – this identified the general location of Greater Penrith to Eastern Creek Investigation Area (GPEC) and establishes a 40-year vision for Sydney as a global metropolis of three cities, including the Western Parkland City covering the nominated areas

The nominated areas were located based on a broad range of strategic planning considerations, including:

- Proximity to current and planned locations of employment
- The cost of infrastructure provision including roads, water, sewerage, public transport, schools, and health facilities
- The economic and social cost to communities of having poor access to employment and services, including transport
- Environmental constraints, including biodiversity values

Action 2.4.2 of *A Plan for Growing Sydney* (DPE, 2014) aimed to develop a long-term framework for the identification of new nominated areas to improve the management of future land release in Sydney. In preparing a framework for the identification of nominated areas, Action 2.4.2 indicates that a range of issues should be considered, including:

- The value of land for drinking water supply, agriculture, environmental management, and other purposes
- Constraints to development, including environmental constraints and natural hazards

The Department undertook investigations into the location of the nominated areas in accordance with Action 2.4.2.

PROCESSES TO LOCATE THE MAJOR TRANSPORT CORRIDORS

The process for identifying, selecting, and designing future corridors and transport projects involves a detailed set of steps and processes to ensure optimum infrastructure, environmental, social and economic outcomes are achieved. The *Planning guideline for Major Infrastructure Corridors* (DPE, 2016) sets out the recommended processes for infrastructure agencies to follow through the different phases of corridor planning.

The guideline provides advice in relation to the three broad phases:

- Strategic planning – identification
- Corridor planning and selection
- Infrastructure delivery

The first two phases lead to the identification and protection of major transport corridors. As part of this process, a Strategic Environmental Assessment (SEA) is prepared which provides an assessment of the environmental, economic and social impacts of reserving the corridor. SEAs are non-statutory documents that assist in the planning and decision-making process for the community and Government. They are subject to public consultation and include justification for a preferred corridor alignment and provide information on the assessment of alternative corridor alignments.

In making decisions on corridor selection, infrastructure agencies undertake a constraints analysis and multi-criteria comparison of options. These include consideration of a wide range of factors including:

- Aboriginal heritage
- Biodiversity
- Costs
- Engineering and construction limitations
- Land use and property impacts
- Landscape character and visual amenity
- Noise and vibration
- Non-Aboriginal heritage
- Socio-economic considerations
- Soils, geology, and contamination
- Transport planning
- Water quality and hydrology

Refer to Chapter 14 for an example of the process used to locate the Outer Sydney Orbital (OSO) (AECOM, 2018).

7 Development under the Plan

7.1 INTRODUCTION

This Chapter describes each of the development elements of the Plan.

An overview of the development under the Plan is provided in Section 1.5 of Part 1. Part 1 (Section 1.6) also describes the scope and boundaries of the approvals being sought by the Department for the development under the BC Act and EPBC Act.

7.1.1 DEVELOPMENT UNDER THE PLAN

The Plan provides for the following development:

- Urban and industrial development within urban capable land in the nominated areas
- Infrastructure within urban capable land in the nominated areas, as well as 'essential' infrastructure in limited cases within avoided lands in the nominated areas
- Intensive plant agriculture within the Western Sydney Aerotropolis agribusiness precinct
- Major transport corridors within and outside the nominated areas

Each type of development is described in detail in sections 7.2 to 7.5. The development is described in terms of actions that are to be included in an approval of a class of actions pursuant to section 146 of the EPBC Act.

The location of these developments is shown in Part 1 (Figure 1-1).

7.1.2 APPROVALS SOUGHT UNDER THE PLAN

As discussed in Part 1, the Department is seeking two separate statutory approvals for the impacts of the urban and industrial development, infrastructure, intensive plant agriculture and major transport corridors on biodiversity values:

- Strategic biodiversity certification under Part 8 of the BC Act
- Approval under Part 10 of the EPBC Act

Table 7-1 shows what development is subject to assessment and approval under the BC Act and EPBC Act.

Table 7-1: Development being assessed for approval under the BC Act and the EPBC Act#

Development	Biodiversity certification under BC Act	Approval under Part 10 of EPBC Act
The following development within the nominated areas: • Urban and industrial development • Infrastructure, including essential infrastructure* • Intensive plant agriculture • Major transport corridors – certified	✓*	✓
The following development outside the nominated areas: • Major transport corridors – non-certified (strategically assessed)** • Major transport corridors tunnel – non-certified (strategically assessed)^	-	✓

Note that a formal modification to the strategic biodiversity certification will be undertaken to seek NSW biodiversity approvals on behalf of Deerubbin Local Aboriginal Land Council. This is included as an action (Action 6) under Commitment 1 of the Plan. *

* Essential infrastructure is a subset of the infrastructure class of action, and relates to development of essential infrastructure within avoided lands within the nominated areas. Essential infrastructure is to be assessed for approval under Part 10 of the EPBC Act only, and is not included in the biodiversity certification under the BC Act

** Biodiversity certification may be sought for the transport corridors outside the nominated areas at a later date, and may be included as a modification or series of modifications to this biodiversity certification

^ A small part of the tunnel section of the major transport corridors occurs within a nominated area (GMAC), but this is not subject to biodiversity certification under the BC Act

7.1.3 MAJOR DEVELOPMENT NOT PART OF THE PLAN

The following major urban and transport development occur within the Plan Area but are not part of this strategic biodiversity certification and strategic assessment process as they have been previously assessed and approved, or are currently being assessed and considered for approval, under NSW and Commonwealth laws:

- Existing North West and South West Growth Areas (previously assessed and approved)
- Western Sydney International (Nancy-Bird Walton) Airport (previously assessed and approved)
- Sydney Metro Stage 1

7.2 URBAN AND INDUSTRIAL DEVELOPMENT

7.2.1 DESCRIPTION OF THE DEVELOPMENT

The Plan provides for urban and industrial development in four nominated areas:

- Wilton Growth Area (Wilton)
- Greater Macarthur Growth Area (GMAC)
- Western Sydney Aerotropolis (WSA) (excluding where there is overlap with the existing South West Growth Area)
- Greater Penrith to Eastern Creek Investigation Area (GPEC)

The nominated areas are shown in Figure 7-1 to Figure 7-4.

Urban and industrial development will be confined to the urban capable land within the nominated areas.

Other land within the nominated areas includes:

- Land covered by the major transport corridors
- Land avoided for development because of its biodiversity value (see Chapter 14)
- Land avoided for development for other reasons (e.g. because it is unsuitable for development)
- Land that is already protected or developed, or otherwise not included in the Plan (excluded land)

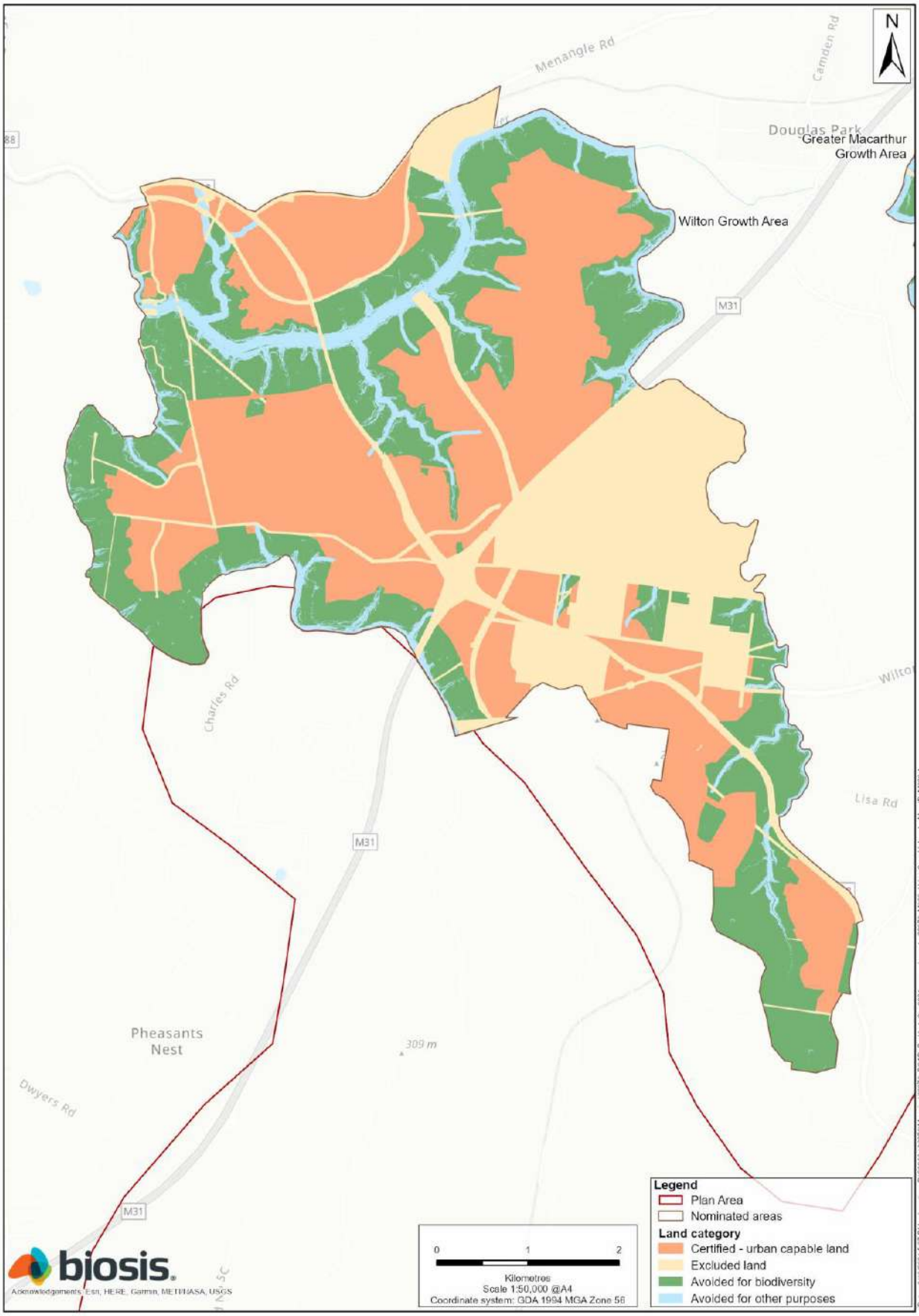

Figure 7-1: Urban capable land within Wilton Growth Area

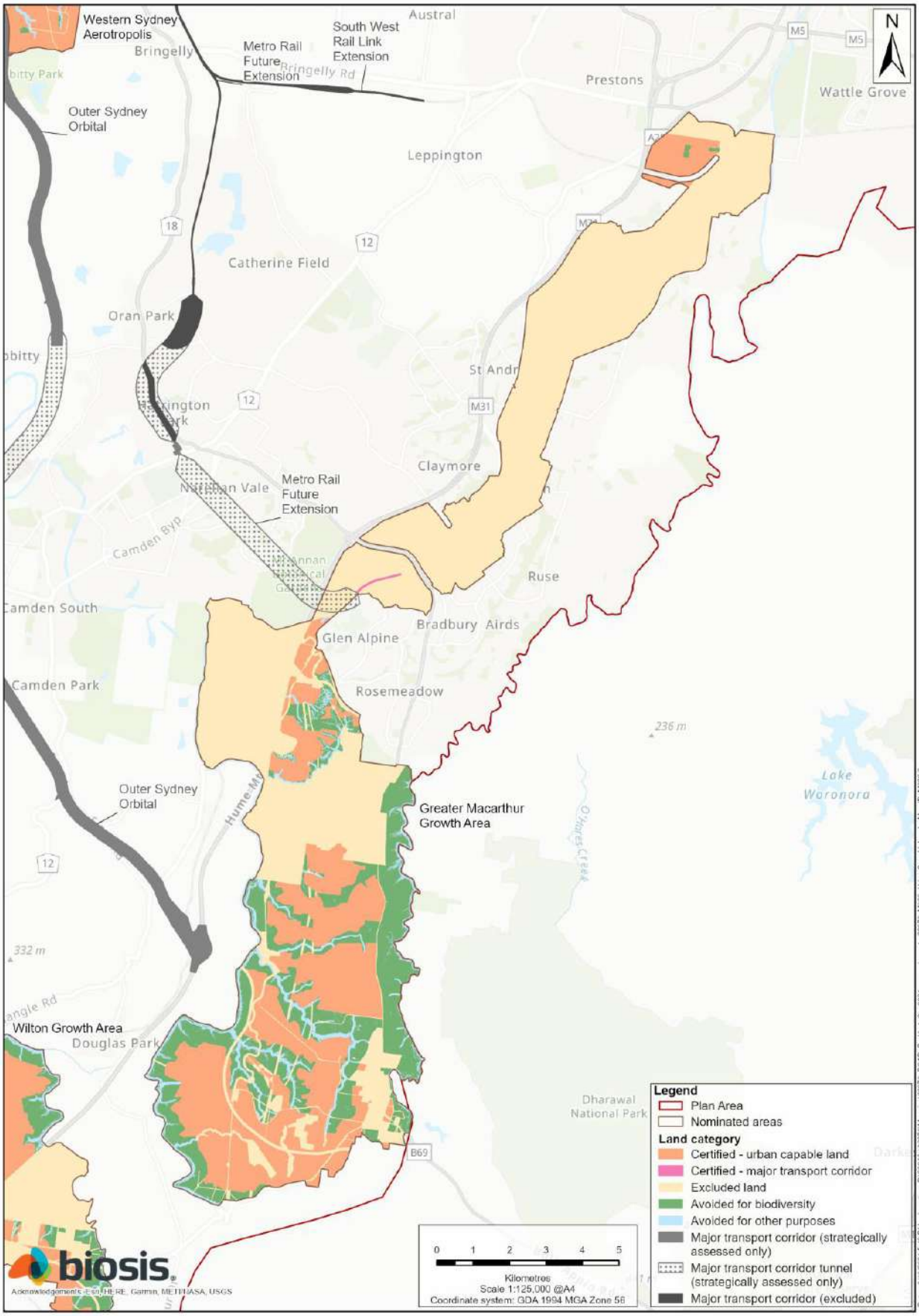

Figure 7-2: Urban capable land within GMAC

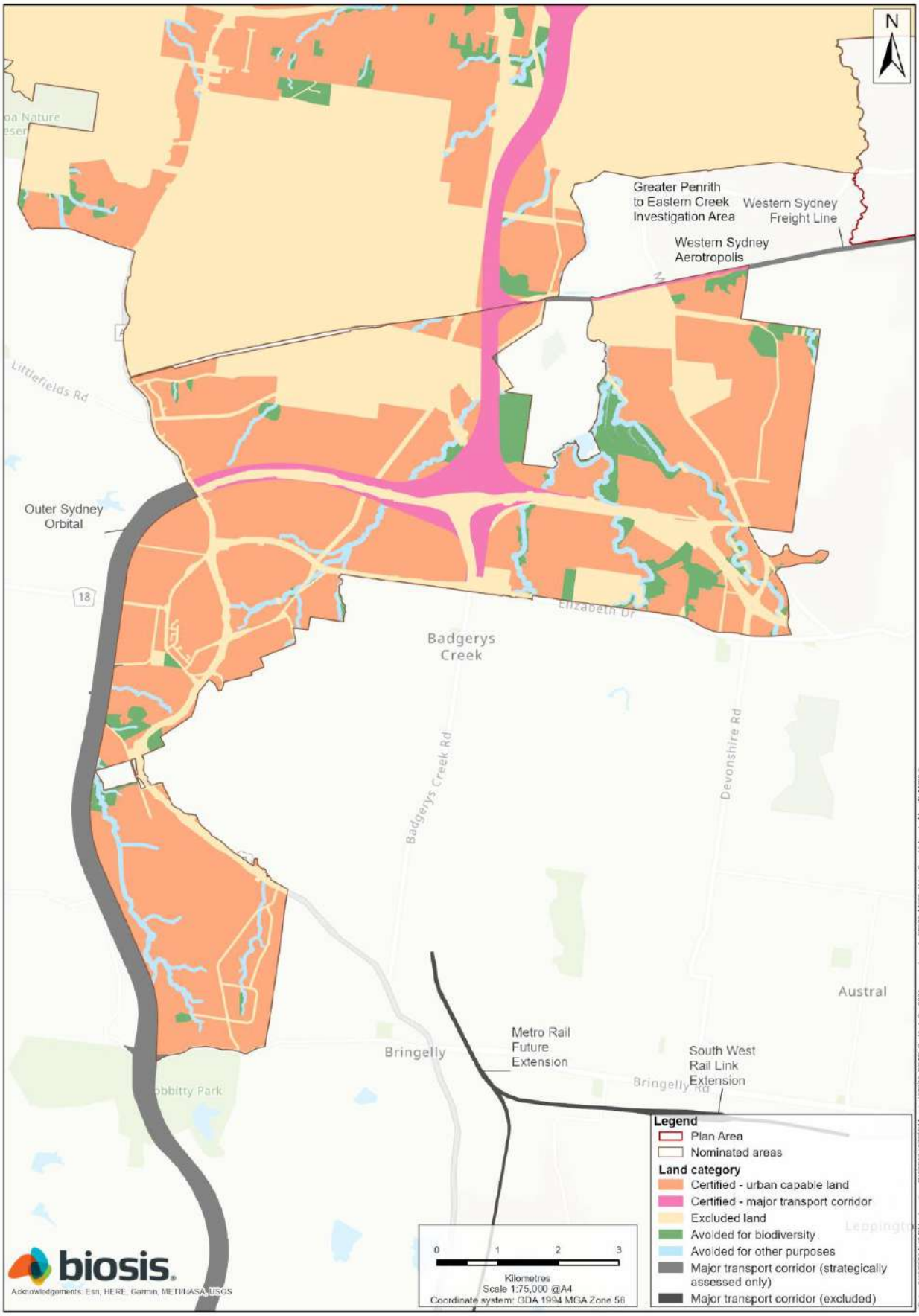

Figure 7-3: Urban capable land within WSA

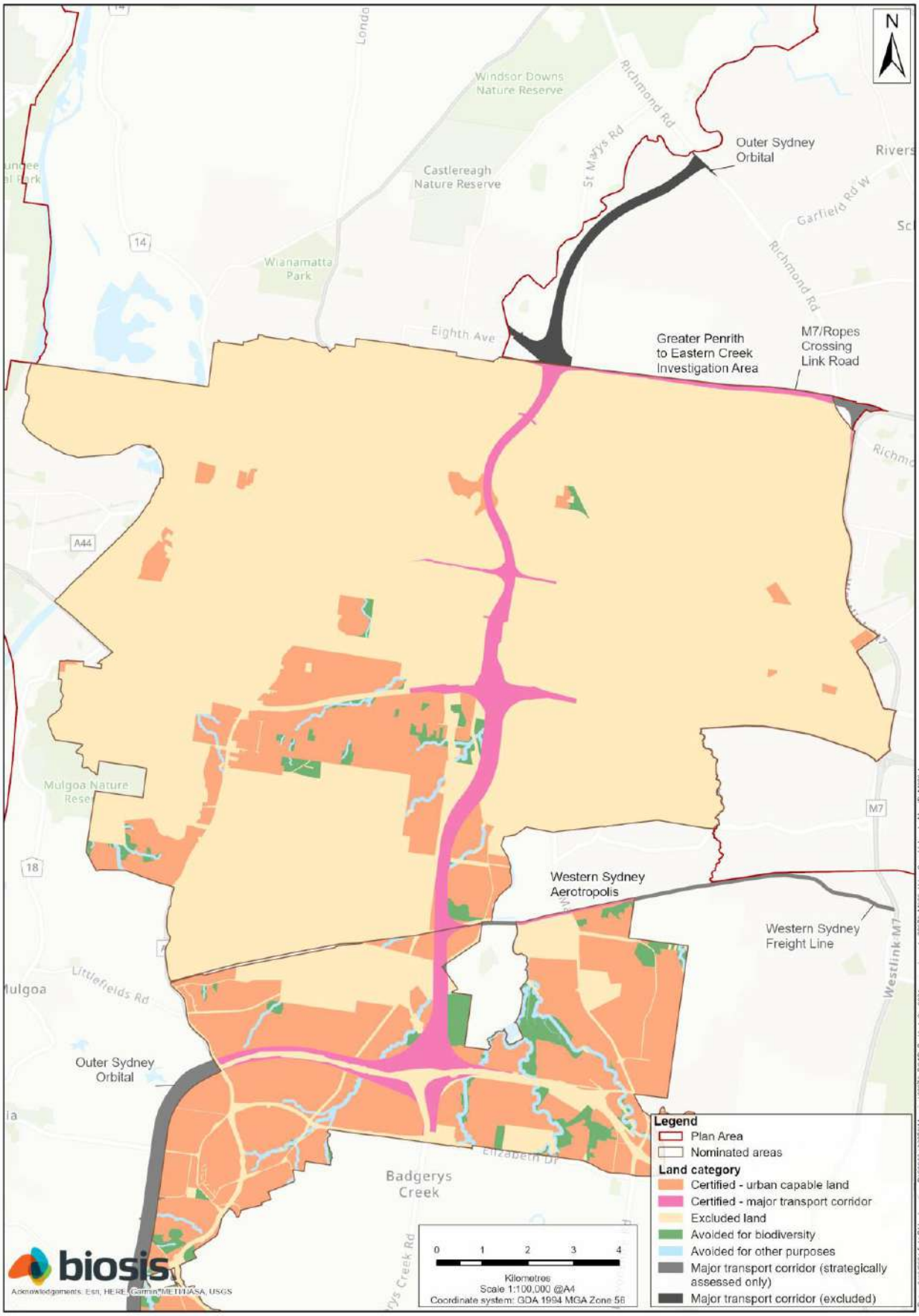

Figure 7-4: Urban capable land within GPEC

Urban and industrial development includes any development permitted through residential, business, or industrial zones, consistent with the structure plan and precinct plans for each nominated area. This includes:

- Mixed residential, commercial, and industrial development, to provide houses, jobs, services, and open and recreational spaces
- Major town centres with a full range of shops, and public and private recreational facilities and services, along with smaller village centres and neighbourhood shops
- Social infrastructure such as education facilities, cultural facilities, childcare services, sports facilities, entertainment facilities, places of public worship, libraries, and community centres
- Essential services such as health facilities and emergency services facilities
- General industrial facilities such as retail outlets, manufacturing industries, training facilities, information and technology facilities, light industries, high-tech industries, material supply centres and distribution centres
- Supporting infrastructure for parks and public reserves (environmental facility, information and education facility, kiosk, recreation area, recreation facilities (outdoor), water recreation structure)
- Agribusiness, including businesses associated with the production, processing, marketing, and distribution of agricultural products. This includes biotechnology research and development, organisations involved in smart high-tech farming practices, data centres, technical services for robotics and farm machinery, food processing, export enabling infrastructure and general administrative services
- Wholesale markets, including retail, accommodation, and large distribution centres, trading floor and associated infrastructure such as cold stores, ripening rooms, treatment facilities and waste management
- Advanced food manufacturing and logistics
- Warehouse, freight, and logistics, including distribution centres, freight transport facilities and heavy industrial storage establishments and storage premises
- Airport and ancillary uses to support the delivery and operation of the new airport

7.2.2 REQUIREMENTS UNDER THE PLAN TO MANAGE IMPACTS

The urban and industrial development will be subject to a range of requirements under the Plan to manage impacts on biodiversity values, and the Plan has introduced mechanisms to support this. This includes:

- Commitments and actions to avoid and minimise, mitigate and offsets impacts. These are provided in Attachment A
- Mitigation measures and processes to manage indirect impacts. These are described in Chapter 15, Section 15.6.1
- Planning mechanisms to support implementation. These are summarised in Chapter 9

7.3 INFRASTRUCTURE

7.3.1 DESCRIPTION OF THE DEVELOPMENT

Infrastructure development includes:

- Electricity transmission or distribution networks
- Gas pipelines
- Road or road infrastructure facilities, including public transport facilities
- Railways and rail infrastructure facilities
- Water reticulation systems, water storage facilities, water treatment facilities, or a water supply system
- Telecommunications facilities or telecommunication network
- Stormwater management system
- Resource recovery facility, waste disposal facility, waste or resource management facility and waste or resource transfer station
- Organic waste and composting facilities
- Koala exclusion fencing as described in the State Environmental Planning Policy (SEPP) (Strategic Conservation Planning)
- Fauna crossings as described in the SEPP (Strategic Conservation Planning)

Related activities and developments associated with the delivery of infrastructure under this class of action are set out in SEPP (Infrastructure) 2007. Development in this class of actions does not include activities described in the Western Sydney Major Transport Corridors class of actions.

Infrastructure development will be limited to urban capable land within the nominated areas, except for 'essential infrastructure', which may be carried out by a public authority on avoided land.

ESSENTIAL INFRASTRUCTURE

'Essential infrastructure' may be carried out by a public authority on avoided land within the nominated areas (i.e. on land outside the urban capable land, but not including excluded land), provided the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development are followed. The guidelines limit the scope of infrastructure development within these areas and ensure development avoids and mitigates and offsets any impacts to biodiversity values.

The guidelines specify a range of requirements to achieve this outcome, including that:

- The environmental impacts of the projects are considered under the EP&A Act, and where triggered, also under the BC Act in accordance with the NSW Biodiversity Assessment Method
- An 'avoid and mitigate' process is applied as part of this assessment process
- Any relevant MNES-specific requirements of the Plan are applied
- The public authority notifies the Department of the development

Essential infrastructure on avoided land will also need to meet specific Plan commitments for avoidance (Commitment 2.1 and Commitment 2.2). This includes limiting cumulative direct impacts to Commonwealth-listed TECs over the life of the Plan in accordance with specific impact thresholds.

The impacts of essential infrastructure are assessed in Chapter 37.

7.3.2 REQUIREMENTS UNDER THE PLAN TO MANAGE IMPACTS

Infrastructure will be subject to future environmental assessment and approval processes under the EP&A Act at the time the projects are proposed. Infrastructure covering the broad types under the Plan is subject to different environmental assessment processes. The SEPP (Infrastructure) 2007 provides a framework for determining how most types of infrastructure are assessed and approved under the EP&A Act.

Infrastructure will be subject to a range of requirements under the Plan to manage impacts on biodiversity values, and the Plan has introduced mechanisms to support this. This includes:

- Commitments and actions to avoid and minimise, mitigate and offsets impacts. These are provided in Attachment A
- Mitigation measures and processes to manage indirect impacts. These are described in Chapter 15 (Section 15.6.2)
- Planning mechanisms to support implementation. These are summarised in Chapter 9

7.4 INTENSIVE PLANT AGRICULTURE

7.4.1 DESCRIPTION OF THE DEVELOPMENT

The Western Sydney International (Nancy-Bird Walton) Airport presents an opportunity to invest in intensive plant agriculture industries. The Agribusiness Precinct within WSA occurs on the northern and western edges of the airport and supports the long-term retention and growth of intensive plant agriculture in the Western Parkland City.

Intensive plant agriculture will be confined to the Agribusiness Precinct within WSA (see Figure 7-5) and includes existing, new, and proposed agricultural areas to support the nominated areas program. While agricultural production will be confined within the Agribusiness Precinct, associated development related to agribusiness, wholesale markets, manufacturing and logistics may occur in other precincts.

Intensive plant agriculture development must satisfy and meet the relevant objectives of the National Airport Safeguarding Framework and may include:

- Intensive plant agriculture, including protective cropping structures used primarily for horticultural applications to control specific environmental conditions and facilitate high-quality, high-quantity production of a defined fruit, vegetable, or flower
- Cultivation of irrigated crops for commercial purposes (other than irrigated pasture or fodder crops)
- Horticulture
- Viticulture

7.4.2 REQUIREMENTS UNDER THE PLAN TO MANAGE IMPACTS

Intensive plant agriculture will be subject to a range of requirements under the Plan to manage impacts on biodiversity values, and the Plan has introduced mechanisms to support this. This includes:

- Commitments and actions to avoid and minimise, mitigate and offsets impacts. These are provided in Attachment A
- Mitigation measures and processes to manage indirect impacts. These are described in Chapter 15, Section 15.6.1
- Planning mechanisms to support implementation. These are summarised in Chapter 9

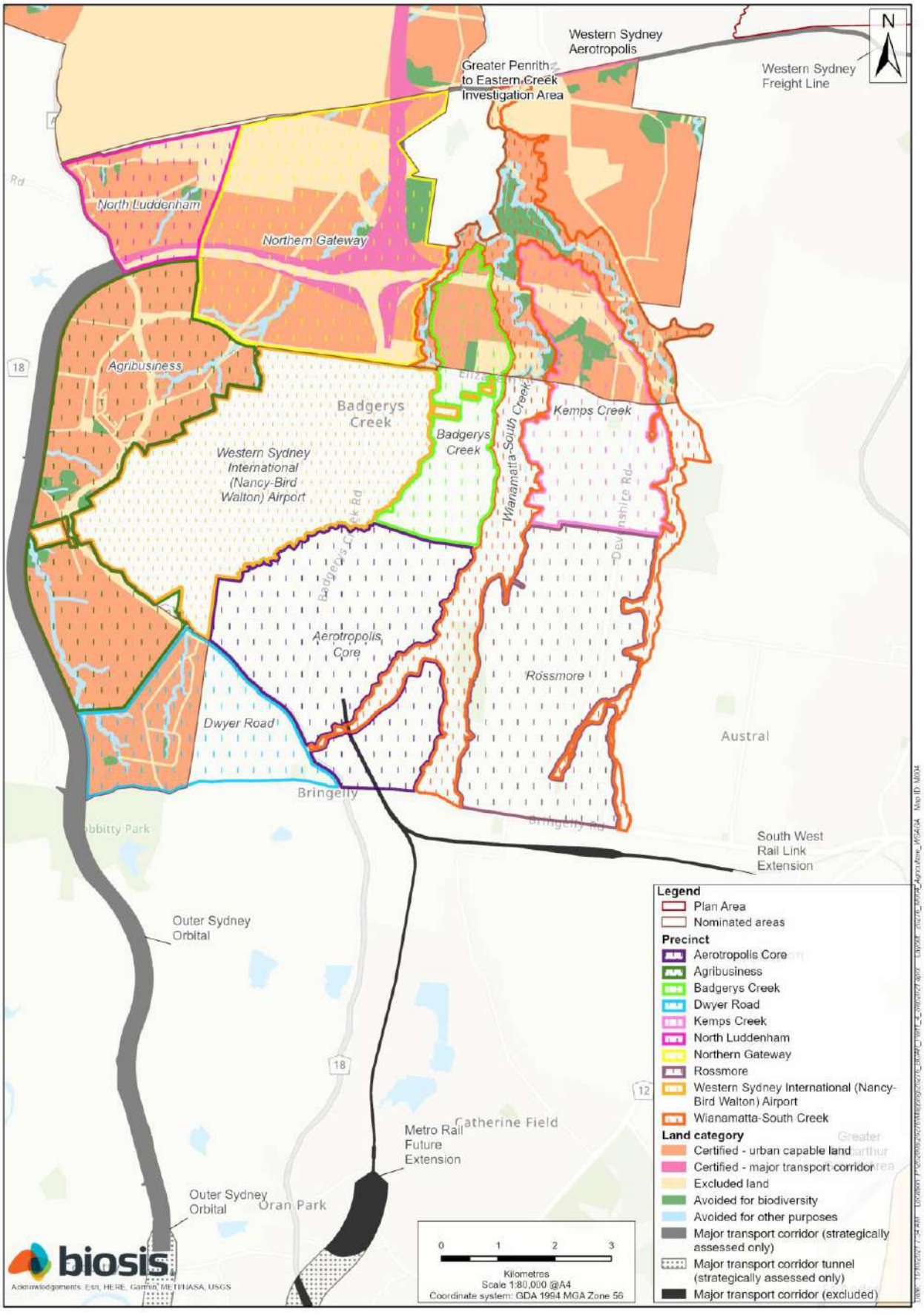

Figure 7-5: Agriculture and Agribusiness Precinct of WSA

7.5 MAJOR TRANSPORT CORRIDORS

7.5.1 DESCRIPTION OF THE DEVELOPMENT

The NSW Government is finalising long term major transport corridors for Western Sydney by identifying and protecting corridors that can be used to deliver the components of a future major transport network. These corridors will facilitate the delivery of major road and rail projects to meet the long-term needs of Western Sydney, as outlined in the *Future Transport Strategy 2056* (Transport for NSW, 2018) and the Greater Sydney Region Plan.

For Western Sydney, the major transport corridors are planned to be delivered over the next 40 years. The delivery and timing of the road and rail infrastructure within the corridors is subject to future NSW Government decisions. The responsibility for delivery of the transport infrastructure rests with Transport for NSW and Sydney Metro.

As described in Part 1, the major transport corridors are subject to different statutory approvals under the Plan and are categorised in this Assessment Report to reflect this. This is shown in Table 7-2.

Table 7-2: Major transport corridors being assessed for approval under the BC Act and the EPBC Act

Major transport corridors	Biodiversity certification under BC Act	Approval under Part 10 of EPBC Act
Within the nominated areas. These corridors are referred to as: • 'Major transport corridors – certified'	✓	✓
Outside the nominated areas. These corridors are referred to as: • 'Major transport corridors – non-certified (strategically assessed)'* • 'Major transport corridors tunnel – non-certified (strategically assessed)'^	-	✓

* Biodiversity certification may be sought for the transport corridors outside the nominated areas at a later date, and may be included as a modification or series of modifications to this biodiversity certification

^ Note that a small part of the tunnel section of the major transport corridors occurs within a nominated area (GMAC), but this is not subject to biodiversity certification under the BC Act

Table 7-3 identifies the proposed major transport corridors under the Plan, the indicative timing for investigating their delivery, their general location in the Plan area, and their approval category under the Plan.

The indicative locations of the major transport corridors are shown in Figure 7-6.

Table 7-3: Major transport corridors

Project	Description	Timing for investigation	General location	Approval categories under Plan
Metro Rail Future Extension from WSA to Macarthur (except for those areas within the existing South West Growth Area)	Provides for a future extension of the metro rail south from the Aerotropolis (Bringelly) to Macarthur	0 to 10 years	Located between Oran Park and Campbelltown	• Major transport corridors – certified • Major transport corridors – non-certified (strategically assessed) • Major transport corridors tunnel - non-certified (strategically assessed)
Western Sydney Freight Line corridor	Provides for a future freight rail line to connect Port Botany and Western Sydney	10 to 20 years	Located between Luddenham and Orchard Hills in the	• Major transport corridors – certified • Major transport corridors – non-

Project	Description	Timing for investigation	General location	Approval categories under Plan
			West and Horsley park in the east	certified (strategically assessed)
Outer Sydney Orbital between Box Hill and the Hume Motorway near Menangle	Provides for a future north-south motorway and freight rail line		Located between Ropes Crossing in the north and Douglas Park in the south	• Major transport corridors – certified • Major transport corridors – non-certified (strategically assessed) • Major transport corridors tunnel - non-certified (strategically assessed)
M7/Ropes Crossing Link Road	Provides for a future east-west motorway linking the M7 to the future Outer Sydney Orbital at Ropes Crossing	20 or more years	Located within and outside the north-east boundary of GPEC between Willmot and Dean Park	• Major transport corridors – certified • Major transport corridors – non-certified (strategically assessed)

The major transport corridors include all activities associated with the design, construction, and operation of the major road or rail projects. Infrastructure development will generally occur within the major transport corridors shown in the Plan (see Figure 7-6) although in some cases, development may be necessary adjacent to the corridor.

The transport activities included under the Plan include, but are not limited to:

- Vegetation clearing
- Earthworks
- Utility works
- Landscaping
- Erosion and sediment control
- Laydown areas
- Road and rail construction and operation
- Tunnel construction and operation
- Construction of supporting infrastructure such as stations, car parks and pedestrian access
- Electricity infrastructure
- Site offices and access roads
- Dust and noise suppression
- Stormwater management (including detention basins, ponds and dams)
- Vehicle and train movements
- Maintenance and upgrade activities
- Installation and maintenance of traffic control and safety infrastructure

Local, state, or regional distributor roads that feed from and to the major transport corridors are not part of the major transport corridor program and will be established as part of the infrastructure class of action (local roads) or via separate planning processes (state, classified or regional roads).

It is important to note that sections of a number of the major transport corridors occur within the existing North West and South West Growth Areas. These sections already have EPBC Act approval under the previous Part 10 strategic assessment for the growth areas and are therefore not further considered in this Assessment Report.

TUNNELS

The major transport corridors include the construction and operation of tunnels. Sections of two of the major transport corridors are proposed to include tunnels. These are:

- Outer Sydney Orbital – Cobbitty to Cawdor
- Metro Rail Future Extension tunnel – Oran Park to Narellan, and Narellan to Macarthur

The locations of the tunnels are shown in Figure 7-6.

7.5.2 REQUIREMENTS UNDER THE PLAN TO MANAGE IMPACTS

As each transport project is brought forward for investigation, the project will be subject to future environmental assessment and approval processes under the EP&A Act and/or the BC Act. The assessment process will depend on whether the project is proposed for certification under the Plan:

- For the 'major transport corridors – certified', the environmental assessment process will comprise the State Significant Infrastructure (SSI) (or equivalent) assessment process under the EP&A Act
- For the 'major transport corridors – non-certified (strategically assessed)' and 'major transport corridors tunnel - non-certified (strategically assessed)', the environmental assessment process will comprise both the SSI (or equivalent) and the BC Act and BAM (or equivalent) assessment processes

The major transport corridors will also be subject to a range of requirements under the Plan to manage impacts on biodiversity values and mechanisms to support this. This includes:

- Commitments and actions to avoid and minimise, mitigate and offsets impacts. These are provided in Attachment A
- Mitigation measures and processes to manage indirect impacts. These are described in Chapter 15 (Section 15.6.3)

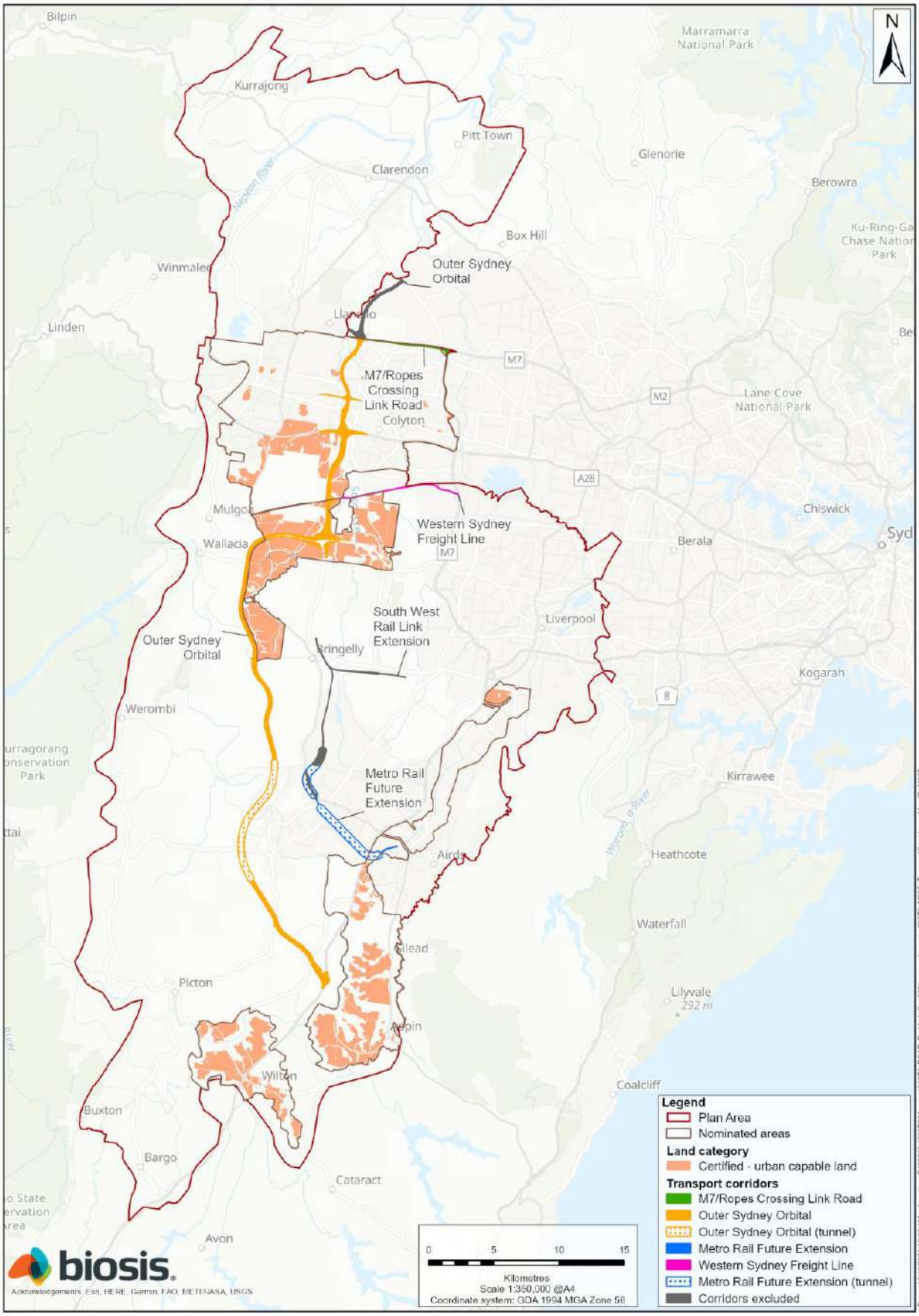

Figure 7-6: Indicative locations of major transport corridors

8 Conservation program of the Plan

8.1 INTRODUCTION

The Plan includes a conservation program to avoid and minimise, mitigate, and offset direct, indirect and prescribed impacts of the development under the Plan on biodiversity values and other protected matters.

This Chapter describes the conservation program under the Plan, including:

- Overview of the conservation program
- Commitments and actions to deliver the conservation program
- Koala conservation program
- Development of the conservation program

The conservation program and commitments and actions associated with the program are supported by a range of implementation mechanisms to ensure its delivery. These are summarised in Chapter 9.

Part 7 provides an evaluation of the adequacy of conservation program in addressing the impacts of the development.

8.2 OVERVIEW OF THE CONSERVATION PROGRAM

8.2.1 PURPOSE OF THE CONSERVATION PROGRAM

The purpose of the conservation program is to achieve the Plan's objective and conservation outcomes and avoid, mitigate, and offset the direct, indirect, and prescribed impacts of the development under the Plan on biodiversity values.

The NSW Government has committed $114 million to fund the conservation program and deliver priority conservation actions over the first five years of implementation. The priority conservation actions include:

- Purchasing land to establish new reserves including the Georges River Koala Reserve
- Commencing restoration of koala habitat including installation of Koala crossings and predator exclusion fences
- Supporting the NSW Koala Strategy including the commencement of annual monitoring in the region
- Establishing partnerships including with the Biodiversity Conservation Trust to facilitate formation of biodiversity stewardship agreements; primarily in the Razorback Area which is dominated by Cumberland Plain Woodland
- Partnering with the NSW Aboriginal Land Council to establish a grant program for Western Sydney Local Aboriginal Land Councils to deliver cultural and conservation opportunities

These actions are detailed further in section 8.3 in relation to key elements of the conservation program (see below).

8.2.2 KEY ELEMENTS OF THE CONSERVATION PROGRAM

The key elements of the conservation program are:

1. Avoiding and minimising impacts
2. Mitigating indirect and prescribed impacts
3. Conserving flora, fauna, and habitat
4. Managing landscape threats
5. Building knowledge and capacity

Each of these elements are discussed in Section 8.3.

The key focus of the conservation program is conserving flora and fauna and habitat by securing priority conservation areas in the Cumberland subregion to offset the impacts of the development under the Plan on biodiversity values and maximise ecological function and resilience at the landscape scale.

8.2.3 OUTCOMES

The outcomes of the Plan deliver the Plan's vision and objective. They include economic, social and environmental outcomes. The environmental outcomes of the Plan are:

> *The extent and condition of native vegetation and Threatened Ecological Communities increases and improves in the strategic conservation area in the Cumberland subregion*
>
> *Populations of targeted threatened species persist, and the condition of suitable habitat improves in the strategic conservation area in the Cumberland subregion*
>
> *Condition of important koala habitat is improved, connectivity between koala sub-populations is maintained, threats to koalas are managed and the koala population in South Western Sydney persists and thrives*
>
> *Areas of high biodiversity value in the nominated areas are protected and threats to species and ecological communities from increased urbanisation is managed*

8.2.4 COMMITMENTS

Commitments are what will be done to deliver the Plan's outcomes. The Plan includes commitments relating to each element of the conservation program. The commitments will be implemented over the life of the Plan.

8.2.5 ACTIONS

Actions are what will be done to deliver the commitments. Each commitment has a set of actions associated with it. Actions are set out in the Sub-Plans and may be subject to change following approval of the Plan.

8.3 COMMITMENTS AND ACTIONS TO DELIVER THE CONSERVATION PROGRAM

This Section provides a summary of the key commitments and actions to deliver the conservation program. The commitments and actions are identified under the five key elements of the conservation program. The full list of commitments and actions in the Plan, including timing for implementation, are provided in Attachment A.

8.3.1 AVOIDING AND MINIMISING IMPACTS

The Plan includes a commitment (Commitment 2) to avoid and minimise impacts from urban and industrial and infrastructure development to at least 4,505 hectares of high biodiversity value area through strategic planning of the nominated areas. This commitment will be delivered through several actions, including:

- Introducing an Environmental Planning Instrument (EPI) to apply development protect important biodiversity on avoided land under the Plan (this EPI is a State Environmental Planning Policy and is described in Section 9.2.1)
- Prepare a Ministerial Direction under section 9.1 of the EP&A Act to require planning proposals by planning authorities to protect or enhance and/or minimise impacts to biodiversity values and to prevent planning authorities from rezoning avoided land for development-related land-uses
- Introducing the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development to manage impacts on biodiversity from infrastructure, including essential infrastructure, on avoided land in the nominated areas
- Monitoring the impacts of development on avoided land through the Plan's reconciliation accounting process
- Notifying proponents of essential infrastructure of their obligations under the EPBC Act, including when development does not have Part 10 EPBC Act approval under the Plan
- Locating asset protection zones wholly within urban capable land

Commitment 2 includes limiting the cumulative direct impacts from essential infrastructure on avoided land for six Commonwealth listed TECs to identified impact thresholds (Commitment 2.1) and prioritising avoidance of known populations of specific flora species and important Koala corridors (Commitment 2.2).

The Plan also includes commitments (Commitment 3 and Commitment 4) for further avoidance and minimisation in relation to the major transport corridors, including the tunnel sections of the corridors.

Note development controls in the SEPP (Strategic Conservation Planning) will not apply to avoided land that is owned or under claim by LALCs.

8.3.2 MITIGATING INDIRECT AND PRESCRIBED IMPACTS

The Plan includes several commitments (Commitment 5, Commitment 6, and Commitment 7) related to mitigating indirect and prescribed impacts. These include to mitigate indirect and prescribed impacts from:

- Urban and industrial development, infrastructure, and intensive plant agriculture on TECs, species and their habitat in accordance with the mitigation measures in Appendix E of the Plan
- Major transport corridors on TECs, species and their habitat in accordance with NSW SSI (or equivalent) approval process and/or BAM process and the mitigation measures in Appendix E of the Plan
- Urban and industrial development, infrastructure, and major transport corridors on the Southern Sydney Koala population to best practice standards and in line with the recommendations of the Office of the NSW Chief Scientist & Engineer and Appendix E of the Plan

Sub-plan A identifies several actions to deliver these commitments, including:

- Incorporating development controls in State-led development control plans for each nominated area setting out development controls that need to be addressed by neighbourhood plans and development applications to mitigate indirect and prescribed impacts on threatened species.
- For the major transport corridors, implementing specific mitigation measures prescribed in Appendix E and identifying and implementing additional mitigation measures based on the outcomes of future environmental assessments in accordance with the requirements of the SSI (or equivalent) approval process
- A range of mitigation measures for Koala, including:
    - Constructing exclusion fencing between important Koala habitat and urban capable land in Wilton and GMAC and several other locations, including the western alignment of the Georges River Koala Reserve
    - Providing safe fauna crossings across Appin Road

8.3.3 CONSERVING FLORA AND FAUNA AND HABITAT

This category of commitments is the key focus of the conservation program. The key commitment of the Plan (Commitment 8) to offset the impacts of the development on biodiversity values is to protect a minimum of 5,325 hectares of native vegetation in the Cumberland subregion to conserve biodiversity values in perpetuity.

As part of this commitment, the Plan will:

- Protect specific minimum amounts of Commonwealth and NSW-listed TECs (Commitments 8.1 and 8.2)
- Protect populations of species considered at risk of residual adverse impacts from the development (Commitment 9)
- Establish a Georges River Koala Reserve to protect a Koala movement corridor along the Georges River (Commitment 10)
- Establish at least two new reserves in addition to the Georges River Koala Reserve to protect TECs and species habitat that are targeted for protection under the Plan (Commitment 11)
- Secure key koala habitat corridors in the Cumberland subregion in perpetuity (Commitment 12)
- Undertake ecological restoration of up to 25% of the Plan's offset target for native vegetation in conservation land established under the Plan (Commitment 13)
- Minimise impacts from development in the Strategic Conservation Area (Commitment 14)

PRIORITY AREAS FOR CONSERVATION (STRATEGIC CONSERVATION AREA)

The Department has identified a Strategic Conservation Area (SCA) within the Cumberland subregion (comprising approximately 27,200 hectares of land within the Plan area) within which the commitment to secure 5,325 hectares of native vegetation and offset the impacts of the development under the Plan will be prioritised. It is anticipated that around 11,500 hectares, or approximately double the Plan's offset commitment of impacted native vegetation will be added to the conservation land network under the Plan. The SCA is shown in Figure 8-1.

The SCA represents the areas in the Cumberland subregion containing habitat for biodiversity values impacted by the development that are considered most likely to be viable in the long-term and maximise ecological function and connectivity across the landscape.

The SCA was identified through a Conservation Priorities Method. The method is described in Section 8.4.1. The method will be reapplied every 5 years and the SCA will be updated as required over the life of the Plan using up to date information on biodiversity values, constraints, and opportunities.

A program of ground-truthing will be undertaken to confirm the biodiversity values of the SCA consisting of desktop and aerial assessment (using satellite imagery) and on-ground surveys.

The Department has developed several approaches to establish conservation lands as offsets within the SCA over the life of the Plan to 2056. These are:

- A series of principles and steps to guide the selection of conservation lands ('Conservation Land Selection Steps')
- A reconciliation accounting process to reconcile offsets acquired through the Plan with development impacts

The Conservation Land Selection Steps allows conservation lands/offsets to be secured in cascading order, from the Cumberland subregion and adjacent subregions as a first preference, to the Sydney Basin bioregion as a second preference, to anywhere in NSW as a last resort, where the preferred options are unable to be achieved.

Offsets secured outside the Cumberland subregion are limited to 20 per cent of the offset target for native vegetation.

In some cases, offset sites may be selected from outside the SCA, but within the Cumberland subregion as a first step. This could include, for example, the purchase of biodiversity credits from existing biodiversity stewardship sites if those areas are contiguous with the SCA and would otherwise meet the criteria for a priority area.

The Department will also develop a Conservation Lands Implementation Strategy that will include:

- Priorities for selecting and purchasing conservation land
- Targets and proposed timeframes for establishing new conservation land
- Proposed land-based conservation type for each area of priority conservation land
- Suitable land managers for each area of priority conservation land
- A process to secure alternative areas where targets and timing cannot be met

MECHANISMS TO SECURE CONSERVATION LAND

Land will be secured for conservation in perpetuity through two programs:

- A reserve program to create reserves through acquisition of land
- A Biodiversity Stewardship Agreement (BSA) program to establish BSAs with landholders

The Department may also seek to purchase biodiversity credits from landholders who have already established BSAs to help deliver the offset targets, particularly the species offset targets.

Reserves

Reserves provide the highest level of in-perpetuity biodiversity protection and a range of social benefits not provided by the other commitments, such as public access to natural areas and open space.

There are a range of reserve types proposed under the Plan, including: National Park, Nature Reserve, State Conservation Area, Regional Park, Council reserve, and community-based reserves. Reserve managers will depend on the type of reserve and will be determined during implementation of the Plan.

Office of Strategic Lands (OSL) will be responsible for securing land for reserves. Land may be secured through:

- Market purchase (a voluntary negotiated sale with the landholder)
- Active acquisition (where OSL actively engage with the landowner to voluntarily purchase their land)
- Acquisition by agreement (where OSL negotiates sale of land identified for acquisition within the landholder through an agreement process and within certain timeframes)

- Compulsory acquisition in limited circumstances

The Department has identified initial locations for land that will be potentially reserved under the *National Parks and Wildlife Act 1974* (NP&W Act) within the SCA. The Georges River Koala Reserve has been announced as a priority, with the first stage (Stage 1A) to be gazetted as a reserve under the NP&W Act by year two of the Plan's implementation. Two additional priority reserves are under investigation for feasibility:

- The Gulguer Reserve Investigation Area
- The Confluence Reserve Investigation Area

These reserve locations are not final and are likely to be refined. Other areas within the SCA have also been identified for further investigation as future reserves to provide greater landscape connectivity.

Biodiversity Stewardship Agreements

BSAs will be a primary mechanism to protect conservation land under the conservation program.

BSAs are voluntary cooperative agreements between a private landholder and the NSW Government. BSAs are registered on the title of a property to provide in-perpetuity protection of biodiversity values. Landholders are responsible to ongoing management of the land using funding provided via developers.

The Biodiversity Conservation Trust (BCT) will be responsible for overseeing the delivery of the BSA program under the Plan and for ensuring compliance with the requirements of BSAs.

Due to the impacts of the development on Cumberland Plain Woodland, the NSW Government has committed to specifically investigating areas for the protection of this TEC through BSAs in the Razorback Area, which contains significant amounts of Cumberland Plain Woodland in addition to other TECs targeted for offsets under the Plan.

The conservation program will also include direct purchase of biodiversity credits from BSAs not established under the Plan, where those sites meet the selection steps and offset requirements as set out in the Plan.

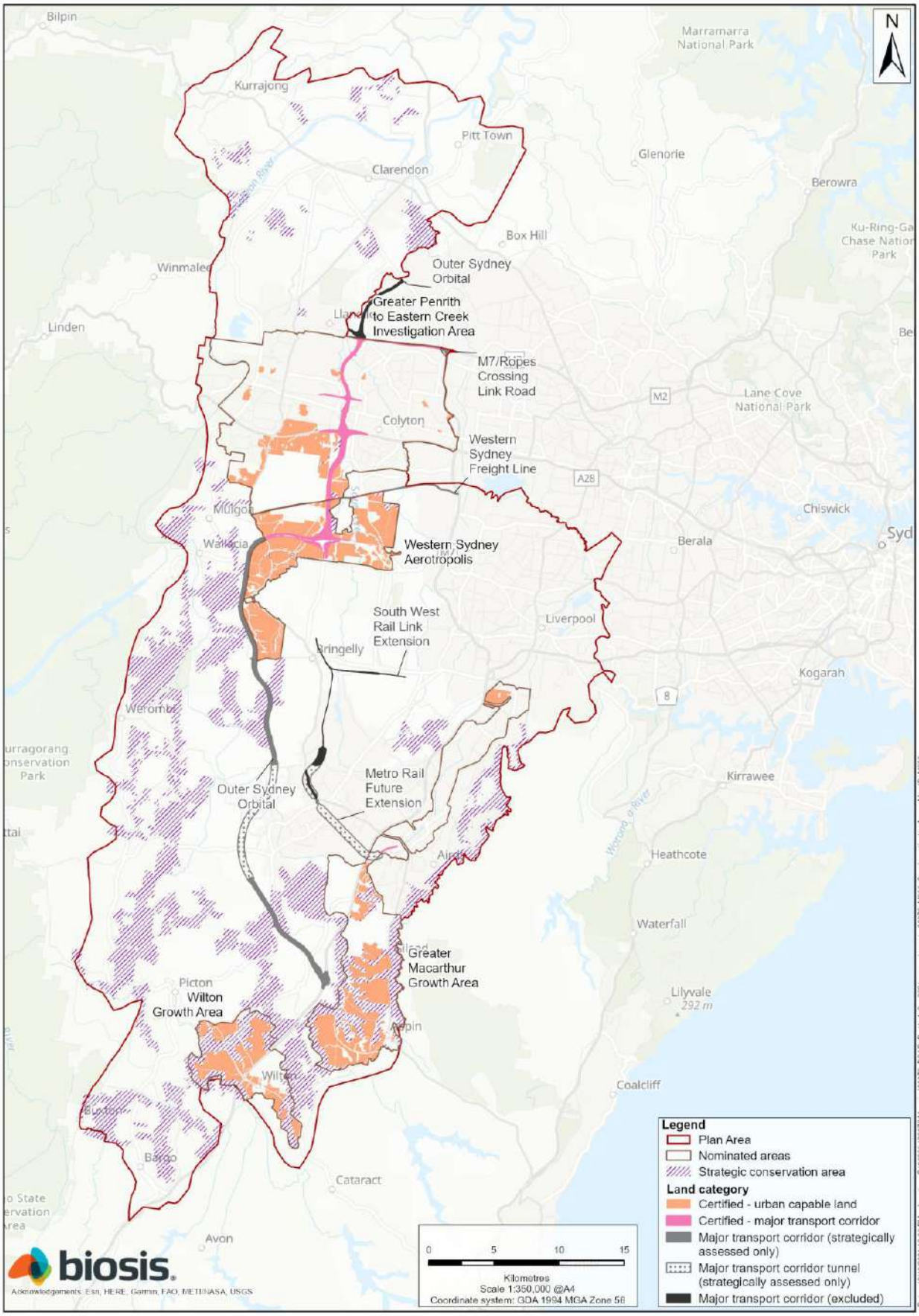

Figure 8-1: Location of Strategic Conservation Areas

RESTORATION OF LAND

As part of the commitments to secure 5,325 hectares of native vegetation (Commitment 8) and undertake ecological restoration of priority areas (Commitment 13), there is a target to restore up to 25 per cent of the offset target for native vegetation through the ecological restoration of land. A key action to deliver this target includes developing a Restoration Implementation Strategy in consultation with key delivery partners to guide restoration priorities.

Restoration efforts will focus on:

- Target TECs where there is a shortfall in established conservation land
- Expanding the habitat area for targeted threatened species
- Enhancing connectivity with reserves and neighbouring areas of high biodiversity value.

Ecological restoration works are intended to be carried out early in the life of the Plan to maximise conservation benefits. Restoration on BSA sites will be overseen by the BCT and undertaken in accordance with BCT guidelines.

INTERIM PROTECTION OF CONSERVATION LAND

The Plan includes a commitment to minimise impacts to biodiversity values on land within the SCA prior to securing land for conservation/offsets (Commitment 14). To achieve this, the Department will:

- Introduce an Environmental Planning Instrument (EPI) to apply development controls to land within the SCA to require consideration of impacts on biodiversity values when consent authorities assess development applications (this EPI is a State Environmental Planning Policy and is described in Section 9.2.1)
- Prepare a Ministerial Direction under section 9.1 of the EP&A Act to require planning proposals by planning authorities to protect or enhance and/or minimise impacts to biodiversity values and to prevent planning authorities from rezoning the SCA for development-related land-uses
- Work with local councils to integrate mapping of the strategic conservation area into local and regional planning through Local Strategic Planning Statements, which guide the local plan-making process

Note development controls in the SEPP (Strategic Conservation Planning) will not apply to land that is owned or under claim by LALCs in the SCA.

EES has provided in-principle support for including the vegetation mapped in the SCA in the Biodiversity Values (BV) map (where the vegetation is not already identified on the map). The BV map is prepared by the Department under Part 7 of the BC Act and identifies land with high biodiversity value that is sensitive to impacts from development and clearing. The map is one of the triggers for determining whether the Biodiversity Offsets Scheme applies to a proposal.

Including the vegetation mapped in the SCA in the BV map will provide additional protection for the SCA from future developments. It ensures proposals for development in the SCA that involve clearing or would result in a prescribed impact are avoided and minimised and subject to assessment and approval under the BC Act.

8.3.4 MANAGING LANDSCAPE THREATS

The Plan includes a range of commitments to manage threats to biodiversity in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA, including:

- Deliver weed and pest control programs (Commitment 15 and Commitment 16) to manage weeds and pests in strategic locations in the Cumberland subregion to reduce threats to conservation lands under the Plan
- Fire management in strategic locations (Commitment 17) to support the maintenance of biodiversity values in conservation lands under the Plan
- Support new or existing disease control programs (Commitment 18) to better manage disease affecting threatened species and TECs within the Cumberland subregion
- Support new or existing programs to help threatened species and TECs adapt to climate change (Commitment 19)

Actions under these commitments include to:

- Establish a working group on pest animals and participate in the Sydney Weeds Network to advise on threat management

- Develop more detailed implementation strategies for weeds and pests and fire in consultation with the working groups and other key stakeholders, including delivery partners, to set out:
  - Priorities for management of the threat
  - Guidance on management approaches
  - Any research needs
  - Delivery arrangements, including the provision of funding under the Plan

The Plan identifies a range of delivery partners to support implementation of these commitments and actions.

8.3.5 BUILDING KNOWLEDGE AND CAPACITY

The Plan includes a range of commitments and actions to build capacity and support stakeholders in relation to biodiversity conservation in the Cumberland subregion, including:

- Providing opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation, including Koala conservation (Commitment 20)
- Partner with Aboriginal communities in Western Sydney to deliver biodiversity conservation and support economic opportunities arising from the delivery of the Plan (Commitment 21)
- Investing in research that will support implementation of the Plan and help deliver its outcomes (Commitment 22)
- Supporting rehabilitation measures to help maintain Koala health and welfare (Commitment 23)

The Plan identifies a range of delivery partners to support implementation of these commitments and actions.

8.4 KOALA CONSERVATION PROGRAM

The Koala is one of Australia's most iconic species and the Plan includes a specific set of commitments, actions and measures to ensure the long-term protection of Koala in the Cumberland subregion.

A key commitment for Koala is to establish a reserve to secure a Koala movement corridor along the Georges River (Commitment 10) between Appin and Kentlyn. The Georges River Koala Reserve will be secured in stages, and overall will protect up to 1,830 ha of existing Koala habitat and enhance the connectivity of fragmented patches of Koala habitat through restoration.

The Plan also includes a commitment to protect Koala corridors in the Cumberland subregion (Commitment 12). Actions under this commitment relevant to Koala include:

- Protecting avoided Koala habitat through the application of new development controls in potential east-west Koala movement corridors between the Georges River and the Nepean River
- Restoring Koala habitat in the Georges River and Ouesdale Creek corridors to ensure they meet requirements for safe and functional Koala movement corridors, consistent with the advice from the Office of the NSW Chief Scientist & Engineer
- Perimeter fencing east-west Koala corridors which are too narrow to support safe passage of Koalas through the landscape

Commitment 7 is also a key commitment relating to Koalas and relates to protecting Koalas from indirect and prescribed impacts under the Plan. Key actions include:

- Installing Koala exclusion fencing between important koala habitat and urban capable land within GMAC and Wilton, or where fencing is not feasible, installing additional controls to protect Koalas
- Installing exclusion fencing along both sides of Appin Road to mitigate the threat of road mortality for Koalas
- Managing the threat to Koalas posed by dogs on all public land identified as important Koala habitat
- Providing safe fauna crossings across Appin Road and other linear infrastructure, including:
  - An underpass at Brian Road
  - Augmenting the existing Kings Fall Bridge at George River to enable Koala passage
  - Investigating options for enhancing Koala movement across the Upper Canal

Appendix E of the Plan also outlines a range of species-specific measures which will be implemented to protect Koalas from indirect and prescribed impacts from development.

The Plan also includes commitments or actions to:

- Undertake ecological restoration to improve Koala habitat quality and connectivity (Commitment 13)
- Establish research programs for the Southern Sydney Koala population (Commitment 22)
- Investing in the NSW Koala Strategy (OEH, 2018) (under Commitments 20 and 23) to:
    - To implement the Koala health and welfare program in South Western Sydney
    - Raise awareness of the Southern Sydney Koala population

Koala movement corridors are shown in Figure 8-2.

Further details on the Koala conservation program are provided in Sub-Plan B.

8.4.1 DEVELOPMENT OF THE CONSERVATION PROGRAM

The conservation program was informed by two key processes to identify priority areas for conservation and establish offset targets that will adequately offset the impacts of the development on biodiversity values.

- A method to identify the SCA (called the Conservation Priorities Method)
- Establishment of offset targets

8.4.2 CONSERVATION PRIORITIES METHOD

The SCA was identified through a Conservation Priorities Method. The method combines detailed spatial information about biodiversity values with an analysis of constraints and opportunities to identify an optimal mix of potential conservation sites to offset the impacts of the development on biodiversity values.

The method builds on the significant amount of strategic conservation planning that has occurred in the Cumberland subregion over the last decade, including the Cumberland Plain Recovery Plan (DECCW, 2011) and Biodiversity Investment Opportunities Map (OEH, 2015).

The method is summarised in Box 2 (taken from Sub-Plan A).

Box 2: Summary of Conservation Priorities Method

The Method uses multi-criteria analysis to achieve a ranking of conservation priorities, using three stages:

Stage 1 – Ecological assessment model

The first stage identifies the areas of highest biodiversity value based on an ecological assessment of remaining vegetation patches and their proximity to key features and applying a set of criteria that would either constrain or permit that area to be used as an offset

Thresholds for the minimum area of offset required for each target Plant Community Type (PCT) were identified based on impact, predicted offset required and the amount of each PCT remaining in the landscape after the application of phase '0' constraints

Offset requirements were determined by applying a matrix that applies an offset ratio to all impacted entities based on their conservation status and condition. In accordance with the matrix, the offset ratio increases both as conservation significance increases and as the condition of vegetation improves

Phase 2 – Constraints assessment model

The remaining vegetation and species habitat available for potential offset is assessed for further constraints that could challenge the implementation of commitments

Stage 3 - Conservation priorities assessment & offset selection method

This stage identifies suitable conservation areas based on Stages 1 and 2 using vegetation and species offset selection methods (noting that the selection of suitable offset areas is done from the ground up', i.e. from PCT and threatened species habitat to the landscape scale)

Stage 4 – Ground-truthing program

The final stage confirms the offset selections using a detailed desktop assessment and an 'over-the-fence' style assessment of specific sites, where observations are generally made at some distance from the property. This is conducted by a BAM-accredited assessor, collecting ecological data using a fit-for-purpose Rapid Assessment Method (RAM) digital form. This stage allows for the vegetation mapping to be updated and offset boundaries adjusted based on the results of the ground-truthing program.

8.4.3 DEVELOPMENT OF OFFSET TARGETS

The conservation program includes commitments to protect 5,325 hectares of native vegetation in conservation lands. As part of this commitment, the Plan establishes offset targets for specific biodiversity values to ensure that the commitment addresses the biodiversity values being impacted. Offset targets have been developed for:

- Each impacted Commonwealth-listed TEC
- Each impacted NSW-listed TEC
- Commonwealth and NSW-listed species likely to be at risk of residual adverse direct impacts

An analysis of the extent to which the TEC offset targets are consistent with the BAM credit requirements and meet the principles of the EPBC offsets policy (DSEWPC, 2012) is provided in Part 7.

CONTEXT FOR DEVELOPMENT OF OFFSET TARGETS

Under a strategic biodiversity certification under the BC Act, no guidance is provided about how to determine offset targets for TECs and species and therefore methods were required to be developed for this Assessment Report.

The offset target methods took a risk-based approach and aimed to ensure offsets under the Plan addressed reasonable or actual risks of impacts to each TEC and species and were proportionate to these risks.

This was particularly challenging for species offsets, because the spatial and temporal scale of the Plan means there is an inherent level of uncertainty in the baseline data (both for species habitat and records). The species habitat mapping is very precautionary as it is based primarily on assumed presence (see Part 3) due to land access constraints. The mapping is unlikely to provide an accurate indication of the likelihood of species occurrence within areas impacted by the development (see Box 3) and is not considered to provide a suitable basis alone for determining offsets. This makes it is important to understand the level of risk to each species in determining appropriate offsets rather than take a simplistic view of direct impacts to potential habitat as indicated in the impact statistics.

It is important to note that potential habitat for most species impacted by the Plan will be secured through the offsets required to meet the NSW TEC targets, and for many species, substantial amounts of habitat (hundreds to thousands of hectares) will be secured (see Section 41.6). The Plan's reconciliation accounting process will track the Plan's progress in securing potential habitat for each species in addition to the species offset targets (see Sub-Plan B).

The approach to developing species offset targets took this into account and aimed to provide greater certainty of conservation outcomes for those species likely to be at risk of residual adverse impacts under the Plan. Species offsets for most species are established in terms of 'offset locations' (see definition below) rather than amounts of potential habitat to ensure known habitat and populations will be secured and managed in perpetuity, rather than merely potential habitat with no certainty that the species will benefit from the offset.

BOX 3: HABITAT MAPPING – ACACIA PUBESCENS

The Plan will directly impact 1,377.6 hectares of habitat for *Acacia pubescens* in the Plan Area.

If the offset rules applied, this would require the retirement of 26,395 credits.

This offset amount is not considered to be proportionate to the level of risk from the Plan to this species. The assessment under the EPBC Act for this species, which applied a risk framework to determine the risks of residual adverse impacts to each Commonwealth listed species, concluded this species is at *very low* risk (see Chapter 29).

This was based on several factors, including the following:

- The likelihood of actual impacts occurring was categorised as unlikely. There will be no impacts to known populations, and there is low confidence that the species could occur in the potential habitat to be impacted. The habitat which is to be impacted within GPEC and WSA consists of small, scattered, and isolated patches which are considered unlikely to support the species. Impacted potential habitat within GMAC and Wilton is located outside of the core range of the species, and the species has never been recorded in these localities
- The consequence of any impacts to the species (if they did occur) was categorised as minor. There will be loss of 3.8 per cent of mapped potential habitat in the Plan Area. Species mapping is highly precautionary, with much impacted habitat being mapped beyond the known range of the species, suggesting the species is unlikely to occur in these localities, and as such there is low confidence of species presence in impacted habitat

The expert report for the species (see Supporting Document C) also acknowledges the precautionary nature of the mapping, stating that it is 'precautionarily modelled potential habitat', and does 'not necessarily equate with actual habitat'. The report states that '[i]t is unlikely that a large percentage of the potential habitat identified in the report would actually support [the species] because this species is naturally rare and patchily distributed…'.

THREATENED ECOLOGICAL COMMUNITY OFFSET TARGETS

The Department developed an approach for defining offset targets to ensure that the commitments address the biodiversity values being impacted. The offset target method determined targets based on the:

- Amount (hectares) of each impacted matter
- Conservation status of the impacted matter
- Condition of the impacted matter

This approach is explained in detail in the Conservation Priorities Method that supports the Plan.

Table 8-1 identifies the offset targets for each impacted TEC.

Table 8-1: Offset targets for threatened ecological communities

Matter	Offset target
Commonwealth-listed TECs	
Shale Sandstone Transition Forest	675 ha
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	665 ha
River-Flat Eucalypt Forest on Coastal Floodplains	570 ha
Cooks River Castlereagh Ironbark Forest	125 ha
Coastal Swamp Oak Forest	20 ha
Western Sydney Dry Rainforest and Moist Woodland on Shale	0.2 ha
NSW-listed TECs	
Cumberland Plain Woodland	2,885 ha
Shale Sandstone Transition Forest	1,455 ha

Matter	Offset target
River-flat Eucalypt Forest	505 ha
Shale Gravel Transition Forest	285 ha
Cooks River Castlereagh Ironbark Forest	115 ha
Swamp Oak Floodplain Forest	70 ha
Freshwater Wetlands on Coastal Floodplains	10 ha
Moist Shale Woodland	0.2 ha

SPECIES OFFSET TARGETS

Species offset targets were developed for each Commonwealth and NSW-listed species likely to be at risk of residual adverse impacts from the direct impacts of development under the Plan.

The determination of what species need offsets was based on:

- For Commonwealth-listed species – individual assessments of the level of risk of residual adverse impacts from the direct impacts of development under the Plan on each species, provided in Chapter 29 and 30
- For NSW-listed species – a set of criteria that aims to address the risk of residual adverse direct impacts

The approach to determining risk for Commonwealth and NSW-listed species was different because of the different methods used to assess impacts on these species used in the Assessment Report.

Species offset targets are specified under the Plan in terms of:

- Number of 'offset locations'
- Hectares of potential foraging habitat and important habitat for Swift Parrot
- Hectares of important habitat for Koala

An 'offset location' is a site where one or more populations and habitat of the species has been confirmed through surveys or an expert report as being present. Offset location sites may be reserves or BSA sites. For a biodiversity stewardship site, this means credits representing a reasonable proportion of habitat and/or number of individuals of a local population of the threatened species are purchased and retired against the Plan's offset targets.

Specifying offset targets in terms of 'offset locations' rather than amounts of potential habitat was considered the most robust approach. This is because it ensures known habitat and populations will be secured and managed in perpetuity, rather than merely potential habitat with no certainty that the species will benefit from the offset.

For Swift Parrot, both potential foraging habitat and important habitat were used as the offset targets. This species is a species credit species for important habitat under the BAM. Both potential foraging habitat and important habitat has been mapped in the Plan Area and will be impacted by the development.

For Koala, important habitat (defined as primary, secondary and tertiary corridors – see Part 3) was used as the offset target as this has been mapped in the Plan Area and will be impacted by the development.

Species offset targets for Commonwealth and NSW-listed species are identified in Table 8-2.

Table 8-2: Offset targets for species

Species	Cth status	NSW status	Offset target
Cynanchum elegans	E	E	2 offset locations
Dillwynia tenuifolia	-	V	3 offset locations
Grevillea juniperina subsp. *juniperina*	-	V	3 offset locations
Haliaeetus leucogaster	-	V	1 offset location
Hibbertia fumana	-	CE	1 offset location

Species	Cth status	NSW status	Offset target
Hibbertia puberula	-	E	1 offset location
Hieraaetus morphnoides	-	V	1 offset location
Koala (*Phascolarctos cinereus*)	V	V	570 ha of important habitat
Lophoictinia isura	-	V	1 offset location
Marsdenia viridiflora subsp. *viridiflora*	-	E	2 offset locations
Cumberland Plain Land Snail (*Meridolum corneovirens*)	-	E	3 offset locations
Persoonia nutans	E	E	2 offset locations
Pimelea spicata	E	E	3 offset locations
Pultenaea parviflora	V	E	2 offset locations
Pultenaea pedunculata	-	E	2 offset locations
Southern Myotis (*Myotis macropus*)	-	V	1 offset location
Swift Parrot (*Lathamus discolour*)	CE	E	4,410 ha of potential foraging habitat, including 100 ha of important habitat

Commonwealth-listed species

The determination of which Commonwealth-listed species need offsets was based on assessments of the level of risk of residual adverse direct impacts undertaken for each species in Chapter 29 and 30. A detailed description of the risk framework applied to assess each Commonwealth-listed species is provided in Chapter 29 and 30.

Risk is generally considered to be the combination of the likelihood and consequence of an event occurring. In summary, the risk framework involved consideration of:

- Likelihood that a species will be directly impacted due to impacts to populations and/or potential habitat, taking into account records and potential habitat mapping, as well as level of confidence in these
- Consequence of the direct impacts, taking into account conservation status, SAII entities, endemicity, and thresholds that were specified for the amount of direct impact on populations and potential habitat due to the development

The risk framework also included an assessment of the likelihood and consequence of impacts due to fragmentation, as well as an amended approach to determining risk for wide-ranging fauna (such as Swift Parrot).

The species considered to require offsets were those with a high or medium risk of residual adverse impacts. These were:

- *Cynanchum elegans*
- Koala
- *Persoonia nutans*
- *Pimelea spicata*
- *Pultenaea parviflora*
- Swift Parrot

Offsets were not considered necessary for species considered to be at low or very low risk.

The method to determine the 'offset location' targets for each species was based on a combination of the identified level of risk of residual adverse direct impacts (high or medium) and conservation status. Consistent with the approach for determining offset targets for TECs, Swift Parrot, and Koala, species with a higher conservation status (as well as a higher risk of residual adverse direct impacts) required larger offset targets. This is shown in Table 8-3.

Table 8-3: Method to determine offset locations for Commonwealth-listed species needing offsets

Risk of residual adverse direct impacts	Conservation status		
	V	E	CE
High	2 offset locations	3 offset locations	4 offset locations
Medium	1 offset locations	2 offset locations	3 offset locations

Offset targets for Swift Parrot and Koala were determined by applying an approach developed by the Department consistent with the approach for determining TEC targets. As for TECs, targets were determined based on the amount (hectares) of habitat of each matter impacted by the development, and were driven by two key principles:

- Impacts to higher conservation status matters require more offsets that lower status matters
- Impacts to higher condition habitat require more offsets than lower condition habitat

This approach is explained in detail in the Conservation Priorities Method that supports the Plan.

NSW-listed species

NSW-listed candidate species credit species needing offset targets were determined based on a set of criteria that aimed to reflect the level of risk of residual adverse impacts to the species. Consistent with the BAM, ecosystem credit species are addressed through offset targets for NSW TECs/PCTs and were not considered for specific species targets.

The criteria used to determine the NSW-listed species needing offset targets were direct impacts to:

- > 5 per cent of records in the nominated areas, or
- > 5 per cent of potential habitat in the nominated areas, or
- > 1 per cent of potential habitat in the nominated areas for SAII entities or endemic/largely endemic species

It is important to note that where a NSW-listed species was assessed under the Commonwealth approach as it was also a Commonwealth-listed species, the determination of whether the species needed an offset target and the offset target needed was based on the approach taken for the Commonwealth-listed species (therefore this criteria was only applied to NSW-only listed species, and not to NSW-listed species that were also Commonwealth-listed).

The method to determine the 'offset location' targets for each NSW-only listed species was based on a combination of the identified level of risk of residual adverse direct impacts (in terms of per cent impacts to records or potential habitat, with lower thresholds for SAII entities and endemic/largely endemic species) and conservation status.

The method is shown in Table 8-4, and Table 8-5 for SAII entities and endemic/largely endemic species.

Table 8-4: Method to determine offset locations for NSW-only listed species needing offsets

Impacts to potential habitat or records as % of total within nominated areas	NSW listing status		
	V	**E**	**CE**
Substantial (> 20%)	1 offset location	2 offset locations	3 offset locations
Small (5–20%)	0 offset location	1 offset location	2 offset locations

Table 8-5: Method to determine offset locations for NSW-only listed species that are SAII entities or endemic

SAII, or Endemic, largely endemic*	Impacts to potential habitat		
	Minimal (1-5%)	**Small (5-10%)**	**Substantial (>10%)**
Yes	1 offset location	2 offset locations	3 offset locations

*A species was considered largely endemic if greater than 90 per cent of total records in NSW occur in the Cumberland IBRA subregion

To determine an appropriate set of criteria for NSW-only listed species, a range of alternative impact thresholds and offset location scenarios were tested and analysed. It should be noted that like all threshold approaches the numbers are arbitrary to a degree. However, the thresholds are considered to be appropriate because they:

- Reflect the nature of the baseline data. In particular the potential habitat mapping which has been generated across the nominated areas is precautionary in many cases and over-maps habitat
- Are structured around conservation status
- Reflect the knowledge of the assessment team about the level of risk to species

It is acknowledged that the criteria may exclude NSW-only listed species (that are not SAII entities or endemic species) that are subject to impacts to records of up to but less than 5 per cent of the total within the nominated areas, or up to but less than 20 per cent if the species is vulnerable. Of the excluded species with records impacted, all species are wide-ranging and highly mobile fauna (two cockatoo species and one owl species). Impacts on records for wide-ranging species are much less of a reliable indicator of risk of impacts relative to restricted species as records are less indicative of the importance of a location to the species. This threshold is therefore considered appropriate in this context.

Note that *Tyto novaehollandiae* is eligible under the criteria for 1 offset location due to impacts to records. However, this species was not included as an NSW-listed species requiring an offset given only 1 record of the species is being impacted (of a total of 2). Furthermore, the species is wide-ranging and highly mobile (impacts on records are much less of a reliable indicator of risk of impacts) and only 0.11 per cent of total habitat in the nominated areas will be impacted.

Table 8-6 identifies the NSW-only listed species needing offset targets and the criteria that triggered the need for a target. Note that for several species, the per cent impacts to records seem large, however very few records are being impacted (for example,

Table 8-6: NSW only-listed species (not Commonwealth-listed) that need offset targets

Species	Status	Criteria triggering the need for a species offset
Dillwynia tenuifolia	V	Direct impacts to 22.5 per cent of potential habitat (endemic species) within the nominated areas
Grevillea juniperina subsp. *juniperina*	V	Direct impacts to 18.7 per cent of potential habitat (endemic species) within the nominated areas
Haliaeetus leucogaster	V	Direct impacts to 34.6 per cent of records within the nominated areas
Hibbertia fumana	CE	Direct impacts to 4.3 per cent of potential habitat (endemic and SAII species) within the nominated areas
Hibbertia puberula	E	Direct impacts to 4.5 per cent of potential habitat (endemic species) within the nominated areas
Hieraaetus morphnoides	V	Direct impacts to 26.1 per cent of records, and 1.6 per cent of potential habitat (SAII species) within the nominated areas
Lophoictinia isura	V	Direct impacts to 2 per cent of potential habitat (SAII species) within the nominated areas
Marsdenia viridiflora subsp. *viridiflora*	E	Direct impacts to 9.6 per cent of potential habitat (SAII species) within the nominated areas
Meridolum corneovirens	E	Direct impacts to 10.7 per cent of potential habitat (endemic species) within the nominated areas
Pultenaea pedunculata	E	Direct impacts to 33.3 per cent of records and 10.6 per cent of potential habitat within the nominated areas
Southern Myotis	V	Direct impacts to 20.6 per cent of potential habitat (endemic species) within the nominated areas

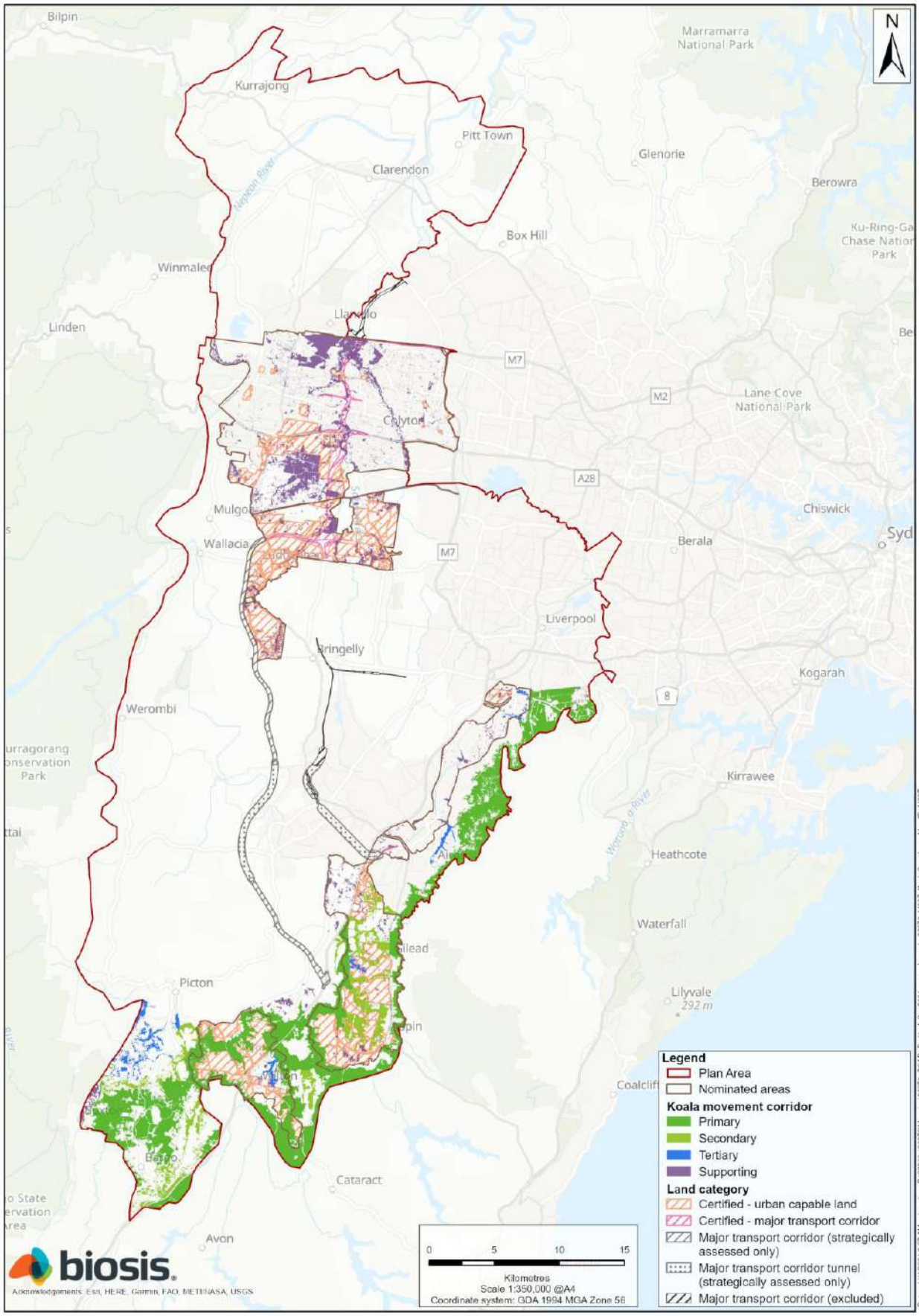

Figure 8-2: Key Koala movement corridors within the Plan Area

9 Implementation of the Plan

9.1 INTRODUCTION

The Plan includes a range of commitments and actions and implementation mechanisms to support its delivery.

This Chapter describes how the Plan will be implemented, including:

- Implementation mechanisms
- Roles and responsibilities
- Funding
- Monitoring, evaluation and reporting and adaptive management
- Compliance

9.2 IMPLEMENTATION MECHANISMS

The Department has committed to undertake the development under the Plan in accordance with the Plan and any conditions of approval (Commitment 1). This commitment will be delivered through several actions, including:

- Integrating the Plan into the planning delivery framework for the nominated areas (see below)
- Monitoring implementation through the Plan's evaluation program (see Section 9.5)
- Requiring proponents of essential infrastructure to notify the Department of any development in avoided land, including how the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development have been addressed
- Implementing the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, including Appendix A of the Plan, by:
    - Notifying proponents of essential infrastructure of their obligations under the EPBC Act, including when development does not have Part 10 EPBC Act approval under the Plan
    - Monitoring the impacts of development on avoided land
    - Monitoring compliance with the avoidance, mitigation and offset commitments under the Plan
    - Providing annual updates to DAWE
    - Sharing information and data to assist councils and infrastructure providers with implementation
    - Undertaking monitoring and auditing of infrastructure construction and operation as required, to ensure adequate mitigation measures are being applied
- Undertaking a formal modification to the Plan's strategic biodiversity certification if required, to adjust the boundaries of the certified-urban capable land in circumstances where:
    - Minor adjustments are identified at the site level
    - Updates are consistent with the Avoidance Criteria and supported by a BAM accredited assessor
    - Residual impacts to biodiversity, including MNES, are mitigated and offset in accordance with the Biodiversity Assessment Method (or equivalent) and EPBC Act Environmental Offsets Policy, 2012 for any EPBC Act matters not covered by the BAM
- Undertaking a formal modification to the Plan's strategic biodiversity certification to seek NSW biodiversity approvals on behalf of Deerubbin Local Aboriginal Land Council

9.2.1 NSW PLANNING SYSTEM

To support a strategic-led planning framework in NSW, the Plan informs the strategic and precinct planning processes that apply to the nominated areas for relevant local government areas in Western Sydney.

Implementation of the Plan will be supported by a range of planning mechanisms under the EP&A Act. These mechanisms support the delivery of both the development and conservation program under the Plan.

PLANNING DELIVERY FRAMEWORK

The planning delivery framework for the nominated areas includes a series of strategic land-use plans, including:

- Structure plans – these are high-level plans that set out the broad land-use intentions for an area and provide the broad framework for more detailed planning of a specific area or precinct
- Precinct plans – these are made under a place-based SEPP, such as the Growth Centres SEPP and Western Sydney Aerotropolis SEPP, and function in the same way as a Local Environmental Plan (LEP). Precinct plans identify permitted land uses and the location and phasing of infrastructure. Precinct plans apply zoning as well as development controls to guide the planning and design of developments permitted by the land use zone. Precinct plans are required to be consistent with the structure plans
- Neighbourhood plans – these show the detailed design and layout of a future neighbourhood and are required to be consistent with precinct plans

Structure plans will be prepared by the relevant planning authority for each nominated area and will show broad land use zones and the boundaries of the urban capable land and will identify the avoided land as land that is not suitable for urban development, consistent with the Plan. Structure plans guide development within each nominated area. They set the vision and strategic direction of each area consistent with the Greater Sydney Region Plan and district plans, and they provide a line of sight from these plans through to planning at a precinct scale.

Land use zoning for nominated areas will be consistent with the boundaries of urban capable land. In some nominated areas, precinct plans guide structure plans that lay out the strategic intent of a precinct. This occurs under the Growth Centres SEPP. In other nominated areas such as a part of the Western Sydney Aerotropolis, the place-based Western Sydney Aerotropolis SEPP determines the zoning for precincts.

Rezoning under each precinct plan will be implemented through the relevant Environmental Planning Instrument (EPI), such as the Growth Centres SEPP, the Aerotropolis SEPP or the relevant local LEP.

Neighbourhood plans will be used to implement more detail rezoning (e.g. allocating specific types of residential zones within a precinct). Where this occurs, a neighbourhood plan would result in rezoning via the LEP.

NEW PLANNING MECHANISMS TO SUPPORT PLAN IMPLEMENTATION

The Department will introduce several planning mechanisms or amendments to the planning system to support the planning delivery framework and implementation of the Plan. These are:

- SEPP (Strategic Conservation Planning), made under the EP&A Act
- Ministerial Direction made under the EP&A Act
- Development Control Plan (DCP) template
- Cumberland Plain Conservation Plan Guideline for Infrastructure Development made under the EP&A Regulation 2000
- Amendment to the EP&A Regulation 2000

These planning mechanisms are summarised in Table 9-1.

The key planning mechanism to support implementation of the Plan is a new EPI made under the EP&A Act – the SEPP (Strategic Conservation Planning). The objectives of the proposed SEPP are to:

- Ensure that development in the nominated areas is consistent with biodiversity certification under the BC Act and the strategic assessment under the EPBC Act
- Facilitate appropriate development on urban capable land in the nominated areas
- Identify and protect areas of high biodiversity value (these are the avoided lands) or regionally significant biodiversity value (this is the SCA land)
- Avoid and minimise impacts from future development in areas of high biodiversity value (avoided lands and SCA)
- Support the acquisition of priority areas with high biodiversity value as conservation lands (these are the lands to be secured for conservation within the SCA under the conservation program)

Table 9-1: Key planning mechanisms or processes to support implementation of the Plan

Planning mechanism	Description	How it supports implementation of the Plan	Land it applies to
SEPP (Strategic Conservation Planning)	A SEPP is an environmental planning instrument (EPI). EPIs are legally binding strategic plans made under Part 3 of the EP&A Act, and include SEPPs and LEPs SEPPs are made by the Minister and can specify planning controls for matters of State or Regional significance. Planning controls specify requirements for specific areas and/or for certain types of development and identify approval and assessment pathways for different development types	The SEPP (Strategic Conservation Planning) provides for the following: • Identifies the location of urban capable land, avoided land, the SCA and conservation lands identified for acquisition on maps • Applies development controls to avoided land and the SCA to limit the impact of future development and subdivisions under Part 4 of the EP&A Act and ensure biodiversity values are protected if development is proposed on these lands • Requires asset protection zones (APZ) for development on urban capable land to be located within urban capable land (and not within avoided land) • Requires infrastructure under Part 4 of the EP&A Act on avoided land to comply with the *Cumberland Plain Conservation Plan Guidelines for Infrastructure Development* • Identifies the authority with the power to acquire conservation lands within the SCA to be secured as offsets under the conservation program (if the land is needed to be acquired under the *Land Acquisition (Just Terms Compensation) Act 1991*) ***Development controls for avoided land and the SCA*** The development controls identify key biodiversity values that are the focus of the Plan, such as TECs, threatened species and their habitats, koala habitat and corridors, and MNES, and requires the consent authority to ensure any future development avoids and minimises impacts on these values. The controls: • Require development consent to clear native vegetation • Require development to avoid and minimise native vegetation and compensate through revegetation on the land for impacts that cannot be avoided • Require the consent authority in granting consent to consider impacts to specific biodiversity values, including TECs and species and habitat connectivity • Limit when the consent authority can grant consent. For example, the consent authority must be satisfied that the development avoids any adverse impacts to the specific biodiversity values described in the SEPP • Limit when the consent authority can grant consent for subdivisions The development controls are similar between avoided land and the SCA, with several	Avoided land SCA Urban capable land

Planning mechanism	Description	How it supports implementation of the Plan	Land it applies to
		differences to account for the different purposes of these lands in relation to the Plan Note: • Existing land use zones and development permissibility in avoided land and SCA are not affected by the proposed SEPP • Development on avoided land and SCA does not have approval under the Plan (except for 'essential infrastructure' under EPBC Act where it meets the requirements of the Plan) and will need to address any relevant requirements of the BC Act/EPBC Act • The SEPP (Strategic Conservation Planning) clarifies that the SEPP (Koala Habitat Protection) 2020 does not apply to urban capable land	
Ministerial Direction	Ministerial Directions are legally binding instructions issued by the Planning Minister under section 9.1 of EP&A Act to bodies with functions under the Act, including to councils for planning proposals and the preparation of LEPs	The Department will introduce a Ministerial Direction under section 9.1 of the EP&A Act that applies to planning proposals by planning proposal authorities (usually councils) in avoided land and the SCA. The Direction: • Requires the planning proposal to protect or enhance and/or minimise impacts to native vegetation, riparian corridors, TECs and species, Koala habitat and corridors, and habitat connectivity and several other biodiversity values • Prevents planning authorities from rezoning land inconsistent with the objectives of avoided land or the SCA	Avoided land SCA
DCPs and DCP template	DCPs provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act. Any development assessed under Part 4 of the EP&A Act must consider the relevant DCP. DCPs are considered by consent authorities in determining development applications	DCPs will be prepared for each nominated area. Some DCPs will led by the Department, while some DCPs will be led by councils DCPs will include the mitigation measures identified in the Plan to address indirect and prescribed impacts on biodiversity values and will require planning authorities to consider these in granting consent to development under Part 4 of the EP&A Act The Department has prepared a DCP template that provides model provisions to help ensure the mitigation measures identified in the Plan are incorporated into DCPs and applied consistently across the nominated areas The Department will: • Incorporate development controls in the DCP template into Department led DCPs • Work with local councils to incorporate the development controls in the DCP template into council led DCPs • Audit DCPs to ensure the development controls are incorporated	Urban capable land

Planning mechanism	Description	How it supports implementation of the Plan	Land it applies to
Cumberland Plain Conservation Plan Guideline for Infrastructure Development	Clause 228 of the EP&A Regulation 2000 allows the Planning Secretary to establish guidelines in relation to any activity for the factors a determining authority must take into account when considering the likely impact on the environment under Part 5 of the EP&A Act	The Department will prepare a guideline under clause 228 of the EP&A Regulation – the Cumberland Plain Conservation Plan Guideline for Infrastructure Development – that applies to infrastructure development, including: • Activities under Part 5 of the EP&A Act • 'Essential infrastructure' under Part 4 of the EP&A Act, as defined in the Plan The guideline ensures infrastructure development within avoided land, the SCA and urban capable land avoids and minimises impacts to biodiversity values and mitigates indirect impacts in accordance with the requirements of the Plan ***Development controls for avoided land, the SCA and urban capable land*** The guideline includes development controls for: • 'Essential infrastructure' (as defined in the Plan) on avoided land to ensure consistency with the Plan's EPBC Act approval. This must: o Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors (these matters were identified at risk from essential infrastructure in this Assessment Report) o Identify and implement mitigation measures to address indirect and prescribed impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing o Offset any impacts in accordance with the BC Act and BAM • Infrastructure activities under Part 5 of EP&A on avoided land and SCA. This must: o Avoid and minimise impacts to biodiversity values, including TECs and species and koala habitat and corridors o Install and maintain the integrity of koala exclusion fencing o For the SCA, consider the impact on biodiversity values, habitat connectivity and the potential for ecological restoration of the land • Infrastructure activities under Part 5 of EP&A Act on urban capable land. This must implement specific set of mitigation measures to address indirect and prescribed impacts (these measures were identified in this Assessment Report as needed to address the impacts of infrastructure and are included in Appendix E of the Plan) The guideline is supported by the SEPP and EP&A Regulation amendment, which includes notification and reporting requirements for infrastructure on avoided land. The guideline specifies what public authorities must include in the notification, including a plan of works,	Avoided land SCA Urban capable land

Planning mechanism	Description	How it supports implementation of the Plan	Land it applies to
		an ecology report that assesses impacts on biodiversity values, how the requirements of the guideline have been addressed, and proposed mitigation measures Note: • Development on avoided land and SCA does not have approval under the Plan (except for 'essential infrastructure' under EPBC Act where it meets the requirements of the Plan) and will need to address any relevant requirements of the BC Act/EPBC Act	
Amendment to EP&A Regulation 2000	The EP&A Regulation is made under the EP&A Act and provides details about how the Act is administered	The amendment introduces requirements into the EP&A Regulation 2000 for public authorities to notify the Department about activities under Part 5 of the EP&A Act proposed on avoided land. Public authorities must: • Notify the Department of the proposed activity • Include a statement of consistency of the proposed activity with the *Cumberland Plain Conservation Plan Guidelines for Infrastructure Development* • Consider any response from the Department about the activity	Avoided land

9.2.2 IMPLEMENTATION STRATEGIES AND PROCESSES

The Plan includes several actions that provide for the preparation of detailed implementation documents that will support the implementation of the Plan. Key implementation documents include (see Chapter 8):

- Conservation Land Implementation Strategy to guide the securing of conservation land
- Restoration Implementation Strategy
- Weed control and pest animal strategies to guide delivery of the weed and pest programs
- Fire Management Strategy to guide fire management
- Reconciliation accounting process to track progress in meeting offset targets
- Written agreements with delivery partners to set out delivery arrangements
- Compliance Strategy

9.3 ROLES AND RESPONSIBILITIES

The governance framework for the Plan is shown in Figure 9-1.

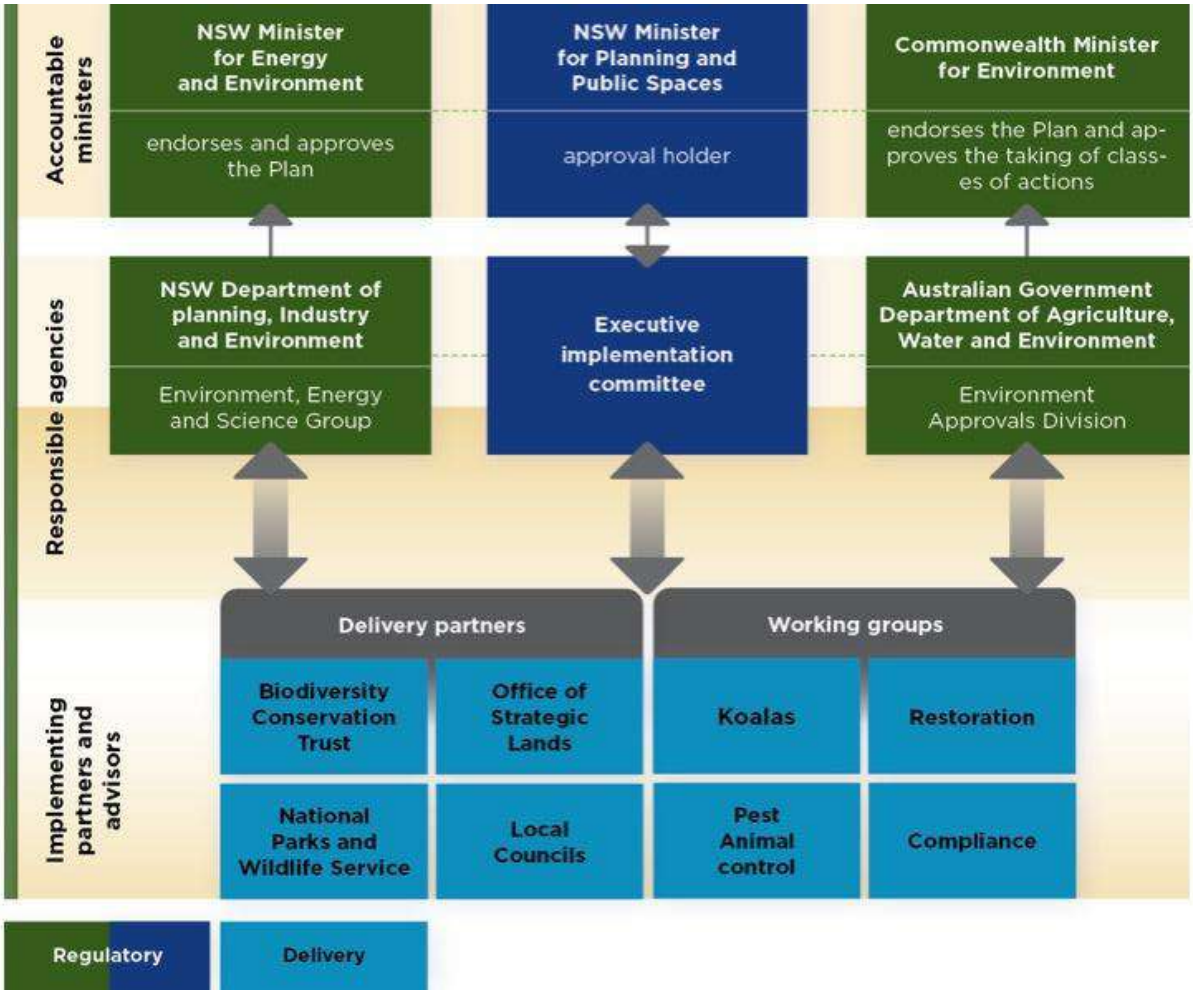

Figure 9-1: Governance framework for the Plan

9.3.1 RESPONSIBLE AGENCIES

The Department is the responsible agency for implementing the Plan and meeting regulatory requirements. The major transport corridors will be administered by Transport for NSW.

The Department's roles will include:

- Central coordination and management of implementation, including:

  - Reporting on the evaluation program
  - Contract and grant management
  - Reports for publication
  - Management of potential compliance breaches
- Working with delivery partners and technical working groups to ensure efficient and effective implementation
- Periodically reporting to approval bodies and relevant NSW and Commonwealth ministers

An executive implementation committee has been established that includes executive level representatives from the Department, approval bodies and partner agencies to act as a steering committee for the Plan. The executive committee will be a key decision-making authority for implementing the Plan.

9.3.2 DELIVERY PARTNERS AND ADVISORS

A range of delivery partners will be responsible for delivering programs under the Plan, including:

- NSW Government bodies, such as:
  - Office of Strategic Lands – key responsibilities include acquisition of reserves for the reserve program
  - National Parks and Wildlife Service – key responsibilities include long-term management of reserves established under the *National Parks and Wildlife Act 1974*
  - Biodiversity Conservation Trust – key responsibilities include delivering the BSA program
- Councils –will play a role in delivering the conservation program and ensuring conservation is embedded in local planning controls. This includes following section 9.1 Directions in considering Planning Proposals
- Community organisations – key responsibilities could include management of smaller community reserves
- Private landholders – may enter into BSAs for conservation on their land

Service level agreements or memorandums of understanding are being prepared as part of the process of engaging delivery partners to clarify the roles and responsibilities of each delivery partner and to ensure accountability.

9.4 FUNDING

The Department will be responsible for funding the Plan's implementation to 2056.

To date, the NSW Government has committed $114 million in the first five years to implement the Plan, including a set of priority conservation actions (see section 8.2.1 above). The Department will be responsible for funding the Plan's implementation to 2056.

The Department will establish arrangements to recover costs of the conservation program from developers (a development levy) within the nominated areas through the Special Infrastructure Contributions (SICs) program or other contribution type. This will include:

- Establishing a Trust or other financial arrangement to administer receipts and expenditure to implement the Plan
- Establishing arrangements to determine how funding decisions will be made, administered, and reported

Transport for NSW is responsible for funding a proportion of the conservation program consistent with their offset obligations associated with the impacts of the major transport corridors on biodiversity values. Transport for NSW will provide funding to the Department in advance of impacts. Finding arrangements will be in accordance with an agreement to be established between Transport for NSW and the Department.

9.5 MONITORING, EVALUATION, REPORTING AND ADAPTIVE MANAGEMENT

The Plan commits to implementing an evaluation program for the Plan within the first year of implementation, which sets out requirements for monitoring, evaluation, reporting and adaptive management (Commitment 25).

The evaluation program will help to assess the progress of the Plan and support its implementation and will be guided by an evaluation plan that is being developed to meet NSW Government guidelines for program evaluation.

The evaluation program will be supported by a monitoring program and evaluation database that will collect and store information across the Plan's key environmental, social, and economic indicators.

The key elements of the evaluation program are outlined in Figure 9-2 and details are provided in Sub-Plan A.

The evaluation program provides for:

- Monitoring of the delivery of actions and commitments and achievement of outcomes
- Evaluation of the Plan to inform adaptive management responses
- Public reporting on progress in delivering the Plan

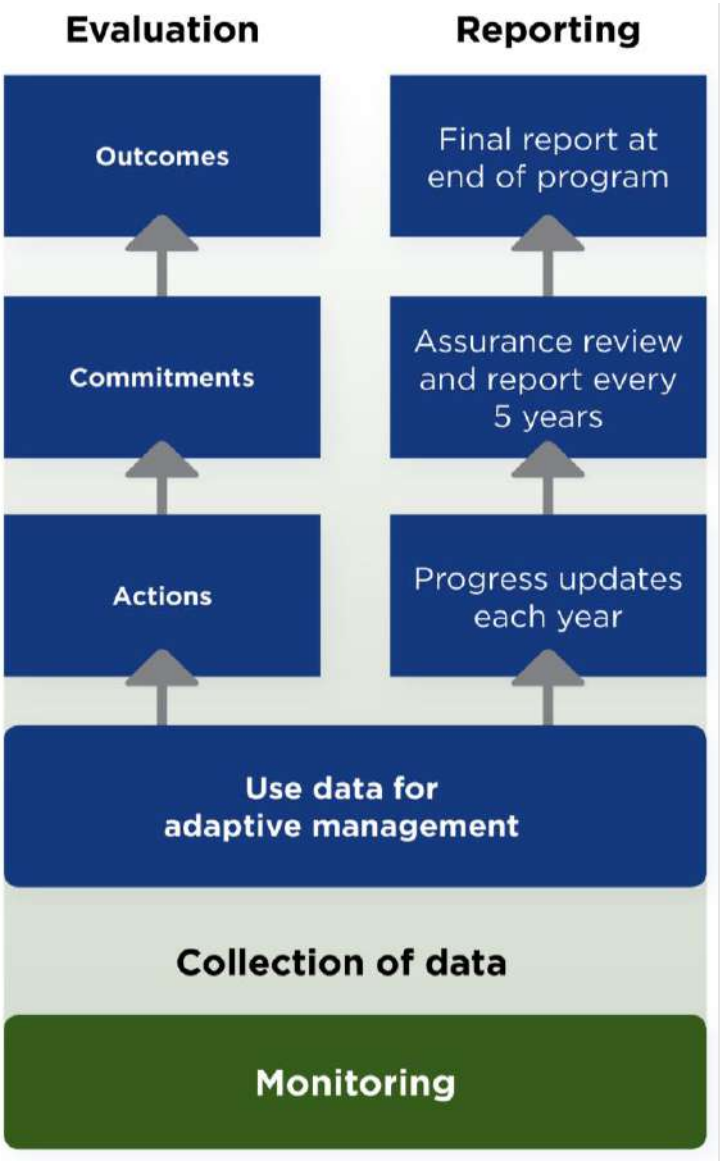

Figure 9-2: Key elements of the evaluation program (MERI framework)

MONITORING

The evaluation program will collect, assess, and store data to evaluate and report on the progress of the Plan. Monitoring for the evaluation program will ensure that data relating to the Plan's outcomes is collected and used to inform the evaluation program.

The Plan will establish a monitoring and data collection methodology and establish formal agreements with delivery partners that include requirements relating to data collection, management and sharing arrangements.

The Department will collect baseline data on biodiversity values through various methods, including vegetation plots, species surveys and rapid assessments. The baseline data will be compared with data collected on specific biodiversity values at specific locations throughout the implementation of the evaluation program to evaluate the effectiveness of the Plan over time and to ensure the Plan is delivering its commitments, actions, and outcomes.

EVALUATION

The effectiveness of the Plan's actions in achieving the environmental, social, and economic outcomes will be evaluated on an ongoing basis to meet reporting requirements and to ensure transparency and accountability.

Evaluations will be undertaken regularly throughout the implementation of the Plan and will aim to:

- Determine the effectiveness of actions, targets, and commitments to deliver outcomes
- Reconsider assumptions made as part of the program logic
- Determine the influence of external factors outside the control of the Plan
- Inform any necessary adaptive management decisions to the implementation of the Plan

The Department will develop and implement the evaluation program within the first year of the Plan's implementation.

PUBLIC REPORTING

The Department will prepare an annual progress update on the delivery of the Plan's commitments and actions, including reporting on program revenue and expenditure.

The Department will also collate finer scale program and project reporting from the relevant delivery partners more frequently, which will be provided to the executive implementation committee to support evaluations.

The NSW Government will commission a comprehensive, independent review on the status of implementation of the Plan and its outcomes every five years over the life of the Plan. The results of the independent review will be submitted in a report to the NSW Minister for Planning and Public Spaces and provided to the NSW Minister for the Environment and the Commonwealth Minister for the Environment.

The Department will undertake internal process reviews of the Plan's implementation at the mid-term point (2.5 years) between independent reviews and provide these to key delivery partners and stakeholders.

The annual updates, mid-term reviews and five-yearly independent reviews will be made publicly available on the Department's website.

ADAPTIVE MANAGEMENT

The Plan will be implemented adaptively to ensure the commitments and actions are delivered and the outcomes are achieved efficiently and effectively. Adaptive management will be triggered on the basis of the findings of the evaluations and will be informed by the monitoring data collected as part of the evaluation program.

The approach to adaptive management under the Plan is described in Chapter 16.

9.6 COMPLIANCE

The Plan includes a commitment to implement a compliance program to ensure compliance with the Plan and conditions of approval (Commitment 26).

A compliance strategy will be prepared under the Plan to ensure that the development occurs in accordance with the Plan and conditions of approval. The compliance strategy will:

- Identify relevant compliance mechanisms
- Set out compliance monitoring and auditing priorities and processes
- Set out procedures and protocols for taking compliance action
- Identify roles and responsibilities for compliance monitoring and action

A compliance and implementation working group will be established comprising the Department, councils, and other relevant stakeholders to guide compliance activities under the Plan and the development of the compliance strategy.

Reporting on compliance will be an important part of the evaluation program. Compliance reporting will be included in all aspects of reporting under the evaluation program, including regular reporting to the executive implementation committee, annual progress updates, mid-term review and the independent five-yearly review.

The Department will prepare reports at least every two years on any identified breaches with commitments and approval conditions, such as through auditing of development consent conditions.

Where non-compliance is identified, the Department will take the following broad steps:

- The regulator will review the deviation or non-compliance and consider its importance
- The regulator advises that either:
    - The deviation or non-compliance is minor or trivial or did not occur and no further action is required
    - The deviation or non-compliance requires corrective action
- If corrective action is required, relevant parties will be provided with an opportunity to correct the non-compliance

Part 2 References

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biosis

OPENLINES
Environmental consulting

2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 2 ATTACHMENT

ATTACHMENT A – COMMITMENTS AND ACTIONS

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
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CONTENT:	Taken from *Sub-Plan A: Conservation Program and Implementation (2021),* produced by the Department of Planning, Industry and Environment
REVIEWED BY:	
OPEN LINES:	Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	N/A
VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 2 Attachment Contents

A. Commitments and actions

These commitments and actions have been taken directly from *Sub-Plan A: Conservation Program and Implementation (2021)* produced by the Department of Planning Industry and Environment. The following tables outline the commitments, their relevant actions and the timing of implementation of the commitments and actions under the Plan.

DEVELOPMENT ACTIONS

Table A-1: Development actions under Sub-Plan A

Commitments	Actions	Timing
Commitment 1 Development will be undertaken in accordance with the Plan and any conditions of approval. This applies to the following classes of actions: • urban and industrial • infrastructure • intensive plant agriculture • major transport corridors	1. Integrate the Plan into the planning delivery framework for the nominated areas through mechanisms including an environmental planning instrument with, development controls, a Ministerial Direction under section 9.1 of the *Environmental Planning and Assessment Act 1979*, and Cumberland Plain Conservation Plan Guidelines for Infrastructure Development (Commitments 2, 4, 6, 7, 13, 14). 2. Monitor the implementation of urban and industrial development, infrastructure, major transport and intensive plant agriculture through the Plan's evaluation program to ensure development is consistent with the Plan. This includes the Plan's: a. Commitments for avoiding, minimising, mitigating and offsetting impacts b. Reporting and compliance requirements c. Class of action approvals (EPBC Act); strategic biodiversity certification order (BC Act) 3. Require proponents of essential infrastructure to notify the department of any development or activity in avoided land, including how the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development have been addressed. 4. Implement the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, including Appendix A of the Plan by: a. Notifying proponents of essential infrastructure of their obligations under the EPBC Act, including when development does not have Part 10 EPBC Act approval under the Plan b. Monitoring the impacts of development on the avoided land c. Monitoring compliance with the avoidance, mitigation and offset commitments under the Plan, relevant to these Guidelines d. Providing annual updates to Australian Government Department of Agriculture Water and Environment e. Share information and data as required to assist councils and infrastructure providers to	Action 1: Before start of Plan Actions 2,3,4: Life of Plan Action 5: Years 1-10 Action 6: Year 1

Commitments	Actions	Timing
	implement these Guidelines f. Undertaking monitoring and audit of infrastructure construction and operation as required, to ensure adequate mitigation measures are being applied 5. Undertake a formal modification to the Plan's strategic biodiversity certification if required, to adjust the boundaries of the certified-urban capable land in circumstances where: a. Minor adjustments are identified at the site level b. Updates are consistent with the avoidance criteria and supported by a BAM accredited assessor c. Residual impacts to biodiversity, including MNES, are mitigated and offset in accordance with the Biodiversity Assessment Method (or equivalent) and EPBC Act Environmental Offsets Policy, 2012 for any EPBC Act matters not covered by the BAM 6. Progress and submit (subject to compliance with legislative requirements) a modification of the strategic biodiversity certification under the Biodiversity Conservation Act 2016 to include lands proposed by Deerubbin Local Aboriginal Land Council	

CONSERVATION PROGRAM

COMMITMENTS TO AVOID AND MINIMISE IMPACTS

Table A-2 Commitments to avoid and minimise impacts under Sub-Plan A

Commitments	Actions	Timing
Commitment 2 Avoid and minimise impacts of up to 4,505 hectares of high biodiversity value area (the avoided land) through strategic conservation planning in the nominated areas. **Commitment 2.1** Limit cumulative direct impacts[1] over the life of the Plan from essential infrastructure to the following EPBC Act-listed threatened ecological community in the avoided land[2]: • Shale Sandstone Transition Forest • Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • River-Flat Eucalypt Forest • Coastal Swamp Oak (Casuarina glauca) Forest • Cooks River Castlereagh Ironbark Forest Western Sydney Dry Rainforest and Moist Woodland on Shale **Commitment 2.2** Prioritise the avoidance of impacts from essential infrastructure on non-certified land to: • known populations[3] of the following threatened flora species:	1. Introduce an environmental planning instrument to apply development controls to protect important biodiversity on avoided land under the Plan. 2. Issue a Ministerial Direction under section 9.1 of the Environmental Planning and Assessment Act 1979 to restrict rezoning of avoided land from its current zone to a zone that permits a more intensive land use. 3. Introduce Cumberland Plain Conservation Plan Guidelines for Infrastructure Development to manage impacts on biodiversity from infrastructure development, including essential infrastructure development, on avoided land in the nominated areas. 4. Monitor the impacts of development on the avoided land through the Plan's reconciliation accounting process. 5. Notify proponents of essential infrastructure of their obligations under the EPBC Act, including when development does not have Part 10 EPBC Act approval under the Plan. 6. Locate Asset Protection Zones wholly within certified-urban capable land.	Actions 1,2,3: Before start of Plan Actions 4,5,6: Life of Plan as precincts are designed.

[1] Impact thresholds for each threatened ecological community per nominated area are listed in the Plan (Table 3, Cumberland Plain Conservation Plan, page 39).
[2] Distributions of these TECs are mapped in the *Cumberland Plain Assessment Report* and will require confirmation of extent through survey or assessment
[3] Known populations are mapped in the Cumberland Plain Assessment Report and will require confirmation of extent through survey or assessment

Commitments	Actions	Timing
○ *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) ○ *Persoonia bargoensis* (Bargo Geebung) ○ *Persoonia nutans* (Nodding Geebung) ○ *Genoplesium baueri* (Yellow Gnat-orchid) ○ *Pimelea spicata* (Spiked Rice-flower) ○ *Pultenaea parviflora* • protected koala habitat[4] within the Wilton and Greater Macarthur Growth Areas to maintain the function of koala movement corridors		
Commitment 3 Avoid and minimise impacts to threatened ecological communities, species and their habitat within certified-major transport corridors through detailed planning and design. This includes: • Avoiding areas of potential habitat[5] connectivity within riparian corridors where possible, particularly for the following species: ○ Eastern Pygmy Possum ○ Green and Golden Bell-Frog ○ Spotted-tailed Quoll ○ Squirrel Glider ○ Yellow-bellied Glider • Avoiding known flora populations[6] within the OSO and M7/Ropes Crossing Link Road	1. To avoid and minimise impacts to threatened ecological communities, species and their habitat Transport for NSW will apply the Plan's Avoidance Criteria during the strategic planning phase of each transport project with specific consideration to the matters identified in Commitment 3. 2. Include the biodiversity benefits of avoiding threatened ecological communities, species and their habitat as well as the costs of offsets into the evaluation of the route options (for example multi-criteria analysis). 3. Locate Asset Protection Zones, if required, within the certified-major transport corridor. 4. Where an action cannot feasibly or practically avoid impacts on an area of high environmental value, these impacts should be minimised as far as possible using design refinements to reduce overall impact. 5. Transport for NSW will provide to the department a Clearing Reconciliation Report within 60 days of the completion of clearing for each major transport corridor project. The Clearing Reconciliation Report will provide information on vegetation cleared, resulting direct impacts to threatened species habitat and threatened ecological communities, and a demonstration of	Life of Plan

[4] Protected koala habitat is mapped in the *Cumberland Plain Assessment Report* and the department's spatial viewer
[5] Potential habitat for fauna species are mapped in the *Cumberland Plain Assessment Report*
[6] Known flora populations are mapped in the *Cumberland Plain Assessment Report*

Commitments	Actions	Timing
corridors where possible, particularly: ○ *Dillwynia tenuifolia* ○ *Grevillea juniperina subs. juniperina* ○ *Pultanea parviflora* ○ *Persoonia nutans* • For the OSO, minimising where possible the placement of waterway crossing structures within riparian corridors, changes to waterway alignments, and bulk earthworks on adjacent floodplain areas	how the Plan's Avoidance Criteria were applied. The report will be used to: a. Inform the Plan's reconciliation accounting process to track impacts b. Determine Transport for NSWs actual offsets liability. Actual offsets liability will be reconciled against Transport for NSWs schedule of estimated forward payments for amounts outstanding or overpaid 6. Ensure that proponents of any Third Party Activities not included in the Western Sydney Major Transport Corridors class of action, are aware that they must consider the need for referral under the EPBC Act for actions likely to have a significant impact on MNES. 7. Impacts to biodiversity (including to MNES) in the major transport corridors will be published through the Plan's annual updates and five yearly reviews.	
Commitment 4 Avoid and minimise impacts on threatened ecological communities, species and their habitat within major transport corridors (strategically assessed only), including the Outer Sydney Orbital and Metro Rail Future Extension tunnel sections, in accordance with the: • Major transport corridors class of action description, including the NSW State Significant Infrastructure (or equivalent) approvals process • Biodiversity Assessment Method (BC Act) (or equivalent) **Commitment 4.1** This includes avoiding and minimising impacts to known flora populations[7] within the OSO and M7/Ropes Crossing Link Road corridors, including:	1. To avoid and minimise impacts to threatened ecological communities, species and their habitat Transport for NSW will: a. Undertake surveys to confirm biodiversity values, including matters of national environmental significance (MNES) during the strategic planning phase of each transport project b. Include the biodiversity benefits of avoiding threatened ecological communities, species and their habitat as well as the costs of offsets into the evaluation of the route options (for example multi-criteria analysis) c. Avoid and minimise impacts to biodiversity values, including MNES, in accordance with the Biodiversity Assessment Method (or equivalent) and with specific consideration to the protected matters identified in Commitments 4.1, 4.2 and 4.3 during the environmental impact assessment phase of each transport project. d. Offset impacts to biodiversity values, including MNES, in accordance with the Biodiversity Assessment Method (or equivalent) and EPBC Act Environmental Offsets Policy, 2012 for any EPBC Act matters not covered by the BAM. e. Report to the department and executive implementation committee on vegetation cleared and adjustments to transport corridor boundaries identified through the NSW SSI approval (or equivalent) for each transport project. This will include: reporting on	Life of Plan

[7] Known flora populations are mapped in the *Cumberland Plain Assessment Report* and will require confirmation of presence through survey or assessment

Commitments	Actions	Timing

• *Dillwynia tenuifolia*
• *Grevillea juniperina* subsp. *juniperina*
• *Pultenaea parviflora*
• *Cynanchum elegans*
Commitment 4.2
This includes avoiding and minimising impacts where possible within and adjacent to the tunnel sections, including:
• Known populations and habitat[8] of:
  o *Eucalyptus benthamii*
  o *Pomaderris brunnea*
  o *Pimelea spicata*
  o Cumberland Plain Land Snail
• Known populations and habitat, and threatened ecological communities[9] within:
  o Mater Dei BioBank site within the Outer Sydney Orbital footprint near Camden
  o Registered Property Agreement site within the Outer Sydney Orbital footprint at Camden Airport
  o Metro Offset site within the footprints for the Outer Sydney Orbital and Metro Rail Future Extension near Harrington Park
  o Nepean River and associated riparian
	avoidance achieved within the mapped or protected corridors identified in this plan; additional impacts outside of mapped corridors for EPBC act-listed species, populations or ecological communities; and offsets to be secured under the NSW SSI approval and EPBC Act Environmental Offsets Policy, 2012, where relevant
	2. The department will use this information to track impacts and adjust TfNSW's offset liabilities through the Plan's reconciliation accounting process, in agreement with TfNSW.
	3. Transport-related impacts to biodiversity (including MNES) will be published through the Plan's annual updates and five yearly reviews.	

[8] Known populations and habitat of listed species are mapped in the *Cumberland Plain Assessment Report* and will require confirmation of extent through survey or assessment. The Assessment Report includes a specific map as part of the assessment of tunnels (See the *Cumberland Plain Assessment Report*, Chapter 36.6)

[9] Known populations and habitat of listed species and distribution of listed TECs are mapped in the *Cumberland Plain Assessment Report* and will require confirmation of extent through survey or assessment. The Assessment Report includes a specific map as part of the assessment of tunnels (See the *Cumberland Plain Assessment Report*, Chapter 36.6)

Commitments	Actions	Timing
corridor within the Outer Sydney Orbital footprint ○ Camden Golf Club at Narellan adjacent to the footprint for the Metro Rail Future Extension ○ Mount Annan Botanic Gardens within the footprint for the Metro Rail Future Extension **Commitment 4.3** This includes avoiding and minimising impacts where possible to environmental values within Commonwealth Land sites[10], including known populations and habitat and threatened ecological communities, and existing infrastructure and services, at: • Camden Airport • Western Sydney University (Campbelltown Campus) • 12 Werombi Road, Grasmere NSW		

COMMITMENTS TO MITIGATE INDIRECT AND PRESCRIBED IMPACTS

Table A-3: Commitments to mitigate indirect and prescribed impacts under Sub-Plan A

Commitments	Actions	Timing
Commitment 5 Mitigate indirect and prescribed impacts from urban and industrial development; infrastructure; and intensive plant agriculture on threatened ecological communities, species and their habitat. This	1. Incorporate development controls in the State-led development control plans (DCPs) where State-led DCPs apply to relevant nominated areas, setting out development controls that need to be addressed by neighbourhood plans and development applications to mitigate indirect and prescribed impacts on threatened species. This includes: a. Specific controls that apply to the nominated areas to mitigate indirect and prescribed	Action 1: Before start of Plan Action 2: Year 1

[10] The Assessment Report includes a specific map as part of the assessment of tunnels (See the *Cumberland Plain Assessment Report*, Chapter 36.6)

Commitments	Actions	Timing
includes: • Meeting specific mitigation requirements for threatened ecological communities, species and their habitat in accordance with Appendix E of the Plan	impacts on specific threatened species or ecological communities or other environmentally sensitive areas in accordance with Appendix E of the Plan b. A common set of development controls to mitigate indirect and prescribed impacts across the four nominated areas that inform general biodiversity protection as listed in Chapter 15 of the Assessment Report. 2. Introduce Cumberland Plain Conservation Plan Mitigation Measures Guidelines (Mitigation Measures Guidelines) consistent with Appendix E of the Plan to address indirect impacts in Greater Macarthur Growth Area and Greater Penrith to Eastern Creek Investigation Area. 3. Provide ongoing support to local councils and other proponents in the application of DCP controls and Mitigation Measures Guidelines within the nominated areas, including the sharing of knowledge, maps and data. 4. Audit Growth Area Development Control Plans (DCPs), for the Plan's nominated areas where they apply, to ensure the Cumberland Plain Conservation Plan DCP Template development controls are incorporated in accordance with the DCP requirements for each Growth Area. 5. Monitor the implementation of the development controls through approval conditions by the relevant consent authority. If monitoring finds that development controls are not being effectively implemented, review and redraft new controls to update relevant State DCPs and Mitigation Measures Guidelines and re-educate councils to ensure stronger consideration of the controls through their assessment process. 6. Introduce the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development to be addressed by a public authority or other proponents of essential infrastructure, that includes mitigation measures for indirect and prescribed impacts to biodiversity from infrastructure activities in accordance with Appendix E of the Plan. 7. Implement mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the requirements of the NSW approval process, as well as published, best practice guidelines. 8. Consult with the relevant public land manager to minimise disturbance and impacts to threatened species in accordance with Appendix E, including: a. Ensuring walking tracks and management trails in Wianamatta Regional Park are located in a way that avoids and minimises exposure of Persoonia nutans to human disturbance b. Ensuring land management in potential habitat for *Pimelea spicata*, particularly mowing and slashing activities and weed management activities involving the use of herbicides, will minimise risks and maintain the species c. Work with NSW Fisheries to address the risk of illegal and incidental recreational fishing	Actions 3,4,5: Life of Plan Action 6: Year 1 Action 7: Life of Plan Action 8: Year 1-5

Commitments	Actions	Timing
	capture along stretches of known habitat for Macquarie Perch in Erskine Creek, Glenbrook Creek, Georges River and Cordeaux River d. Installing signs and/or interpretive displays at appropriate sites in areas used for recreational fishing along Erskine Creek, Glenbrook Creek, Georges River and Cordeaux River to assist with identification of Macquarie Perch and awareness of threats	
Commitment 6 Mitigate indirect and prescribed impacts on threatened ecological communities, species and their habitat within major transport corridors, including the Outer Sydney Orbital and Metro Rail Future Extension tunnel sections, in accordance with the: • Major transport corridors class of action description, including the NSW State Significant Infrastructure (or equivalent) approval for certified-major transport corridors • Major infrastructure corridors class of action description and the Biodiversity Assessment Method (BC Act) (or equivalent) for non-certified major transport corridors (strategically assessed) • Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E	1. To mitigate indirect and prescribed impacts on threatened species and their habitat Transport for NSW will, across all major transport corridors: a. Assess the impacts on biodiversity values (for non-certified major transport corridors) and other environmental values (for certified- and non-certified major transport corridors) based on detailed design b. Implement specific mitigation measures prescribed in Appendix E and identify and implement additional mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the requirements of the State Significant Infrastructure (or equivalent) approval process, as well as published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines c. Apply further mitigation according to the Biodiversity Assessment Method (BC act) (or equivalent) for non-certified major transport corridors (strategically assessed), including the tunnels sections d. Identify potential design options for major watercourse crossings to reduce disruption to connectivity and the risk of fauna vehicle strikes e. Establish baseline monitoring data and undertake ongoing monitoring of high-value environmental areas, and review and adjust mitigation measures (where practical) in response to monitoring outcomes, in accordance with the requirements of the State Significant Infrastructure (or equivalent) approval 2. Transport for NSW will report to the department and executive implementation committee on mitigation measures proposed to manage impacts of each major transport corridor project, including proposed techniques, timing, frequency and responsibility for implementing each measure.	Actions 1,2: Life of Plan
Commitment 7 Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in	1. Install koala exclusion fencing, including gates and grids, between koala habitat that can safely support koalas and urban land within the Greater Macarthur Growth Area and Wilton Growth Area, except where exclusion fencing is not feasible or necessary due to slope, heritage or water courses. a. Manage impacts to fences by locating koala exclusion fencing at least three metres from any trees where practical (measured from canopy)	Action 1: Life of Plan Action 2: Year 1 Action 3:

Commitments	Actions	Timing
accordance with Appendix E of the Plan.	b. Apply koala specific mitigation actions in accordance with Appendix E c. Where fencing must cross existing or planned linear infrastructure such as gas and electricity transmission, consider appropriate access treatments such as gates to ensure the integrity of the koala exclusion fencing d. Fence off koala corridors that are too narrow to safely support koalas and relocate koalas out of the unsafe corridors if needed. (Commitment 12 Action 1f) e. Address the requirements of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, as essential infrastructure for EPBC Act approval in the avoided land 2. Complete a feasibility study on the koala exclusion fencing to help inform the design, locations and construction of the fencing and identify fencing priorities for the first five years. 3. Install koala-exclusion fencing along the western alignment of the Georges River Koala Reserve where existing urban development is a threat to koalas. 4. Install koala-exclusion fencing, in the vicinity of koala habitat, along both sides of Appin Road between Rosemeadow and Appin, to mitigate koala vehicle strikes at roadkill hotspots. Fencing along Appin Rd will be in addition to planned fencing works to be delivered by Transport for NSW. 5. Undertake targeted stakeholder and community engagement to support the delivery of koala-exclusion fencing. 6. Establish a koala working group with representation from relevant government agencies to support implementation of the koala commitments and actions. The working group will support implementation of the koala sub-plan, by providing advice to inform: a. Alignment, staging, and design of the koala exclusion fencing and fauna crossing, including advice about providing appropriate koala movement corridors b. Priority locations and approach for koala habitat restoration c. Monitoring and evaluation of the plan's koala commitments, including providing advice to support adaptive management based on monitoring and evaluation data d. Community and stakeholder engagement for the koala conservation commitments and actions e. Research and management actions relating to koalas 7. Work with local councils, NPWS and OSL to ensure the threats posed by dogs on all public land that is identified as koala habitat protected under the Plan, are managed. a. For land that is not publicly accessible, this will include the installation of signs and/or	Years 1-20 Action 4: Years 1-5 Action 5: Years 1-3 Action 6: Before start of Plan Action 7: Life of Plan Action 8: Years 1-5

Commitments	Actions	Timing
	fences b. For land managed as a reserve or for recreation, this will be achieved by incorporating requirements in a relevant Plan of Management 8. Provide safe fauna crossings, based on current best practice design, across Appin Road and other linear infrastructure by: a. Installing a koala underpass culvert under Appin Road, near the intersection with Brian Road to support east-west koala movement from the Georges River to the Nepean River b. Augmenting the existing Kings Falls Bridge at the Georges River by constructing a bench adjacent to the bridge abutments, to allow dry passage for koalas (and other fauna) under Appin Road, supporting north–south koala movement from the Georges River Koala Reserve to the southern koala habitat c. Investigation options for enhancing koala movement across the Upper Canal d. Address the requirements of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, as essential infrastructure for EPBC Act approval in the avoided land	

CONSERVING FLORA, FAUNA AND HABITAT

Table A-4: Commitments and actions for conserving flora, fauna and habitat under Sub-Plan A

Commitments	Actions	Timing
Commitment 8 Protect a minimum of 5,325 hectares of native vegetation[11] in the Cumberland subregion to conserve biodiversity values in perpetuity in accordance with the conservation land selection steps which may require up to 11,900 hectares of conservation land. **Commitment 8.1** This target includes minimum areas of the following EPBC Act-listed threatened ecological communities: • 675 hectares of Shale Sandstone Transition Forest • 665 hectares of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • 570 hectares of River-flat eucalypt forest of eastern Australia • 125 hectares of Cooks River Castlereagh Ironbark Forest • 20 hectares of Coastal Swamp Oak Forest • 0.2 hectares of Western Sydney Dry Rainforest and Moist Woodland on Shale **Commitment 8.2** This target includes minimum areas of the following BC Act-listed threatened ecological	1. Prepare a Conservation Land Implementation Strategy to guide the establishment of land for conservation, including: a. Priorities for selecting and purchasing land b. Targets and proposed timeframes for establishing new conservation land c. Proposed land-based conservation type for each area of priority conservation land (reserve or biodiversity stewardship agreement) d. Suitable land managers for each area of priority conservation land e. A process to secure alternative areas where targets and timing cannot be met 2. Enter into written agreements with delivery partners to set out the arrangements for conservation land under the Plan, including: a. Roles and responsibilities b. Processes for implementation c. Land management arrangements, including prior to purchase d. Funding arrangements e. Progress reporting 3. Seek to include the strategic conservation area (excluding cleared areas) in the Biodiversity Values (BV) Map. 4. Undertake surveys within the strategic conservation area or other avoided land prior to protecting the land to confirm plant community extent and condition and update vegetation mapping if necessary. 5. Protect and manage land containing targeted plant communities within the strategic conservation area by: a. Establishing reserves under relevant legislation including the National Parks and Wildlife Act 1974, Crown Land Management Act 2016, and Local Government Act 1993	Action 1,2: Year 1 Actions 3: Year 1 Action 4,5,6,7: Life of Plan Action 8: Before start of Plan Action 9,10,11: Life of Plan

[11] While there is overlap between the TEC targets listed in commitments 8.1 and 8.2, there are differences in the listings between EPBC Act-listed and BC Act-listed TECs, such as differences in approach and criteria. Therefore, the BC Act-listed TECs in commitment 7.2 incorporate targets for EPBC Act-listed TECs.

Commitments	Actions	Timing
communities: • 2,885 hectares of Cumberland Plain Woodland • 1,455 hectares of Shale Sandstone Transition Forest • 505 hectares of River-Flat Eucalypt Forest • 285 hectares of Shale Gravel Transition Forest • 115 hectares of Cooks River Castlereagh Ironbark Forest • 70 hectares of Swamp Oak Floodplain Forest • 10 hectares of Freshwater Wetlands on Coastal Floodplains • 0.2 hectares of Moist Shale Woodland	b. Establishing Biodiversity Stewardship Agreements under the Biodiversity Conservation Act 2016 c. Purchasing and retiring biodiversity credits under the Biodiversity Offsets Scheme (BOS) 6. Track the progress of meeting threatened ecological community targets (in hectares) through the reconciliation accounting process (Commitment 25 Action 2). 7. Provide upfront funding for business cases and Biodiversity Assessment Method assessments to support landholders entering into biodiversity stewardship agreements, where this investment can be recouped through the later sale of biodiversity credits. 8. Define a land purchase strategy that will guide decision-making and processes to be used when purchasing land for conservation under the Plan. 9. Purchase land within the strategic conservation area to commence establishing reserves under the Plan with priority given to land listed for sale and land in the proposed Koala Reserve. 10. Introduce an acquisition clause in an environmental planning instrument to land identified for future reserves under the Plan as funds become available through the program. 11. Work with local councils and other land managers to ensure that reserves established under the Plan provide for increased public access, including the provision of compatible low biodiversity impact recreation activities.	
Commitment 9 Protect threatened species likely to be at risk of residual adverse impacts from development under the Plan (target species) in accordance with the Plan's conservation land selection steps. This includes securing offsets to protect known locations for the following target threatened species: Flora species • 2 offset locations for *Cynanchum elegans* • 3 offset locations for *Dillwynia tenuifolia* • 3 offset locations for *Grevillea juniperina* subsp. *juniperina* • 1 offset location for *Hibbertia fumana* • 1 offset location for *Hibbertia puberula* • 2 offset locations for *Marsdenia viridiflora* subsp.	1. Assess and record the habitat attributes of where target species have been located and use the information to establish baseline monitoring data for areas of known habitat for target species and incorporate into the evaluation program (Commitment 25). 2. Protect offset locations and species habitat for the target threatened species through establishing reserves or biodiversity stewardship sites or through the direct purchase of species credits in the Cumberland subregion or across NSW. 3. Achieve the Plan's species targets by applying the conservation land selection steps. 4. Identify species-specific management measures for areas of known habitat for target species, in consultation with future land managers of reserves established under the Plan and incorporate these into management plans for the land. 5. Track progress in meeting species offset targets through the reconciliation accounting process (Commitment 25 Action 2).	Action 1: Year 1 Action 2,3,4,5: Life of Plan

Commitments	Actions	Timing
viridiflora • 2 offset locations for *Persoonia nutans* • 3 offset locations for *Pimelea spicata* • 2 offset locations for *Pultenaea parviflora* • 2 offset locations for *Pultenaea pedunculata* Fauna species • 1 offset location for *Haliaeetus leucogaster* • 1 offset location for *Hieraaetus morphnoides* • 1 offset location for *Lophoictinia isura* • 3 offset locations for *Meridolum corneovirens* • 1 offset locations for *Myotis macropus* And habitat for the following target threatened fauna species: • 4,410 hectares of potential foraging habitat for *Lathamus discolour* (including 100ha of *Lathamus discolour* important habitat as defined under the BAM) • 570 hectares of important habitat[12] for *Phascolarctos cinereus* as defined in the Cumberland Plain Assessment Report.		
Commitment 10 Establish a reserve to protect the north-south koala movement corridor along the Georges River between Appin and Long Point.	1. Transfer and reserve lots identified for early transfer to National Parks and Wildlife Service as the first stage in establishing Georges River Koala Reserve. 2. Reserve additional areas of the Georges River Koala Reserve between Appin and Kentlyn using NSW government land as a priority and by purchasing additional land (Stages 1a and 1b). 3. Reserve additional areas of the Georges River Koala Reserve between Kentlyn and Long Point using NSW government land as a priority and by purchasing additional land (Stage 2). 4. Restore up to 80 hectares of cleared land for koala habitat in priority areas including the Georges	Action 1: Years 1-2 Action 2: Years 1-10 Action 3: Years 1-20 Action 4:

[12] Important koala habitat is the term used to describe primary, secondary and tertiary corridors, as defined in the *Cumberland Plain Assessment Report*. It is the area that is critical to the long-term viability of koalas (primary corridors) as well as the areas (if enhanced) that would support the population (secondary and tertiary corridors).

Commitments	Actions	Timing
	River Koala Reserve to strengthen the north-south koala corridor. 5. Restore additional koala habitat within the Georges River Koala Reserve to strengthen the north-south koala movement corridor. 6. Work with NPWS, OSL and other key stakeholders to prepare a concept plan for the Georges River Koala Reserve.	Years 1-5 Action 5: Years 6-25 Action 6: Year 1
Commitment 11 Establish at least two new reserves in addition to the Georges River Koala Reserve that will protect threatened communities, species and habitat that are targeted for protection through the Plan.	1. Investigate a new reserve that will provide an ecological connection between Gulguer Nature Reserve, Bents Basin State Conservation Area and Burragorang State Conservation Area. 2. Investigate a new reserve on Wianamatta (South Creek) that will allow for the restoration of up to 370 hectares of threatened ecological communities. 3. Establish a community engagement program with landholders in the reserve investigation areas to provide information and seek expressions of interest for land purchase to support establishment of new reserves. 4. Establish biodiversity stewardship agreements appropriate on land purchased for a future reserve to commence management of the site. 5. Gazette at least two new reserves in addition to the Georges River Koala Reserve by Year 20 of the Plan.	Action 1,2: Year 1 Action 3: Years 1-10 Action 4: Life of Plan Action 5: Year 1-20
Commitment 12 Protect koala corridors in the Cumberland subregion, including those along the Nepean River, Georges River, Cataract River and Ousedale Creek.	1. Apply development controls to koala habitat protected under the Plan and ensure safe, functional corridors for koala movement (consistent with advice from the Office of the NSW Chief Scientist & Engineer) including: a. The north-south koala corridor along the Georges River (Commitment 10) b. The north-south koala corridor along the Nepean and Cataract rivers c. The east-west corridor along Ousedale Creek between the Georges River and Nepean River d. Elladale Creek and Simpsons Creek as an area of functional koala habitat. e. The north-south koala corridor along Allens Creek f. Excluding koalas from east-west corridors that do not meet the minimum requirements for a functional koala corridor (Corridor C: Nepean Creek to Beulah, and Corridor D: Mallaty Creek to Georges River) 2. Restore koala habitat in the Georges River and Ousedale Creek corridors to ensure they meet requirements for safe and functional koala movement corridors, consistent with advice from the Office of the NSW Chief Scientist & Engineer (Commitment 13).	Action 1: Before start of Plan Action 2: Life of Plan

Commitments	Actions	Timing
Commitment 13 Deliver and support ecological restoration activities in conservation land including ecological reconstruction of up to a maximum of 25% of the Plan's offset target for native vegetation (Commitment 8).	1. Establish a Restoration working group to guide the implementation of restoration activities under the Plan including the preparation of a Restoration Implementation Strategy and supporting technical guidance where relevant. 2. Develop a Restoration Implementation Strategy in consultation with the Restoration working group and other key stakeholders to establish best practice principles and methodologies, to: a. Identify the range of restoration activities and what will be undertaken under the Plan b. Ensure the long-term sustainability of restoration considers genetic diversity in what is established c. Identify considerations for restoration potential and constraints of land d. Provide reference to guidelines for restoration, including the NSW BCT Guidelines for restoring native vegetation undertaken in a biodiversity stewardship site e. Develop a seed-procurement approach f. Reference research needs being considered through the Research Program Implementation Strategy (Commitment 22, Action 1) g. Enter into written agreements with delivery partners and engage specialist providers where necessary to implement the restoration actions. 3. Deliver ecological restoration (including reconstruction) to restore koala habitat in the Georges River Koala Reserve and other priority locations in the strategic conservation area including along Ousedale Creek and around Appin. 4. Incorporate adaptive management principles into restoration actions including pilot sites to trial and develop restoration methodologies and applying new research as appropriate. 5. Deliver up to a maximum of 1,330 hectares of ecological reconstruction on conservation land targeting the following threatened ecological communities: a. Cooks River Castlereagh Ironbark Forest b. Cumberland Plain Woodland c. River-flat Eucalypt Forest d. Shale Gravel Transition Forest e. Swamp Oak Forest	Action 1,2: Year 1 Action 3: Year 1 onwards Action 4: Life of Plan Action 5: Years 1-3 Action 6: Life of Plan
Commitment 14 Minimise impacts from development on biodiversity values in the strategic conservation area.	1. Introduce a State Environmental Planning Policy to apply development controls to the strategic conservation area to require consideration of impacts on biodiversity values when consent authorities assess development applications. 2. Issue a Ministerial Direction under section 9.1 of the Environmental Planning and Assessment Act	Actions 1,2: Before start of Plan Action 3:

Commitments	Actions	Timing
	1979 (NSW) to require consistency with the objectives of the strategic conservation area when a planning authority prepares a planning proposal or reviews Local Environmental Plans within the strategic conservation area. 3. Work with local councils to integrate mapping of the strategic conservation area into local and regional planning through Local Strategic Planning Statements, which guide the local plan-making process.	Life of the Plan

MANAGING LANDSCAPE THREATS

Table A-5: Commitments and actions to manage landscape threats under Sub-Plan A

Commitments	Actions	Timing
Commitment 15 Manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the strategic conservation area.	1. Participate in the Sydney Weeds Network to inform the implementation of weed control activities under the Plan including the preparation of a Weed Control Strategy. 2. Prepare a Weed Control Strategy, in consultation with the Sydney Weeds Network to establish a coordinated weed control program in the Cumberland subregion, that: a. Identifies priority weed species and priority locations for weed control to maximise benefits to biodiversity in the strategic conservation area b. Identifies the training, extension and resource needs to address threats c. Provides guidance on weed control methods d. Identifies roles, responsibilities, delivery partners and other stakeholders e. Provides guidance on funding decisions under the weed control program f. Is consistent with existing weed control programs, reserve or BSA management requirements 3. Enter into written agreements with delivery partners to implement the Weed Control Strategy. 4. Integrate weed control actions for conservation land into reserve management plans. 5. Fund organisations to help deliver actions in the Weed Control Strategy for example Bushcare and Landcare groups, and Local Aboriginal Land Councils.	Action 1: Year 1 Actions 2,3: Year 2 Action 4: Life of Plan Action 5: Year 3 onwards
Commitment 16 Manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected within the strategic conservation area.	1. Establish a Pest Animal Control working group to guide the implementation of pest animal control activities under the Plan including preparation of a Pest Animal Control Implementation Strategy. 2. Prepare a Pest Animal Control Strategy to guide the implementation of the pest control program, that: a. Identifies pest control priorities, including priority pest species and priority locations for pest control to maximise benefits to biodiversity in the strategic conservation area b. Identifies the training, extension and resource needs to address threats c. Provides guidance on pest control methods d. Identifies roles, responsibilities delivery partners and other stakeholders e. Provides guidance on funding arrangements under the pest control program f. Is consistent with existing pest control programs, reserve or BSA management requirements 3. Ensure that the Pest Animal Control Strategy specifies the use of pest control techniques that will reduce the risk of secondary poisoning from Pindone or second-generation rodenticides in accordance with Appendix E.	Action 1: Year 1 Actions 2,3,4: Year 2 Action 5: Year 3 onwards

Commitments	Actions	Timing
	4. Enter into written agreements with delivery partners to implement the pest animal control program. 5. Fund organisations to help deliver actions in the Pest Animal Control Strategy for example Greater Sydney Local Land Care Services, Bushcare and Landcare groups, and Local Aboriginal Land Councils.	
Commitment 17 Manage fire in strategic locations in the Cumberland subregion to support the maintenance of biodiversity values on conservation land.	1. Consult with the NSW Rural Fire Service, NSW National Parks and Wildlife Service, and the department (Environment, Energy and Science Group) to identify fire management priorities, including fire sensitive species and ecological communities. 2. Partner with Aboriginal knowledge holders and organisations to learn about Indigenous fire management techniques and consider how this knowledge may be applied to manage and protect conservation land. 3. Prepare a Fire Management Strategy, that: a. Identifies priority locations for fire management to maximise benefits to biodiversity in the strategic conservation area b. Identifies priority fire-sensitive species and ecological communities c. Provides guidance on fire management to maintain and promote biodiversity values, particularly among fire sensitive species and ecological communities d. Identifies roles and responsibilities and co-ordinates delivery partners e. Provides criteria to guide decisions on funding of fire management under the Plan 4. Enter into written agreements with delivery partners to implement the Fire Management Strategy. 5. Integrate fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans.	Actions 1-4: Year 2 Action 5: Year 3 onwards
Commitment 18 Support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion.	1. Consult with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion including consideration of the following key threatening processes: a. *Phytophthora cinnamomi* root fungus b. Amphibian chytrid fungus c. Psittacine circoviral beak and feather disease d. Psyllid and Bell Miner associated dieback in Eucalypts 2. Enter into written agreements with delivery partners to implement priority disease control programs. 3. Require regular reporting by delivery partners on the disease control program outcomes to the department and to the executive implementation committee.	Actions 1,2,3: Year 6 onwards

Commitments	Actions	Timing
Commitment 19 Support existing or new programs to help threatened species and ecological communities adapt to the impacts of climate change in the Plan Area.	1. Consider funding research on climate change adaptation in developing the Research Program Implementation Strategy (Commitment 22, Action 1). 2. Partner with the Royal Botanic Gardens Greater Sydney to develop seed sourcing guidelines for ten keystone Cumberland Plain Woodland species and define the species-specific seed transfer zones for these species. 3. Update the strategic conservation area if new priority locations are identified through research that will support biodiversity adaptation to climate impacts and incorporate these new areas into the Conservation Land Implementation Strategy (Commitment 8).	Action 1: Year 1 Action 2: Years 1-3 Action 3: Every 5 years

BUILDING KNOWLEDGE AND CAPACITY

Table A-6: Commitments and actions to build knowledge and capacity under Sub-Plan A

Commitments	Actions	Timing
Commitment 20 Provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation including koala conservation.	1. Prepare an Education and Engagement Implementation Strategy to guide implementation of the education and engagement program, that: a. Identifies priority topics for education b. Identifies intended audiences c. Proposes implementation mechanisms d. Outlines governance arrangements for implementing the program 2. Establish three full-time community engagement officers to work across the local councils in the Plan Area to: a. Undertake activities according to the Education and Engagement Implementation Strategy and monitor its implementation b. Support biodiversity programs that are consistent with the objectives of the Plan c. Coordinate activities and pop-up events d. Coordinate grants to local councils and community groups for projects that meet criteria developed in the Strategy 3. Fund local councils and community groups to help deliver an education and engagement program that is consistent with the Education and Engagement Implementation Strategy, with indicative activities that include: a. Engaging with local schools to provide biodiversity education b. Hosting community activities such as tree planting and nature walks c. Developing a mobile education trailer as a shared resource for local councils in the plan area d. Promoting new and existing citizen science programs to encourage participation in nature-related science e. Raising awareness of the cultural significance of biodiversity to Aboriginal people 4. Invest in the NSW Koala Strategy to raise awareness of the Southern Sydney koala population and encourage community participation in koala conservation in Western Sydney. 5. In partnership with the Biodiversity Conservation Trust establish a community engagement program to educate landholders within the strategic conservation area and promote the opportunities and benefits of biodiversity stewardship sites. 6. Work with councils and other landholders to install signs and interpretive displays at identified	Action 1: Year 4 Action 2: Year 5 Action 3: Year 5 onwards Action 4: Year 1 onwards Action 5: Year 1 Action 6: Life of the Plan

Commitments	Actions	Timing
	conservation land to raise awareness of the biodiversity values of a site.	
Commitment 21 Partner with Aboriginal groups and community to help maintain a distinctive cultural, spiritual, physical and economic relationships with their land and waters in Western Sydney	1. Fund a grants program to build capacity in the three LALCs in the Plan Area to fund land management and biodiversity works, and culture and heritage projects on Aboriginal-owned lands and other important areas. 2. Partner with Aboriginal community such as Traditional Custodians, Aboriginal Land Councils and other interested Aboriginal people in Western Sydney to collaboratively develop a 10-year Aboriginal Engagement and Implementation Strategy. 3. Partner with Western Sydney's Aboriginal community to implement the Plan and a 10-year Aboriginal Engagement and Implementation Strategy through: a. Establishing partnerships, including the co-design of actions under the Strategy, with Traditional Custodians, Aboriginal Land Councils, Aboriginal businesses and other interested Aboriginal groups b. Establishing an Aboriginal advisory group to provide advice on the delivery of the Aboriginal Engagement and Implementation Strategy and the Plan c. Actively engage and empower Aboriginal groups and community to enable participation in decision making to deliver the Aboriginal Engagement and Implementation Strategy and the Plan 4. Implement a 10-year Aboriginal Engagement and Implementation Strategy to support economic participation for Aboriginal people and cultural outcomes under the Plan to: a. Recognise, celebrate and promote Aboriginal culture and heritage in Western Sydney with a focus on natural areas and protecting biodiversity b. Recognise and embed the knowledge and connection that Aboriginal people have with Country c. Enable traditional custodians and interested Aboriginal groups to care for Country on new conservation land d. Grow Aboriginal businesses and employment in the environmental sector	Action 1: Year 1-2 Action 2: Year 1 Action 3,4: Years 2-11 Action 5: Year 5 onwards
Commitment 22 Invest in research priorities that will support the implementation of the Plan and help to deliver the Plan's outcomes.	1. Develop a Research Program Implementation Strategy to guide delivery of a 35-year research program that will help achieve the Plan's outcomes in Western Sydney, including identifying research priorities for the first four years of the program. 2. Deliver a research program in accordance with the Research Program Implementation Strategy. The research program may include: a. Research on the vulnerability of threatened species and ecological communities to climate change	Action 1: Year 1 Action 2: Year 2 onwards

Commitments	Actions	Timing
	b. Research that increases knowledge of the adaptive capacity of plant, animal and microbial organisms used in active restoration of ecological communities of the sub-region c. Research that improves restoration outcomes, including ecosystem function and resilience, for threatened ecological communities of the sub-region d. Research on ecological connectivity and landscape function at site, local and regional scales to enhance conservation outcomes e. Research into changing community attitudes and behaviour to biodiversity and conservation values including factors influencing those and how they evolve and change f. Research into the connections between land management, biodiversity and aboriginal culture and practices in Western Sydney as proposed by the Aboriginal Engagement and Implementation Strategy (Commitment 21) 3. Support NSW Government programs for threatened species research in Western Sydney including: a. Research on threatened species impacted by the Plan in the Cumberland subregion through the Saving our Species program b. Research that increases knowledge of population demographics, life-history and ecology of the Southern Sydney koala population, as part of the NSW Koala Strategy's NSW Koala Research Plan	
Commitment 23 Support rehabilitation measures to help maintain koala health and welfare.	1. Invest in the *NSW Koala Strategy* and other potential partners to implement the koala health and welfare program in South Western Sydney with key deliverables including: a. Monitoring of koalas including key threats and effectiveness of mitigation measures as part of the NSW Koala Strategy Monitoring Framework b. Designating the koalas in South Western Sydney as one of the dedicated monitoring sites for the NSW Koala Strategy c. Providing enhanced training in wildlife treatment for veterinarians d. Providing grants for community wildlife organisations for resources and carer recruitment and training e. Establishing health and welfare programs to support koalas from threats including vehicle strike, fire, disease and climate change 2. Koalas that are captured and/or handled as part of a monitoring program will be vaccinated against chlamydia and have a tissue sample taken for genetic analysis, with the tissue samples lodged with the NSW Koala Biobank.	Action 1,2: Year 1 onwards

GOVERNANCE AND REPORTING

Table A-7: Commitments and actions for governance and reporting under Sub-Plan A

Commitments	Actions	Timing
Commitment 24 Establish governance arrangements including roles, responsibilities, and funding to ensure the efficient and effective implementation of the Plan.	1. Establish a multi-agency executive implementation committee to act as a central governance steering committee for the Plan. 2. Enter into written agreements with delivery partners, including Transport for NSW as project partner responsible for delivering the major transport corridors to support the implementation of specific commitments and actions. 3. Establish working groups to advise the executive implementation committee and oversee implementation of specific commitments and actions (commitments 7, 13, 16 and 26). 4. Establish arrangements to fund delivery of the Plan's commitments and actions through contributions from residential, commercial and industrial developers in the nominated areas. 5. Ensure that at least 90% of conservation program funding is spent on establishing and restoring conservation land or purchasing biodiversity credits consistent with the conservation land selection steps.	Actions 1-7: Year 1 Action 8: Life of Plan
Commitment 25 Implement an evaluation program for the Plan that sets out requirements for monitoring, evaluation, reporting and adaptive management.	1. Finalise the evaluation program in consultation with key stakeholders, including: a. Establishing governance arrangements for the evaluation program as part of the Plan's governance arrangements for implementation b. Establishing a monitoring and data collection methodology c. Finalising evaluation questions including scope and frequency d. Developing a method for evaluation outputs to support adaptive management e. Establishing the reconciliation accounting process to track progress of the Plan's commitments and actions f. Developing templates for reporting quarterly to the executive implementation steering committee and annual updates over the life of the Plan. g. Establishing processes to support independent five-yearly reviews of the Plan 2. Track progress of meeting conservation targets in hectares through the reconciliation accounting process 3. Implement adaptive management steps for offsets if the reconciliation accounting process determines that the Plan's offsets are not keeping track with development. 4. Publish annual updates on implementation of the Plan. 5. Undertake independent five-yearly reviews of the progress of the Plan, including progress towards	Actions 1: Year 1 Action 2,3,4,5: Life of the Plan Action 6: Year 1 onwards

Commitments	Actions	Timing
	meeting commitments and achieving outcomes, and publish a review report. 6. Undertake internal process reviews at the mid-term point (2.5 years) between independent reviews and provide to key delivery partners and stakeholders. 7. Develop an overarching Communication and Engagement Strategy to support the Plan's implementation. This would be reviewed every 5 years and updated accordingly.	
Commitment 26 Implement a compliance program to ensure compliance with the Plan and conditions of approval.	1. Establish a Compliance and Implementation working group comprising the department, local councils and other relevant stakeholders to guide the implementation of compliance activities under the Plan including preparation of a Compliance Strategy. 2. Prepare a Compliance Strategy under guidance of the working group to: a. Identify relevant compliance mechanisms b. Set out compliance monitoring and auditing priorities and processes c. Set out a decision-making framework for taking compliance action d. Set out procedures and protocols for taking compliance action e. Identify roles and responsibilities for compliance 3. Provide funding to employ six full-time compliance officers to work with local councils to carry out compliance activities in the Plan Area. 4. Share knowledge, maps and data and provide ongoing support and training to council staff to assist local councils with carrying out implementation and compliance activities. 5. Publish a compliance report as part of the yearly update on implementation of the Plan and provide to local councils for review and investigation. 6. Prepare reports every two and a half years on any identified breaches with Plan commitments and approval conditions e.g. auditing development consent conditions, environmental management plans etc.	Actions 1,2: Year 1 Action 3: Year 2 onwards Action 4,5,6: Life of Plan

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Environmental consulting

2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 3: ASSESSMENT APPROACH AND METHODS

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	James Shepherd, Callan Wharfe, Rebecca Dwyer, Matthew Hyde (Biosis)
CONTENT:	Callan Wharfe, Jane Raithby-Veall, Rebecca Dwyer (Biosis) Darren James (DAJ Environmental) Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines)
REVIEWED BY:	
OPEN LINES:	Darren James (DAJ Environmental), Tom Holden and Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor – BAAS18134
VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 3 Contents

Part 3 List of Tables

This Part sets out the approach and methods used to prepare the Assessment Report:

- Chapter 10: Provides an overview of the assessment approach
- Chapter 11: Describes the approach and methods for understanding the biodiversity values and other matters that require assessment within the Plan Area
- Chapter 12: Identifies where the approaches to assessing the impacts of the development under the Plan are described in the Assessment Report
- Chapter 13: Provides an overview of the data used in the Assessment Report and the limitations with the data

10 Overview

This Chapter sets out:

- An overview of the scope of the assessment
- A summary of the Biodiversity Assessment Method (BAM) that applies to the Biodiversity Certification Assessment Report (BCAR) and the Terms of Reference that applies to the Strategic Assessment Report (SAR)
- A discussion of the key steps in the assessment process
- An overview of the peer review processes for key methods

10.1 SCOPE

The scope of the assessments under the BC Act and EPBC Act are different (see Part 1). This relates to both:

- The development that is being assessed for approval
- The impact assessment requirements under each piece of legislation

The assessment approach was designed to meet the requirements of the assessment processes under both the BC Act and EPBC Act (see Table 10-1), as well as address the various overlaps and differences.

Table 10-1: Impact assessment requirements of the BC Act and the EPBC Act*

Legislation	Impact assessment requirements	Comments
BC Act	Relevant provisions of the legislation and regulations	The Cumberland Plain Conservation Plan (the Plan) is being assessed as a strategic application for biodiversity certification under Part 8 of the BC Act. The relevant regulatory provisions need to be met
	BAM	The BAM specifies the requirements for the BCAR
	Conservation measures in strategic applications for biodiversity certification (DPIE, 2020a)	The purpose of the DPIE strategic application guidelines is to help planning authorities preparing applications for strategic biodiversity certification 'demonstrate that proposed conservation measures adequately address the likely impacts on biodiversity values of the biodiversity certification of the land'. The guidelines must be addressed in the BCAR
EPBC Act	Relevant provisions of the legislation and regulations	The Plan is undergoing strategic assessment under Part 10 of the EPBC Act. The relevant regulatory provisions need to be addressed in the SAR
	Terms of Reference (ToR) for the SAR	The ToR specify the requirements for the SAR
	Relevant statutory documents	The EPBC Act requires that certain statutory documents be considered in the impact assessment process. For example, these include recovery plans, threat abatement plans, and conservation advices

Legislation	Impact assessment requirements	Comments
	EPBC Act policies and guidelines	The Australian Government has published a range of EPBC Act policies and guidelines which need to be considered in the impact assessment process

* See Part 1 for detail on the regulatory context of this project

10.2 BIODIVERSITY ASSESSMENT METHOD

The BAM was established under the BC Act to assess impacts on NSW listed threatened species and ecological communities and their habitats. As outlined on the Environment Energy and Science (EES) website:

> *"*[The BAM] *is a scientific document that provides:*
>
> - *a consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site,*
> - *guidance on how a proponent can avoid and minimise potential biodiversity impacts, and*
> - *the number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity."*

The BAM specifies the assessment requirements for the BCAR and was applied within the nominated areas.

The BAM also provides a strong starting point for meeting the EPBC Act ToR. For example, the detailed requirements around data gathering within the nominated areas are also largely appropriate for protected matters.

The BAM is structured around three stages:

- **Stage 1 – Biodiversity assessment**. This stage establishes a consistent approach to identifying and assessing the biodiversity values on land (including the land to be biodiversity certified). It sets out the data gathering requirements for the landscape context, native vegetation, and threatened species
- **Stage 2 – Impact assessment**. This stage provides the method for assessing impacts to biodiversity values. It specifies requirements around:
  - Avoiding and minimising impacts
  - Assessing both direct and indirect impacts
  - Dealing with issues such as prescribed impacts, and serious and irreversible impacts
  - Determining the credits required for meeting the no net loss standard
- **Stage 3 – Improving biodiversity values**. This stage is used to determine the credits that can be created at stewardship sites. This stage does not need to be applied at the time of application for strategic biodiversity certification and has therefore not been applied in this Assessment Report (see Chapter 2)

The outputs of the BAM for this project need to be presented in a BCAR. The components of this Assessment Report that comprise the BCAR are set out in Part 1.

The current version of the BAM came into force on 22 October 2020. The Assessment Report is operating under transitional arrangements and is prepared in accordance with the 2017 version of the BAM. The transitional arrangements are provided under clause 6.31 of the BC Regulation 2017 and allow this project to continue operating under the 2017 BAM for a period of 12 months since the change to the new BAM or 'such longer period as the Minister approves in a particular case'. The Environment Minister (through a delegated authority) has approved an extension to the transitional arrangements for the BAM that apply to this project to April 2022.

10.3 EPBC ACT TERMS OF REFERENCE

The ToR for the SAR are part of the Strategic Assessment Agreement between the NSW Government and Australian Government. The ToR set out the information requirements that this Assessment Report needs to address for matters protected under the EPBC Act.

Clause 4.2 of the ToR outlines how the Assessment Report should describe the methods used in the assessment:

> *"The Report must describe the method used to understand likely impacts on all protected matters of actions taken under the Plan. The level of the assessment will be proportionate to the level of likely risk to each protected matter. The method must:*
>
> 1. *Be appropriate for assessment at a strategic scale*
> 2. *Rely on the best available information*
> 3. *Discuss uncertainty, including reference to the technical data and information relied upon*
>
> *The Report must identify the data used in the assessment, any limitations it may have, where (or if) the data is available and where it can be accessed, including publicly accessed."*

The ToR specifies the assessment requirements for the SAR and was applied within the Plan Area. The ToR are provided in Supporting Document A.

10.4 PEER REVIEW OF KEY METHODS

Section 4.8 of the ToR for the SAR specifies:

> *"The Report must include justification for key methods used in the assessment, including summaries of independent peer review processes and where the review/s are available to the public."*

The term 'key methods' refers to technical methods for describing the protected matters impacted by the Plan, such as methods used to collect data on protected matters and map the location of protected matters.

The term does not include approaches to understand the likely impacts on protected matters of actions taken under the Plan, such as the approach to assessing direct, indirect and cumulative impacts.

In accordance with section 4.2 of the ToR, the SAR has described these impact assessment approaches in detail and any uncertainties or limitations with them (see Chapter 12 and Chapter 13).

The NSW Department of Planning, Industry, and Environment (the Department) commissioned an independent peer reviewer, Dr Rhidian Harrington, from Niche Environment and Heritage, to review the key methods. The key methods reviewed were:

- The approach to determining the relevant EPBC matters for assessment (see Section 11.1.2)
- The methodology for mapping EPBC listed TECs (see Section 11.4.3)
- The method for identifying important populations of flora and fauna (see Section 11.5.3)
- The approach and criteria for mapping habitat across the Cumberland subregion for approximately 30 threatened species using an expert knowledge-based process (see Section 11.5)
- An evaluation method for determining the viability of the Southern Sydney koala population (see Chapter 30)

The peer review process involved:

- Initial review of key methods by peer-reviewer
- One day workshop with ecological consulting team, technical staff from the Department and peer reviewer to discuss key methods
- Preparation of report that:
    - Sets out the context of the peer review (including expertise of the peer reviewer)
    - Analyses each method against the following questions:
        - Is the general approach to the method appropriate?
        - Are the details of the method appropriate?
        - Are there critical components of the method that need improvement?

The peer review report is provided in Supporting Document B.

The peer review report concluded that in general:

- The datasets, methods for data collection and assumptions associated with the methods are appropriate for a large-scale strategic assessment process such as this project
- The methods used are generally conservative and are unlikely to under-represent the presence or distribution of any TEC or species, and are more likely to over-predict presence and distributions

The report recommended that further details associated with the input data and assumptions be provided in the Assessment Report to provide the regulators and the public more complete understanding of limitations.

The limitations associated with the methods are set out in Chapter 13.

Several other methods were used to prepare the SAR. These methods and a rationale for not undertaking a peer review of them is provided in Table 10-2.

Table 10-2: Rationale for not undertaking peer review of other methods

Method	Rationale
Data collection and surveys for EPBC listed TECs and species	Data collection within the nominated areas was undertaken in accordance with the BAM. The BAM was independently peer reviewed in 2015. The previous formalised biodiversity assessment method – the BioBanking Assessment Method – was also independently reviewed
Species Distribution Modelling for Commonwealth-listed species	The Species Distribution Modelling work was undertaken by a Senior Research Fellow at RMIT University. The modelling process is a well-recognised and peer reviewed method for mapping species habitat at a landscape scale. References to published literature establishing the validity of the method are provided in the Species Distribution Modelling Report (see Supporting Document F) Species experts at EES reviewed several example outputs of the model and provided input into the modelling method
Migratory shorebird mapping	Mapping was undertaken in accordance with EPBC Policy Statement 3.21 (DEWHA, 2009b)
Trend analysis	The trend analysis was undertaken by a Senior Research Fellow at RMIT University. The work involved an expert elicitation process involving eight people considered to be experts on the native vegetation of the Cumberland subregion, including representation from academia. As part of this process, several experts reviewed or provided input into the trend analysis method

11 Approach to understanding biodiversity values

This Chapter describes the approach and methods for understanding the biodiversity values and other matters that require assessment within the Plan Area. It includes information about:

- The approach to identifying NSW and Commonwealth matters needing assessment
- The approach to understanding the landscape context
- The surveying and mapping methods for native vegetation communities
- The mapping methods for threatened ecological communities (TECs)
- The surveying and mapping methods for threatened species and their habitats
- The approach to understanding the other matters protected by the EPBC Act

It should be noted that an initial assessment of the implications of the 2019/2020 NSW bushfires on species impacted by the Plan was also undertaken based on available information. This assessment is set out in Part 1 and Supporting Document G.

11.1 IDENTIFICATION OF MATTERS FOR ASSESSMENT

The BAM and ToR require the Assessment Report to identify the NSW and Commonwealth matters that may occur in the Plan Area and that may be impacted by the development.

Section 6.4 of the BAM provides a process to predict all NSW-listed species that may occur in the nominated areas and consider whether any of these species can be excluded from the assessment.

The ToR requires all Commonwealth matters relevant to the Strategic Assessment Area to be identified. Clause 4.2 provides that the level of assessment be proportionate to the level of likely risk of impacts to each matter.

Separate processes were undertaken to identify the NSW and Commonwealth matters needing assessment.

11.1.1 NSW MATTERS NEEDING ASSESSMENT UNDER THE BCAR

PURPOSE

Section 6.4 of the BAM requires several steps be applied to determine the NSW-listed threatened species that require assessment under the BCAR. This process was applied to the nominated areas.

The BAM categorises species into two groups:

- Ecosystem credit species (ECS) – these species can be reasonably predicted to occur at a location based on habitat type and condition
- Species credit species (SCS) – these species cannot be reasonably predicted to occur at a location based on habitat

In some cases, SCS can be both listed as an ECS as well as a SCS, based on species life cycle and breeding requirements.

The process for determining what species require assessment is different for ECS and SCS.

METHOD

NSW-listed species

Relevant NSW-listed species were identified by application of the following three step process:

- Step A: Identification of an initial list of species (Step 1, Section 6.4 of the BAM)
- Step B: Initial exclusion of SCS (Steps 2 and 3, Section 6.4 of the BAM)
- Step C: Consideration of best available ecological data as provided by Section 6.1.1.2 of the BAM

Step A: Identification of an initial list of species (Step 1, Section 6.4 of the BAM)

Identification of an initial list of species using the BAM credit calculator was undertaken in accordance with Step 1, Section 6.4 of the BAM. The calculator uses data contained in the Threatened Biodiversity Data Collection and on Plant Community Types (PCTs) in the nominated areas to predict the initial list of species based on the following:

- Distribution of the species includes the relevant IBRA subregion where the nominated areas occur
- Nominated areas are within any geographic constraints of the distribution of the species in the IBRA subregion
- Species are associated with any of the PCTs identified as occurring within the nominated areas
- Native vegetation cover within the assessment area (including a 1,500 m wide buffer surrounding the boundary of the nominated areas) is equal to or greater than the minimum native vegetation cover required for a species
- Patch size of which the vegetation zone is equal to or greater than minimum value specified for a species

Step A was completed separately for each nominated area. This included inputting PCT data from all PCTs present in the nominated areas (i.e. not just those in the urban capable land) into the BAM calculator (BAM-C). This ensured the widest suite of species were considered from the outset, with some potential candidate SCS later excluded on the basis of a lack of suitable habitat in the urban capable land (further information is provided in Attachment A to Part 3).

All ECS identified in Step A were identified for assessment in the BCAR.

SCS identified in Step A were considered further under Steps B and C.

Step B: Initial exclusion of SCS (Steps 2 and 3, Section 6.4 of the BAM)

Steps 2 and 3 of Section 6.4 of the BAM specify that an SCS may be excluded from needing further assessment because:

- Habitat constraints (as defined in the Threatened Biodiversity Data Collection) confirmed by ground surveys were not present (Section 6.4, Step 2) within a vegetation zone or the nominated areas. The BAM specifies that this step is not applicable where no habitat constraints are listed for a species in the Threatened Biodiversity Data Collection, or
- The species is a vagrant in the IBRA subregion (Section 6.4.1.14), or
- Habitat within a vegetation zone or the nominated areas is substantially degraded (Section 6.4, Step 3). This must be considered based on a field assessment of the habitat constraints or microhabitats of the subject land, or
- An expert report determines that habitat for the species is unlikely to be present (Section 6.4.1.17 (b))

For the most-part, Step B did not result in the exclusion of many SCS from the initial list in Step A as its application at the very large landscape scale of the Plan was not possible. Further, it was not posssible to use an assessment of habitat constraints or degraded habitat to exclude any SCS due to the large size of the assessment area coupled with land access constraints (see Chapter 21). Field assessments were restricted to sites where access was granted by landholders and these limitations meant it was not possible to assess either all vegetation polygons within a vegetation zone, or the entire subject land to adequately determine habitat degradation or the presence / absence of habitat constraints. Furthermore, no species were determined to warrant exclusion on the basis of being a vagrant.

Expert reports were prepared for 14 candidate SCS under Section 6.4.1.21(c) of the BAM, and the majority of the reports concluded that habitat was likely to be present in the nominated areas where the species was identified as a candidate. However four species were excluded from specific nominated areas by the experts.

It was the conclusion of the expert report for *Grevillea juniperina* subsp. *juniperina* within Wilton and GMAC, that the species was unlikely to be growing wild in either nominated area, and has probably never been native to either of these areas (Weston, 2019). The expert also concluded that no suitable habitat for *Pterostylis saxicola* exists in WSA, and it is most unlikely to occur there (Weston, 2018). Similarly the expert report for *Persoonia nutans* concludes that the species is unlikey to occur within the urban capable land in GMAC, or Wilton (Douglas, 2019b). *Melaleuca deanei* was also excluded from occuring within GPEC on the basis of the expert report for that species (Douglas, 2019a).

Step C: Consideration of best available ecological data as prescribed by Section 6.1.1.2 of the BAM

Steps A and B led to a highly conservative list of species needing assessment. However, the accredited assessor considered many of these species unlikely to occur (or that the species habitat was unlikely to occur) within the nominated areas and/or urban capable land based on:

- Knowledge of the species in the subregion
- BioNet records, or
- Peer-reviewed literature

Section 6.1.1.2 of the BAM specifies that:

> *'An assessor may use additional information about a threatened species, in BioNet (e.g. the profile of a threatened species) or published, peer reviewed literature, when assessing the habitat suitability of a site'*

Due to the inability of Step B to be applied comprehensively at the landscape scale of the project, the accredited assessor applied an approach that used Section 6.1.1.2 of the BAM to help provide information and justification for excluding SCS from further assessment. This process was considered necessary to ensure that both:

- The species likely to occur on the subject land were identified, and
- The species unlikely to occur were appropriately excluded

Step C involved a series of workshops with accredited assessors and ecologists from Biosis and Ecoplanning to consider each SCS identified in Step A on the basis of the following (as prescribed by Section 6.1.1.2 of the BAM):

- Best available ecological data
- The Threatened Biodiversity Data Collection
- Species records in BioNet
- Published peer reviewed literature

In relation to species records, it is acknowledged that records do not represent complete information on the absence of a species. However, records do represent the best available information and are suitable to infer trends in distribution and likelihood of occurrence in the landscape. This is particularly the case for the nominated areas which have been extensively surveyed relative to other parts of NSW and it can be reasonably expected that a species would have been previously recorded if present.

The workshops involved:

- Consolidating information on habitat types present within the urban capable land for each nominated area based on field surveys and the most up to date native vegetation mapping
- Reviewing each species habitat preferences based on BioNet and published peer reviewed literature, including habitat constraints identified in the Threatened Biodiversity Data Collection
- Reviewing each species distribution/geographic extent based on BioNet and published peer reviewed literature, including interrogation of records data, including BioNet records
- Application of knowledge and expertise of accredited assessors and ecologists who had surveyed the nominated areas, as well as ecologists with detailed knowledge of the flora and fauna of Cumberland subregion

The exclusion of SCS from the final candidate species list under Step C was based on the factors identified in Table 11-1.

A total of 83 SCS were predicted to occur within the nominated areas. Of these, 41 SCS were determined to be candidate SCS needing further assessment, and 42 were removed.

Table 11-1: Factors for excluding SCS from the final candidate species list under Step C

Factors for excluding SCS	Description
Geographic extent of a species occurring outside one or more of the nominated areas, or urban capable land	This was considered for each species based on: • BioNet records and surveys for this project • BioNet profiles • Final determinations • Conservation advice or recovery plans • Other published peer reviewed literature A total of 28 species were excluded from one or more nominated areas on this basis

Factors for excluding SCS	Description

Lack of suitable habitat within one of more of the nominated areas or urban capable land	This was considered for each species based on:
	• The lack of PCTs associated with the species in the urban capable land
	• An absence of microhabitats associated with:
	  ○ Creeklines/floodplains
	  ○ Sandstone clifflines/outcropping
	  ○ Transitional soil/ecotonal community associations
	  ○ Tree hollows and larger undisturbed vegetation patches suitable for species occurrence and/or breeding
	This was determined based on the accredited assessors knowledge of the nominated areas, and best available ecological data on the species' microhabitat requirements
	A total of 22 species were excluded from one or more nominated areas on this basis

Lack of records in one or more of the nominated areas over the past 55 or more years (up to >200 years)	This was considered for each species based on BioNet records and surveys undertaken for this project. Four flora species were excluded on this basis, these include *Deyeuxia appressa*, *Gyrostemon thesioides*, *Pilularia novae-hollandiae*, and *Thesium australe*. These species are considered locally extinct within the nominated areas. Furthermore, Bush Stone-curlew was also excluded based on being considered locally extinct within the nominated areas. It was concluded that the species no longer occurs in the area because: • Any potential suitable micro-habitats for the species have undergone a long history of degradation and are now considered scarce in urban capable land • There are very few recent records within the subregion • The species has not been recorded in the nominated areas since 1996 (more than a generations length) despite a high level of surveys since that time

NSW-listed TECs

Relevant NSW-listed TECs were identified by:

- Identifying the relationship between PCTs and NSW-listed TECs. In accordance with the BAM, this relationship was identified in the NSW BioNet Vegetation Classification System
- Reviewing updated native vegetation maps that identify the PCTs within the nominated areas
- Conformance with NSW listed TEC profile information (structure, floristics, landscape position, soil association etc.)

RESULTS

The results of the process to identify the matters requiring assessment under the BCAR are presented in Section 11.5 and Attachment A to Part 3. This includes the list of NSW-listed candidate SCS requiring assessment under the BCAR, along with justification for the inclusion or exclusion of species from further assessment.

11.1.2 EPBC ACT MATTERS NEEDING ASSESSMENT UNDER THE SAR

PURPOSE

As required by Section 3.2 of the ToR, the SAR must identify the protected matters that may be impacted directly, indirectly or cumulatively by actions taken under the Plan.

METHOD

This was undertaken by:

- Identifying the full list of protected matters that may potentially be relevant to the Plan and require assessment under the SAR (both within and outside of the Strategic Assessment Area)
- Categorising those matters to identify the subset that have the potential to be impacted and require assessment

A precautionary approach was applied to both steps to ensure that all matters requiring assessment were identified. In accordance with Section 4.8 of the ToR, the approach was supported by peer review of both the method and results.

It is important to note that this process did not relate to how protected matters were assessed. Rather, this step merely identified the matters requiring assessment under the SAR.

Identification of protected matters

The full list of protected matters potentially relevant to the Plan was identified through searches of:

- The Australian Government's online Protected Matters Search Tool
- NSW BioNet
- Atlas of Living Australia
- The Australian Government's Finalised Priority Assessment List (FPAL)

These searches were done using the Strategic Assessment Area boundary plus an additional 10 km buffer. This was considered an appropriate area to identify matters that may be impacted directly, indirectly or cumulatively by the Plan. This work identified the following groups of protected matters as being relevant to the assessment:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of international importance (Ramsar wetlands)
- World and National Heritage
- Commonwealth land

The full list of protected matters was then assigned to one of two categories:

- Category 1: matter needs detailed assessment. These matters are reliant on the Strategic Assessment Area, have some potential to be impacted (directly, indirectly or cumulatively), and are addressed in detail
- Category 2: matter does not need further assessment. These matters are not reliant on the Strategic Assessment Area, are subject to no or very low risk of impacts (directly, indirectly or cumulatively), and are not addressed further

Commonwealth-listed TECs

Commonwealth-listed TECs present in the Strategic Assessment Area that have some potential to be impacted (directly, indirectly or cumulatively), were identified and assigned to Category 1 based on:

- The Australian Government's Protected Matters Search Tool
- Existing native vegetation mapping for the Cumberland Plain (OEH, 2013b, 2016b)
- Detailed native vegetation mapping undertaken within the nominated areas for this project
- Assignment of a PCT in the BioNet Vegetation Classification (formerly known as Vegetation Information System Classification (VIS-C))
- Conformance with Commonwealth-listed TEC profile information (structure, floristics, landscape position, soil association, patch size etc.)

Commonwealth-listed threatened species

Two steps were applied to categorise threatened species for assessment:

- Application of criteria
- Expert review

Application of criteria

Criteria were applied to initially identify the threatened species that may be impacted by actions under the Plan (see Table 11-2). A species was allocated to Category 1 (meaning it required detailed assessment) if it met any of the criteria. Species that did not meet one or more of the criteria were assigned to Category 2 (no further assessment required).

Two senior ecologists with extensive expertise in species within Western Sydney reviewed the criteria and overall approach to ensure that all matters that may be directly, indirectly or cumulatively impacted by the Plan were identified. The ecologists recommended taking a precautionary approach and simplifying some of the criteria.

Table 11-2: Criteria and process for categorising threatened species

Category 1 criteria*	Rationale for the criteria	Process to apply the criteria
1. **The species was identified as a species requiring assessment as part of the BAM process for the nominated areas**	The BAM process identifies the NSW-listed species that may be impacted within the nominated areas. The process is based on a range of detailed on ground surveys and analysis Where these species are also listed as a Commonwealth-listed species they should be assigned to Category 1	See Section 11.5 for a description of the relevant part of the BAM process
2. **The species was subject to a commitment in the Sydney Growth Centres Strategic Assessment Program Report (DECCW, 2010)**	A range of species are subject to commitments associated with the previous Growth Centres strategic assessment. Given the close association in areas that may be affected by the Plan it is appropriate that these species be assigned to Category 1	This criterion was applied through a review of the Growth Centres Program Report to identify relevant species
3. **The Strategic Assessment Area contains a known important population**	Important populations of threatened species require particular consideration under the EPBC Act (DoE, 2013). Where they are present in the Strategic Assessment Area the species should be assigned to Category 1	Important populations within the Strategic Assessment Area were identified through: • Review of recovery plans, conservation advices, species profiles, EPBC policies, and other published literature • Application of the process for mapping important populations in the Strategic Assessment Area It is important to note that any record of an endangered or critically endangered species is considered to form part of an important population (DoE, 2013)
4. **The Strategic Assessment Area contains >5 per cent of all known records in NSW of a species since 1990 on the BioNet Atlas of NSW Wildlife**	Known records provide an indication of the importance of the Strategic Assessment Area to a species. Using a precautionary approach, greater than 5 per cent of records in NSW was chosen as a threshold for assigning species to Category 1	This criterion was applied using post 1990 species records from the BioNet Atlas of NSW Wildlife database. Records within the Strategic Assessment Area were compared to the total number of records across NSW
5. **The Strategic Assessment Area comprises >5 per cent or more of the mapped distribution of the species according to the Department of Agriculture, Water and the Environment's (DAWE) current distribution mapping**	DAWE's distribution mapping of habitat showing where a species is 'known to occur', 'likely to occur' and 'may occur' also provides an indication of the importance of the Strategic Assessment Area to a species. Using a precautionary approach, greater than 5 per cent of a species distribution was chosen as a threshold for assigning species to Category 1	This criterion was applied using distribution statistics provided by DAWE about the percentage of each species distribution within the Strategic Assessment Area

Category 1 criteria*	Rationale for the criteria	Process to apply the criteria
6. It is an FPAL species, and available information suggests it occurs in the Strategic Assessment Area	The FPAL includes species nominated for listing as threatened or for up-listing. Any FPAL species likely to occur in the Strategic Assessment Area warrants assessment and should be assigned to Category 1	Where DAWE's distribution and records information for an FPAL species was available, this was used to determine occurrence in the Strategic Assessment Area Where this information was not available, information from the NSW Threatened Biodiversity Data Collection in BioNet or DAWE's listing documentation was used

* A species was allocated to Category 1 if it met any of the criteria

Review of the initial list

The initial list was reviewed by two expert senior ecologists to confirm the categorisation or to move species between categories based on specific expert knowledge. This step was important as it provided the opportunity to consider specific information to ensure that all species that may be impacted were identified.

The findings of this review are incorporated into the results in Chapter 28.

Migratory species

Migratory species were addressed in three groups:

- Migratory shorebirds
- Migratory birds addressed in the *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE, 2015)
- Other migratory species

Migratory shorebirds

Thirty-seven migratory shorebirds visit Australia each year. They are addressed as a group in EPBC Act Policy Statement 3.21 (DoE, 2017). Given the overlap in habitat used by many of these species and the similar way they are treated under the EPBC Act, any migratory shorebirds that were known to occur in the Strategic Assessment Area were assigned to Category 1. This was based on post 1990 records within the area from NSW BioNet and Birdlife Australia.

Any species without records were assigned to Category 2.

Other migratory birds

Fourteen migratory bird species are addressed in the EPBC guideline (DoE, 2015) for which a similar approach to shorebirds was applied. Any species with records in the Strategic Assessment Area was assigned to Category 1.

Any species without records were assigned to Category 2.

Remaining migratory species

For the remaining migratory species, two steps were applied to categorise them:

1. **Application of criteria:** Criteria were applied to initially identify the other migratory species that may be impacted by actions under the Plan (see Table 11-3). A species was allocated to Category 1 if it met any of the criteria. Species that did not meet one or more of the criteria were assigned to Category 2
2. **Expert review:** The list was reviewed by two senior ecologists to confirm the categorisation or to move species between categories based on specific expert knowledge

Table 11-3: Criteria and process for categorising the remaining migratory species

Category 1 criteria*	Rationale for the criteria	Process to apply the criteria
1. **The Strategic Assessment Area supports important habitat or an ecologically significant proportion of a species**	"Important habitat" and "ecologically significant proportion" are key concepts for migratory species (DoE, 2013). Where these are present within the Strategic Assessment Area it is appropriate to assign a species to Category 1	Important habitat and ecologically significant proportion need to be determined on a species-by-species basis. The guidance around these concepts from the EPBC Act significant guidelines (DoE, 2013) were applied Information from recovery plans, conservation advices, species profiles, EPBC policies, and other published literature were used to identify if the Strategic Assessment Area supported important habitat or an ecologically significant proportion of a species
2. **The Strategic Assessment Area contains >5 per cent of all known records in NSW of a species since 1990 on the BioNet Atlas of NSW Wildlife**	Known records provide an indication of the importance of the Strategic Assessment Area to a species. Using a precautionary approach, greater than 5 per cent of records in NSW was chosen as a threshold for assigning species to Category 1	This criterion was applied using post-1990 species records from the BioNet Atlas of NSW Wildlife database. Records within the Strategic Assessment Area were compared to the total number of records across NSW

* A species was allocated to Category 1 if it met any of the criteria

Wetlands of international importance (Ramsar)

There are no Ramsar Wetlands within the Plan Area. However, Towra Point Nature Reserve occurs downstream of the Plan Area and was assigned to Category 1.

World and national heritage

Any World or National Heritage places within or within the vicinity of the Plan Area were assigned to Category 1.

Commonwealth land

Any Commonwealth land within the Plan Area was assigned to Category 1.

Finalised Priority Assessment List (FPAL) matters

Any matters on FPAL that were known to occur in the Strategic Assessment Area were put into Category 1.

RESULTS

The results of the process to identify the matters requiring assessment under the SAR are presented in Chapter 28.

11.2 LANDSCAPE CONTEXT

11.2.1 LANDSCAPE CONTEXT WITHIN THE NOMINATED AREAS

PURPOSE

Section 4 of the BAM requires the BCAR to describe:

- Landscape context, including landscape features such as waterways, wetlands and habitat connectivity
- Site context, including native vegetation cover and patch size

METHOD

Native vegetation cover

Native vegetation cover was assessed within a 1,500 m buffer from the urban capable land footprint of each of the nominated areas separately, and entered into the BAM Calculator.

This approach was undertaken in accordance with Section 6.4.1.3 of the BAM and to ensure that all ECS and SCS with a native vegetation cover class requirement lower than, or equal to that of each nominated area, were considered. This ensured accurate and area specific information was used, and that no species were excluded based on a higher overall value for native vegetation cover resulting from averaging across all nominated areas.

Rivers and streams

Rivers and streams were identified in accordance with Appendix 3 of the BAM.

Wetlands

Wetlands were identified through aerial photographic interpretation (API), as well as data in the Digital Topographic Database hydro area layer (LPI, 2016) and the Directory of Important Wetlands (DoEE, 2018).

Habitat connectivity

Habitat connectivity refers to the degree of connectedness of areas of habitat. Habitat connectivity can include:

- Corridors of vegetation linking other areas of habitat
- Isolated patches of habitat that provide 'stepping stones' between other areas of habitat
- Habitat features (such as large trees with hollows) scattered within areas of non-habitat (e.g. urban land) that provide habtiat connectivity between intact areas of habitat

Habitat connectivity within the nominated areas was mapped by:

- Identifying Biodiversity Investment Opportunities Map (BIO Map) regional corridors and core areas (OEH, 2015). The BIO Map project aims to achieve better biodiversity outcomes by directing investment funding to the strategic locations of greatest benefit. BIO Map corridors/core areas are likely to be the most important areas of habitat connectivity in the nominated areas for most species. EES had only identified BIO Map corridors within the boundaries of the Cumberland subregion. To undertake the mapping for the small parts of the nominated areas outside the Cumberland subregion the Priority Conservation Lands layer (DECCW, 2010) (EES used this layer as basis for BIO Map) or the native vegetation map (see Chapter 19) was used to extend the BIO Map corridor mapping
- Identifying local corridors using the native vegetation mapping to identify connected patches of native vegetation. This was done visually in GIS, with only contiguous patches identified as being connected
- Identify any remaining native vegetation not within a regional corridor or local corridor as:
    - Connected – within 100 m of another patch of woody vegetation
    - Isolated – greater than 100 m from another patch of woody vegetation

Key areas of habitat connectivity in the nominated areas are shown in Chapter 24.

Areas of geological significance and soil hazard features

The likely locations of areas of geological significance, including cliffs, caves and escarpments, were identified on the basis of existing knowledge of senior ecologists, field investigation results, topographic and geological maps, and the following datasets:

- Geological sites of NSW (Cartoscope, 2019)
- Karst Environments of NSW (OEH, 2018c)

Soil hazard features including dryland salinity, acidification, compaction, structural breakdown, sodicity and contamination were identified on the basis of the following datasets:

- NSW soils datasets at 1:100,000 from the EES data portal
- NSW geology datasets at 1:250,000 from the Department data portal
- eSpade (OEH, 2018b)
- NSW (Mitchell) Landscapes (OEH, 2018d)
- Western Sydney Hydrogeological Landscapes (OEH, 2011)

RESULTS

The results of the landscape context analysis within the nominated areas are provided in Chapter 18.

11.2.2 LANDSCAPE CONTEXT WITHIN THE STRATEGIC ASSESSMENT AREA

PURPOSE

Clause 3 of the ToR requires the SAR to describe the nature of the environment within the Strategic Assessment Area, and other areas outside this area that may be impacted by actions taken under the Plan. This includes:

- A description of historical and current land use
- The extent and quality of native vegetation
- The nature of the environment (including ecosystem processes and threatening processes)
- A description of landscape context for key matters (including habitat connectivity, fragmentation, ecological processes)
- Consideration of environmental variation
- A map of areas that are already protected

METHOD

The nature of the environment was described through a review of relevant literature. Key source documents are referenced in Chapter 28 and included:

- The Cumberland Plain Recovery Plan (DECCW, 2011)
- Cumberland subregion BIO Map report (OEH, 2015)
- A range of technical papers on the ecology and ecological processes of the Cumberland subregion
- Relevant government policies and guidelines

Habitat connectivity within the Plan area was mapped as per the method described above for the nominated areas. Key areas of habitat connectivity in the Plan area are shown in Chapter 28.

RESULTS

The results of the landscape context analysis within the Strategic Assessment Area are provided in Chapter 28.

11.3 NATIVE VEGETATION

11.3.1 OVERALL APPROACH TO NATIVE VEGETATION MAPPING

Native vegetation maps were prepared:

- Within the nominated areas to meet the requirements of the BAM. Detailed mapping of the nominated areas was undertaken based on a combination of field surveys and API (OEH, 2013b, 2016b)
- Within the Strategic Assessment Area outside the nominated areas to meet the requirements of the ToR. Mapping of the Strategic Assessment Area was based on existing native vegetation maps

11.3.2 NATIVE VEGETATION MAPPING WITHIN THE NOMINATED AREAS

PURPOSE

Section 5 of the BAM requires the BCAR to identify and map for the nominated areas:

- Extent of native and exotic vegetation
- PCTs and TECs
- Vegetation integrity

METHOD

The native vegetation mapping in the nominated areas was undertaken:

- After reviewing existing native vegetation mapping and data gaps, with new vegetation mapping undertaken over the entire nominated areas rather than relying on existing native vegetation mapping
- Using a systematic field-based floristic vegetation survey, capturing plot based data in accordance with the BAM, with results then fed back to GIS/ecologists developing or updating the native vegetation map

Where land access was available, plot-based floristic vegetation survey was completed in a stratified manner ensuring all vegetation zones were sampled across the nominated areas and in consideration of environmental variation.

Where access was unavailable:

- Existing vegetation mapping was used in conjunction with other existing, and project derived desktop-based data to accurately map vegetation within the nominated areas
- Rapid assessment ground-truthing was undertaken if suitable vantage points in public areas allowed. At these vantage points ecologists confirmed continuity of vegetation communities and assessed broad condition state and level of habitat degradation to verify the project's vegetation mapping wherever possible

The methods used to develop the vegetation map are further described below.

Draft PCT map based on desktop analysis

A draft PCT map for each nominated area was prepared based on desktop analysis. This involved:

Step 1: Collating relevant datasets and GIS layers, including:

- Recent Nearmap imagery at 15 cm resolution
- NSW landuse polygons (OEH, 2013a)
- NSW soils datasets at 1:100,000 from the NSW Government data portal
- NSW geology datasets at 1:250,000 from the NSW Government data portal

Step 2: Processing multispectral aerial imagery into Normalised Difference Vegetation Index (NDVI) imagery

Step 3: Amalgamating previous native vegetation mapping across the nominated areas

Step 4: Combining two existing EES maps of native vegetation within the Cumberland subregion (OEH, 2013b, 2016b) into a single layer and clipping the layer to the nominated area boundaries

Step 5: Creating a canopy height model using 1 m LiDAR data (see Section 13.2 for details on the LiDAR data used)

Step 6: Processing the canopy height model into amalgamated canopy polygons for vegetation over 1 m in height (exotic vegetation only)

Step 7: Manually creating and attributing GIS polygons to accurately capture native vegetation extent, type and condition

Step 8: Compiling the data into a single GIS map for the nominated areas with 500 m by 500 m grid squares

Interpretation of Nearmap imagery, desktop analysis and refinement of existing native vegetation mapping (OEH, 2013b, 2016b) using the BioNet Vegetation Classification database (OEH, 2018a) and the ArcGIS mapping application was undertaken by botanists experienced in the survey and identification of the PCTs of the subregion. The botanists moved cell by cell through the grid within each nominated area. All vegetation polygons were created with reference to the existing native vegetation mapping and any unmapped vegetation was assessed and assigned a PCT.

Native vegetation community extent

Native vegetation community extent within the nominated areas was determined using API, existing vegetation mapping (OEH, 2013b, 2016b) and GIS analysis. All native vegetation, including native ground cover and the canopy area of trees was mapped. A rule-set was applied to ensure mapping of vegetation extent was consistent and precautionary across the mapping area. The rule-sets included:

- Map vegetation to canopy extent with a +/-2m buffer where grassland surrounds the mapped polygon
- Consider visible changes in condition and obvious changes to vegetation type (PCTs)
- Include gaps within surrounding polygons where:
    - Gaps are ≤60m wide and surrounded by intact vegetation, except where significant disturbance is evident
    - Gaps are ≤30m wide and surrounded by thinned vegetation (or partly surrounded by thinned and partly by intact), except where significant disturbance is evident
- Map scattered trees comprising mature gum trees as a single polygon where trees occur ≤60m apart and the internal area is +/- uniform grassland
- Map scattered trees comprising shrubs or scattered regrowth as separate polygons where separated by ≥10m
- Map a 30m buffer along the edges of intact and/or thinned vegetation in grassland areas that appear to have lower levels of disturbance history (i.e. these areas may comprise derived native grassland)
- Excise roads and waterbodies, but map canopy overhanging
- Map aquatic vegetation where it is contiguous with vegetation on the adjacent bank

The extent of native vegetation within the nominated areas was mapped by Biosis botanists using purpose-built GIS web apps supporting hi-definition aerial imagery, over multiple capture dates and seasons. This was done to ensure accuracy of tree canopies versus shadows, extents of more disturbed shrubby areas, and extents of dynamic wetland / swampy areas. A grid-based approach was used whereby Biosis mapping staff would systematically move through the nominated areas drawing vegetation extent polygons to accurately capture areas of vegetation, and then subsequently attribute (and/or cut) polygons with vegetation type (PCT) and condition data.

Existing vegetation mapping (OEH, 2013b, 2016b) was used as a guide, but was not relied upon to determine native vegetation cover and extant. LiDAR derived datasets including a canopy height model and digital elevation model, as well as slope and ruggedness models were also used to differentiate types of vegetation.

Native grasslands were challenging to map in areas where ground validated data could not be captured due to access restrictions. However, ground validated data on the presence of native and exotic grasslands were used as reference point by Biosis mapping staff to help determine the status of areas that lacked field data.

The final process to map areas of native grasslands (i.e. derived native grasslands) involved undertaking detailed investigation of high resolution aerial imagery, over multiple capture dates and seasons, to ascertain areas of significant ground disturbance, paddock scale historical and ongoing management practices, areas of heavy grazing and/or compaction, or discernible areas of exotic pasture, which were then ruled out from being potential native grasslands. The NSW 2017 Landuse mapping dataset was also interrogated to ascertain areas considered unlikely to support native grasslands, which included areas mapped as supporting the following land uses:

- Areas observed (or assumed) to be recently cleared under rural allowable activities
- Cropping
- Exotic areas >90% areas identified as vulnerable regulated land in relation to slope
- Grazing irrigated modified pasture
- Grazing modified pastures
- Grazing native vegetation (partly associated)
- Intensive animal production
- Irrigated perennial horticulture
- Manufacturing and industrial
- Mining
- Reservoir/dam
- Residential and farm infrastructure

- Services

Following the determination of areas of significant disturbance that do not conform to native grasslands, and any areas of exotic grasslands, the remaining grassland areas were either mapped as native vegetation (derived native grassland) or native grassland 'to be confirmed', where some doubt remained. Following the completion of the field campaign all areas of native grassland 'to be confirmed' that remained were attributed as native grassland vegetation.

To further refine the mapping of native versus exotic grasslands, multispectral imagery analysis was attempted using NDVI imagery. However, the initial results of this method did not appear to provide reliable classification of native/exotic grassland extent and this methodology was not used in the creation of the vegetation map.

Identification of Plant Community Types

All PCTs potentially present within the nominated areas were determined using the BioNet PCT identification tool and the Tozer-types PCT identification tool, as well interrogation of BioNet data and existing vegetation mapping projects (OEH, 2013b, 2016b) for vegetation communities of the Cumberland subregion.

Botanists experienced in the survey and identification of the PCTs of the Cumberland subregion attributed updated vegetation polygons that accurately represented vegetation extent with the appropriate PCTs based on consideration of landscape and location specific factors. Existing vegetation mapping was used as a basis for PCT attribution. The accuracy of the mapping was assessed and the 'best fit' PCT for each vegetation polygon was determined through:

- API of high resolution Nearmap (over multiple capture dates and seasons)
- Consideration of landform and landscape positioning
- Consideration of soil and geology mapping
- LiDAR derived datasets including canopy height model, digital elevation model and slope and ruggedness model
- All available field data including both project captured and BioNet floristic data, as well as the use of Google Street Viewer where appropriate, all with reference to BioNet data PCT descriptions and vegetation mapping PCT profiles (OEH, 2013b, 2016b; Tozer, Turner et al., 2010)

LiDAR derived datasets provided a useful tool to distinguish between PCTs, for example PCT 849 and PCT 850. The digital elevation model and slope models could be used to discern higher/steeper areas more suited to PCT 850 that were less discernible using other datasets. The canopy height model was useful in determining the presence of remnant canopy trees, or large paddock trees, and discerning these from planted trees.

All data collected in the field was analysed to determine the most suitable PCT based on floristics with all data captured being fed back to GIS mapping staff to update the native vegetation map based on ground validated data. This included rapid assessment ground-truthing surveys undertaken at the request of botanists preparing the native vegetation maps (where ground validation could provide clarity about areas of uncertainty associated with the desktop analysis).

In making use of all available desktop and field validated data the process used to map PCTs is considered appropriate for the very large scale of the project, where land access constraints prevented ground validation of much of the nominated areas. All PCTs potentially present within the nominated areas, including PCT 774, PCT 781, PCT 877 and PCT 1800 (representative of TECs with little known distributions, small or restricted spatial extents, dynamic wetter boundaries, or potentially difficult to detect using aerial imagery), were specifically considered in developing the native vegetation map, and three of these four PCTs were mapped across the subject land in the final PCT map.

It is acknowledged that there is a slight risk that these four PCTs/TECs have been under-mapped. However, the systematic and methodical approach undertaken to develop the native vegetation map, by experienced botanists, along with the ongoing reference to all best available data (including field data whenever available) is considered to sufficiently mitigate the risk of small areas not being mapped, and the even smaller risk of any small under-mapped areas occurring within urban capable land. This is considered to be the case for PCT 774, as urban capable land is not proposed in the landscape position known to support this PCT, and the PCT was not recorded during any ground validation surveys. The methodology used is appropriate for the scale of the project.

Polygons with a lower level of confidence, based on a paucity of data, or fewer distinguishing attributes suitable for splitting similar PCTs, occur in the vegetation dataset and have been attributed with a low level of confidence. Despite this, the overall confidence in the native vegetation mapping in the context of the very large scale of the project is high.

Determination of vegetation condition

A condition type for each vegetation polygon was assigned through analysis of canopy structure using LiDAR, the canopy height model, air photo interpretation of the Nearmap imagery, and the use of Google Street Viewer where appropriate. In most instances, subject to land access restrictions, this was verified in the field by collection of data in accordance with the BAM. The condition states used for each vegetation polygon were:

- **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present. This condition state was assigned during the desktop mapping to areas where the Nearmap imagery indicated significant patches of continuous canopy and the canopy height model indicated vegetation in both the upper and middle storeys
- **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
    - Wooded vegetation with a partly-cleared canopy and a more open structure compared to the intact PCT
    - Wooded vegetation that has been under scrubbed. This condition state was assigned during desktop mapping to areas where the Nearmap imagery indicated patches of notably reduced canopy density, which was typically where the canopy height model indicated canopy and visible ground only, with no discernible shrub layer or structural complexity
- **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed. This condition state was assigned during the desktop mapping to areas where the Nearmap imagery and LiDAR canopy polygons indicated one or a few likely native trees surrounded by cleared land
- **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands. Areas of potential derived native grassland (DNG) were identified from the Nearmap imagery and later verified or reclassified in the field. Grasslands were considered to be DNG where they had a vegetation integrity score of greater than or equal to 15 (based on data collected in the field). Where grasslands were dominated by exotic species and the vegetation integrity score was less than 15, these were considered to be 'non-offsettable grasslands' (NOG)
- **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species. This condition type was also used to map areas of exotic vegetation

In determining vegetation condition in accordance with these definitions for each vegetation polygon, a rule-set was considered to ensure this work was consistent and precautionary across the mapping area. This included:

- Using all available data sources when considering PCTs; existing mapping, soils layer, geology layer, LiDAR derived layers, watercourses, slope/topography, aspect, mapping profiles, etc
- Assigning vegetation to the intact condition category where there was any uncertainty about whether a polygon in thinned condition could be in the higher condition category
- Consideration of the expected density of tree and shrub layers for each PCT when assigning condition and considering evidence for disturbance. For example, PCT 849 in intact condition may regularly have gaps in vegetation layers whereas this is less likely for PCT 1395
- Including confidence level fields in the data and providing regular feedback to botanists about low confidence areas that would benefit from field verification

Final draft PCT maps

Draft PCT maps were made available online to the ecologists in the field to allow an ongoing process of field verification and refinement. Ecologists undertook rapid assessment ground-truthing and amended the PCTs and/or condition states assigned during the desktop analysis. Amendments were recorded in the field using Collector for ArcGIS and later cross checked with field data.

Final draft maps were used to determine the number of plot-based survey sites required to be surveyed to meet BAM requirements. As plots were surveyed, the number of plots required for each PCT and condition state (in Section 5.3.4 of the BAM) was reviewed and the vegetation mapping was updated to develop a final PCT map for each nominated area.

BAM plot data was analysed to update the vegetation map. BAM plot floristics were assessed to determine whether the correct PCT and vegetation condition had been attributed during the desktop mapping process.

This process involved analysis of the floristic composition using both the BioNet (PCT ID tools) as well as 'Tozer tool' spreadsheets to determine to the 95% confidence interval (where sufficient data was available) for the 'best fit' PCT based on the profile data provided in Tozer and Turner et al. (2010).

Condition was tested by analysing the floristic structure and composition of each plot, and comparing it to what would be considered to be an 'Intact', 'Thinned', 'Scattered Trees' condition example of the determined PCT. BAM VI scores were not used to attribute vegetation condition, this was done through analysis of the raw floristic data.

Floristic plot surveys

A stratified field survey was designed to verify and identify PCTs within the nominated areas, including:

- PCT and condition state
- Environmental variation
- Gaps in existing mapping and site data

Plot surveys were undertaken in accordance with the requirements of the BAM by accredited assessors and ecologists considering environmental variation and in a stratified manner, where land access was permitted allowed.

The number of plots surveyed for each PCT and vegetation zone within the nominated areas are shown in Table 11-5.

Plot surveys were undertaken during the period February 2018 to March 2019 with an additional few plots undertaken in October 2021 (due to development footprint changes through the life of project). Where land access was unavailable, existing vegetation mapping was used in conjunction with available desk-based data and rapid assessment ground-truthing to verify or alter existing vegetation mapping.

Plot data was collected from a 20 m x 20 m plot to capture:

- Species presence (by scientific name and any relevant common name)
- Stratum and layer in which each species occurs
- Growth form of each species (as per the BAM)
- Percent foliage cover
- Abundance count (as per the BAM)

The PCT at each plot location was assigned in the field and later verified by assessing several attributes including soil type, landscape position, diagnostic species and community structure. Floristic data collected from the plot surveys was analysed to identify PCT to the best match using the BioNet PCT identification tool.

The PCT results obtained from the identification tool were then checked by a senior ecologist for any discrepancies and a final PCT was allocated to the plot and to the broader vegetation community polygon.

The vegetation maps were continually updated throughout this process.

Plot data collected during previous surveys in accordance with the previous BioBanking Assessment Method (BBAM) was also used to supplement plot data collected in accordance with the BAM. Additional data was collected to supplement the BBAM data in order to meet BAM requirements, including:

- Tree stem count
- 1 x 1 metre plots (litter, bare ground, cryptogram and rock cover)
- High threat weed cover
- Updated growth forms

Vegetation integrity assessment

Vegetation zones

Areas of each PCT in different broad condition states were stratified into separate vegetation zones. Derived grasslands were assessed against the benchmark data for the original, or likely original PCT, and included as a separate vegetation

zone. Non-offsettable Grasslands were also included as a separate vegetation zone. A map of vegetation zones was prepared by GIS consultants using the final native vegetation map.

To ensure consistency of data across the assessment area and to prevent over-complicating the assessment approach and data collection requirements, vegetation zones were not broken down by nominated area. For example, vegetation zone 849 (thinned) occurs across all four nominated areas, and all data collected from within that zone has been pooled to determine the vegetation integrity score, independent of where each plot was collected.

This approach ensured that an accurate and consistent landscape scale vegetation integrity assessment for each vegetation zone was undertaken, which is considered the most suitable approach for an assessment of this scale.

Patch size

The patch size of each vegetation zone was assigned using GIS based on the final native vegetation map as follows:

- Vegetation zones were assigned to the same patch where they were located within 100 m of each other for intact native woody vegetation and within 30 m of each other for intact native non-woody vegetation
- Any intact native vegetation that adjoined vegetation zones beyond the nominated areas was included
- Each patch was digitised, and separate polygons were mapped where multiple patches existed
- The area of each patch in hectares was calculated

Site condition

For each vegetation zone identified within the urban capable land or major transport corridors, a quantitative measure of composition, structure and function was determined through plot and transect surveys in accordance with the BAM.

Table 11-4 shows the attribute data collected.

Table 11-4: Site condition attributes

Growth form groups to assess composition and structure	Attributes to assess function
Tree	Number of large trees
Shrub	Tree regeneration
Grass and grass like	Tree stem size class
Forb	Total length of fallen logs
Fern	Litter cover
Other	High threat exotic vegetation cover
	Hollow-bearing trees

Vegetation integrity plot surveys

For this Assessment Report, the plots used for floristic survey were also used to assess vegetation integrity. Plots and transects were established to provide a representative assessment of the vegetation integrity of the vegetation zone. Plots were undertaken on properties where land access was available, which resulted in a number of plots being collected in patches of vegetation outside the urban capable land or major transport corridors of the nominated areas. All plots were collected within vegetation contiguous with the urban capable land or major transport corridors within the nominated areas, and within vegetation mapped specifically for this assessment.

Plots were randomly located within each vegetation patch using the following method:

- PCT vegetation polygons identified based on the desktop native vegetation mapping were verified in the field to confirm or revise PCT and/or extent
- Locations of BAM plots were determined with the aim of capturing the representative condition of the PCT within the zone, avoiding bias wherever possible
- Ecotones, vehicle tracks and their edges, or other disturbed areas that are readily distinguishable from the broad condition state of the vegetation zone were avoided

- In large patches, the orientation of transects were randomly assigned by throwing an object flagged with tape into the patch of vegetation, the direction that the tape pointed following landing was assigned the plot orientation
- In smaller patches of vegetation, particularly narrow, linear strips, the location of plots was determined based on capturing a representative sample of the patch, avoiding edge areas where possible

The floristic survey plots were 10 m either side of the first 20 m of the transect line (nested within the larger 0.1 ha quadrat).

The following data were collected from the plots and transects:

- 20 m x 20 m plot: floristic data (composition and structure) attributes listed in Table 11-4
- 20 m x 50 m plot: function attributes listed in Table 11-4 (except litter cover)
- Five 1 m x 1m sub-plots: average litter cover

A minimum of 131 plots are required for the assessment, with 251 plots completed across the 31 vegetation zones assessed. Table 11-5 shows the number of plots/transects required to be surveyed to meet BAM requirements for each vegetation zone, and the number of plots and/transects completed for this Assessment Report.

Plot data was supplemented in some cases with data collected previously for other projects in accordance with the Biobanking Assessment Methodology (BBAM). This was done by using BBAM floristic plot data and collecting BAM function attribute data at the locations of previous BBAM plots to supplement this floristic data.

This was largely only used to add to the number of plots collected across the nominated areas rather than to meet minimum plot requirements under BAM. A total of 53 BBAM plots collected across Wilton were upgraded to BAM plots and used to supplement data for PCTs 849 and 1395 across all vegetation zones. However, all of these vegetation zones, with the exception of PCT 1395 Scattered Trees and PCT 1395 Non-offsettable Grassland, would meet the minimum required number of plots under BAM without the use of these additional BBAM plots.

Of the 5 plots collected within PCT 1395 Scattered Trees, 3 were upgraded BBAM plots, with the minimum number of plots required being 4. Of the 9 plots collected within PCT 1395 Non-offsettable Grassland, 3 were upgraded BBAM plots, with the minimum number of plots required for impacts being 7.

Attachment D provides additional detail about the number and location of BAM plots collected during field work, including a breakdown of plots by nominated area and land category (urban capable land, major transport corridors, or non-certified land outside the development footprints). Information is also provided on PCT and vegetation zones, what plots were used to calculate vegetation integrity, and what plots were supplemented by use of BBAM data.

Table 11-5: Number of plots surveyed for each PCT and vegetation zone within the nominated areas

PCT	State	Total impact area (ha)	Minimum plots required	Total plots completed
724	Intact	7.2	3	4
	Thinned	75.3	5	5
	Scattered Trees	25.7	4	4
725	Intact	16.0	3	3
	Thinned	18.7	3	7
	Scattered Trees	2.9	2	2
781	Thinned	4.2	2	4
830	Intact	0.04	1	1
	Thinned	0.01	1	2
835	Intact	13.9	3	3
	Thinned	150.0	6	6
	Scattered Trees	22.1	4	6

PCT	State	Total impact area (ha)	Minimum plots required	Total plots completed
	Non-offsettable Grassland	1201.3	8	8
849	Intact	27.5	4	9
	Thinned	301.7	7	18
	Scattered Trees	120.6	6	12
	DNG	227.4	6	16
	Non-offsettable Grassland	5343.1	8	18
850	Intact	4.0	2	9
	Thinned	43.63	4	6
	Scattered Trees	11.52	3	4
	DNG	195.15	6	6
	Non-offsettable Grassland	704.9	7	9
1395	Intact	45.7	4	16
	Thinned	145.6	6	30
	Scattered Trees	41.0	4	5
	DNG	227.49	6	15
	Non-offsettable Grassland	793.5	7	9
1800	Intact	0.7	1	4
	Thinned	24.0	4	8
	Scattered Trees	1.55	1	2
		Total	**131**	**251**

Final PCT map and updates to native vegetation mapping following public consultation

Following completion of field work the native vegetation map was finalised in consideration of all floristic data collected in the field and prior to public submission of the draft Assessment Report.

Native vegetation map was then updated following public consultation. The mapping was updated where landholders provided evidence in submissions as part of the public consultation process to support changes to the mapped vegetation on their properties. The process for updating mapping involved:

- Reviewing submissions and undertaking further analysis of the evidence provided in the submission(s) and the data used by the consulting team to create the mapping where changes to mapping had been requested
- Where sites were not visited on ground by the project team and clear evidence was provided by a BAM Accredited Assessor in the submission, these changes were accepted and the mapping was updated

There were circumstances where the geometry of vegetation mapping (polygons) provided via public submissions and based on field-validated mapping were different. In these circumstances, the geometry of the field-validated mapping was accepted and the mapping updated if prepared by a BAM Accredited Assessor.

Where there was a challenge to the mapping that had been based on field-validated data, a comparison of the data collected by the consulting team was undertaken where the data provided in the submission was field-validated by a BAM Accredited Assessor. The data considered best fit was applied, and the mapping updated where necessary.

RESULTS

The native vegetation maps of the nominated areas, including plot locations relative to vegetation zones, are provided in Chapter 19.

11.3.3 NATIVE VEGETATION MAPPING ACROSS THE BROADER STRATEGIC ASSESSMENT AREA

PURPOSE

Clause 3 of the ToR requires the SAR to describe the nature of the environment within the Strategic Assessment Area. This includes the extent and quality of native vegetation.

METHOD

The approach to identify and map native vegetation across the broader Strategic Assessment Area involved the following steps.

Step 1: Collating the most recent and highest resolution existing native vegetation mapping data relevant to the Cumberland subregion. This data included:

- Native Vegetation of the Sydney Metropolitan Area Version 3.0 (OEH, 2016b)
- Remnant Vegetation of the Western Cumberland subregion, 2013 Update (OEH, 2013b)
- Native Vegetation of Southeast NSW (Tozer, Turner et al., 2010)
- Biometric Vegetation Compilation for the South East Local Land Services Region (Eco Logical Australia, 2015)

Step 2: Merging the data into a single native vegetation data layer for the Cumberland subregion using GIS and clipping the data to the Cumberland subregion boundary

Step 3: Incorporating the updated the native vegetation maps for the nominated areas into the single native vegetation data layer for the parts of the Cumberland subregion within the nominated areas

Step 4: Reviewing vegetation condition or disturbance data held within the attributes the existing mapping data (Step 1) and updating this data to align with the condition types used for the nominated areas (see Section 11.3.2)

Step 5: Where condition data was unavailable in the existing mapping data, undertaking a desktop assessment of the vegetation polygons and determining condition based on patch size, connectivity and edge impacts. This was only required for the Tozer et al (2010) and Eco Logical Australia (2015) data layers

RESULTS

The native vegetation maps of the nominated areas are provided in Chapter 19.

11.4 THREATENED ECOLOGICAL COMMUNITIES

11.4.1 OVERALL APPROACH TO TEC MAPPING

To meet the requirements of the BAM and the ToR, TEC maps have been prepared for all:

- NSW-listed TECs (see Section 11.1.1) within the nominated areas
- Commonwealth-listed Category 1 TECs (see Section 11.1.2) within the Strategic Assessment Area

TECs were mapped based on associations between PCTs and TECs and rule-sets applied to these associations to refine the maps based on TEC definitions. Separate rule-sets were applied to NSW-listed TECs and Commonwealth-listed Category 1 TECs because of the typically different definitions of each TEC under the BC Act and EPBC Act.

Table 11-6 summarises the mapping approaches within and outside the nominated areas for NSW-listed TECs and Commonwealth-listed Category 1 TECs.

Table 11-6: Summary of mapping approaches for NSW- and Commonwealth-listed TECs

TECs	Mapping area	Mapping method
NSW-listed TECs	Nominated areas	Simple rule set specific to NSW-listed TECs applied to updated native vegetation maps of the nominated areas (see Section 11.3). The rule set applied PCT associations to map NSW-listed TECs and in some cases addressed the condition of the TEC by removing areas of non-offsettable grasslands from the TEC (see Table 11-7)
Commonwealth-listed Category 1 TECs	Strategic Assessment Area	Rule set specific to Commonwealth-listed TECs applied to: • Within the nominated areas – updated native vegetation maps of the nominated areas (see Section 11.3) • Outside the nominated areas – existing native vegetation maps of the Cumberland subregion (see Section 11.3)

11.4.2 NSW-LISTED TECS

PURPOSE

Section 5 of the BAM requires the BCAR to:

- Identify any TECs that are associated with PCTs, or the most likely PCT
- Map the extent of TECs

METHOD

The method to identify and map NSW-listed TECs within the nominated areas was based on the following steps.

Step 1: The updated native vegetation map (see Section 11.3) was used to identify areas of potential TECs on the basis of associations between PCTs and TECs and the rule set in Table 11-7

Step 2: A draft map showing candidate TECs was created by GIS consultants on the basis of Step 1

Step 3: Plots were surveyed in the field within and outside potential TEC areas. The plot data were cross checked by ecologists with the definition of TECs using the BioNet PCT identification tool and against final determinations by the NSW Scientific Committee, to confirm that the specific criteria as shown in Table 11-7 were met for the TEC at that location. Where no field survey of a potential TEC was possible, the TEC was assumed to be present at that location

Step 4: Draft TEC maps for the nominated areas were developed and a report on the method and field verification was prepared for consultation and review by regulators

Step 5: The method and rule set were amended based on feedback from regulators. Final TEC maps for the nominated areas were prepared based on the updated method and rule-set and final native vegetation maps. Table 11-7 shows the rule set developed for mapping NSW TECs

GRASSLAND TECS

Where derived native grasslands form part of a TEC listing all such vegetation zones were mapped as the relevant TECs. Where grasslands were assessed as potentially supporting a native component, but were not determined as derived native grasslands, they were not considered to form part of the relevant TEC. These vegetation zones were deemed 'non-offsettable grasslands' and floristic plot data was collected in accordance with the BAM to determine the associated vegetation integrity score. In each case, the vegetation integrity score was found to be less than 15, which is lower than the minimum score required to offset a TEC in accordance with the BAM (Section 10.3). Non-offsettable grasslands with a vegetation integrity score of less than 15 were not considered to form part of a TEC as the vegetation is considered so degraded it no longer meets the minimum requirements for the TEC or requires any offsetting.

Table 11-7: Rule set for mapping NSW listed TECs within the nominated areas

PCT	NSW TEC	Condition state	Specific criteria – field verification
724 Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	*Shale Gravel Transition Forest in the Sydney Basin Bioregion*	All	Species composition, elevation, soils and landscape position met based on final determinations of the NSW Scientific Committee
725 Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	*Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	All	
781 Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	*Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*	All	
830 Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*Moist Shale Woodland in the Sydney Basin Bioregion*	All	
835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	*River-flat Eucalypt Forest in the Sydney Basin Bioregion*	All except non-offsettable grasslands	
849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	*Cumberland Plain Woodland in the Sydney Basin Bioregion*	All except non-offsettable grasslands	
850 Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*Cumberland Plain Woodland in the Sydney Basin Bioregion*	All except non-offsettable grasslands	
877 Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion	*Western Sydney Dry Rainforest in the Sydney Basin Bioregion*	All	
883 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	*Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion*	All	
1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*	All except non-offsettable grasslands	

PCT	NSW TEC	Condition state	Specific criteria – field verification
1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	All	

11.4.3 COMMONWEALTH-LISTED TECS

PURPOSE

Section 3.1 and 3.2 of the Terms of Reference requires the SAR to:

- Describe the nature of the environment within the Strategic Assessment Area, and other areas outside the Strategic Assessment Area that may be impacted by actions taken under the Plan. This must include the extent and quality of native vegetation, including mapping of Commonwealth-listed TECs
- Identify and describe each protected matter that may be impacted directly, indirectly and cumulatively by actions taken under the Plan, including:
    - Key sites
    - Condition, including seasonal and annual variability, and likelihood to alter over time

IDENTIFYING POTENTIALLY RELEVANT COMMONWEALTH TECS

Commonwealth TECs potentially present in the Strategic Assessment Area (see Table 11-8) were identified based on:

- The Australian Government's Protected Matters Search Tool
- Existing native vegetation mapping for the Cumberland Plain (OEH, 2013b, 2016b)
- Detailed native vegetation mapping undertaken within the nominated areas for this project

Table 11-8: EPBC Act TECs potentially relevant to the Plan

Commonwealth TEC	Commonwealth status
Blue Gum High Forest of the Sydney Basin Bioregion	CE
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	E
Coastal Swamp Oak (Casuarina glauca) Forest of NSW and South East Queensland ecological community	E
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CE
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	CE
River-flat Eucalypt Forest on Coastal Floodplains of southern NSW and eastern Victoria	CE
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	CE
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	CE
Western Sydney Dry Rainforest and Moist Woodland on Shale	CE

The general relationship between these TECs and PCTs is set out in Table 11-9.

Table 11-9: General relationship between Commonwealth TECs and PCTs

EPBC TECs	Associated PCTs	General relationship
Blue Gum High Forest in the Sydney Basin Bioregion	1237 Sydney Blue Gum – Blackbutt – Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	883 Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)

EPBC TECs	Associated PCTs	General relationship
	958 Narrow-leaved Apple – Hard-leaved Scribbly Gum heathy woodland on sand at Agnes Banks, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland	1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	PCT is largely equivalent to Commonwealth TEC (VIS database)
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	725 Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	724 Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
	849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
	850 Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	774 Coast Banksia scrub on sand in the Elderslie area, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	PCT is equivalent to Commonwealth TEC (VIS database)
	1281 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	PCT partially contains Commonwealth TEC (VIS database
Turpentine–Ironbark Forest of the Sydney Basin Bioregion	1281 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	PCT is largely equivalent to Commonwealth TEC (VIS database)
	1284 Turpentine - Smooth-barked Apple moist shrubby forest of the lower Blue Mountains, Sydney Basin Bioregion	PCT partially contains Commonwealth TEC (VIS database
Western Sydney Dry Rainforest and Moist Woodland on Shale	830 Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	PCT is largely equivalent to Commonwealth TEC (VIS database)

EPBC TECs	Associated PCTs	General relationship
	877 Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion	PCT partially contains Commonwealth TEC (VIS database)

COMMONWEALTH TEC MAPPING METHOD

Within the nominated areas

The approach to identify and map Commonwealth-listed TECs within the nominated areas was broadly similar to the approach used to map NSW-listed TECs, but involved a number of additional steps which reflected the typically different listing definitions of the TECs. The approach involved:

Step 1: The updated native vegetation map (see Section 11.3) was used to identify areas of potential TECs on the basis of associations between PCTs and TECs (see Table 11-9)

Step 2: Rapid assessment ground-truthing was undertaken to contribute to the reliability of the desktop process. GIS consultants used this data to assist with assigning condition classes to the PCTs within the nominated areas

Step 3: PCTs were correlated with potential TEC types. Once the vegetation maps were updated, the PCTs were selected for further assessment against the EPBC TEC criteria

Step 4: To account for potential occurrence of DNG around treed patches of PCTs, polygons were buffered by 30 m and overlapping buffers were merged into single polygons

Step 5: A patch size was attributed to each polygon and distribution criteria for each potential TEC were applied to the polygons. Table 11-10 shows the distribution criteria and patch size criteria for each TEC with potential to occur within the nominated areas. Where a polygon did not meet the criteria, it was not considered further as an area of TEC

Step 6: Projected Foliage Cover (PFC) as assessed (where relevant to the TEC threshold criteria (see Table 11-10) and polygons not meeting the criteria were removed. This was done by:

- Reclassifying the canopy height model raster (derived from 1 metre LiDAR point cloud) to select vegetation pixels over 15 m tall to represent canopy trees
- Calculating the number of 1 m x 1 m tree pixels in each contiguous patch of vegetation
- Calculating the per cent canopy coverage by dividing the area covered by tree pixels by the total area of the polygons and multiplying by 100
- Calculating PFC by multiplying the per cent canopy coverage by 0.5
- Removing polygons that fell below the criteria for the TEC

Step 7: Where a TEC included elevation criteria, this was applied and polygons not meeting the criteria were removed. This was done by calculating the maximum elevation for each vegetation polygon (derived from 1 m LiDAR point cloud) and removing areas that fell outside the elevation threshold criteria

Step 8: Candidate TEC polygons were mapped. If a vegetation polygon satisfied the conditions in Steps 3-7, it was mapped as a 'candidate' TEC polygon, and Step 9 or Step 10 were undertaken to further classify the PCT

Step 9: Where plot data was available in a candidate TEC polygon, condition class criteria were applied to determine if the polygon met the definition of the TEC. The following steps were undertaken as part of this process:

- BAM plot data points were joined to TEC candidate polygons
- Condition class criteria for respective TECs were applied
- For polygons achieving all criteria, they were assigned to the respective TEC as 'known'
- For all other candidate polygons that did not meet the condition class criteria, they were removed from being considered a TEC

Step 10: Where plot data was not available in a candidate TEC polygon, they were categorised into 'high', 'moderate' or 'low' potential EPBC TEC based on the following parameters:

- High potential TEC – Intact veg with a patch size > 10 ha
- Moderate potential TEC – All veg conditions with a patch size > 1 ha
- Low potential TEC – All veg conditions with a patch size between 0.5-1 ha

Table 11-10 shows the rule set developed for identifying Commonwealth TECs.

Outside the nominated areas

The approach for TEC mapping outside the nominated areas within the Strategic Assessment Area used additional mapping sources and did not apply detailed criteria to the mapping models.

The approach involved:

Step 1: Potential areas of the TEC were identified from existing native vegetation maps. This involved:

- Combining the Cumberland Plain West vegetation mapping with SMCMA vegetation mapping into a single layer and clipping it to the Cumberland subregion
- Correlating PCTs with potential TEC types

Step 2: Distribution and patch size class criteria were applied. A patch size was attributed to each potential TEC polygon and polygons were filtered for distribution criteria. Where a polygon did not meet the criteria, it was not considered further as an area of TEC

Step 3: Condition class criteria were applied. This involved selecting potential TEC polygons for further consideration by sorting for the following condition classes in the vegetation mapping (OEH, 2013b, 2016b): A and B, and Low and Moderate condition classes respectively. These condition classes are the only ones considered likely to meet EPBC condition class criteria. This step was undertaken by GIS consultants

Step 4: Candidate TEC polygons were mapped. If a vegetation polygon satisfied the conditions in Step 3, it was mapped as a candidate TEC polygon. The candidates were based on the following parameters:

- High potential TEC – Intact veg with a patch size > 10 ha
- Moderate potential TEC – All veg conditions with a patch size > 1 ha
- Low potential TEC – All veg conditions with a patch size between 0.5-1 ha
- Not TEC

Justification of method

The mapping of Commonwealth-listed TECs is particularly challenging at the scale of the Strategic Assessment Area. It poses greater challenges to the mapping of NSW-listed TECs as Commonwealth-listed TECs are subject to additional key diagnostic characteristics and condition thresholds identified in conservation or listing advices that determine whether a patch of vegetation comprises the TEC. These criteria aim to focus protection on the most valuable patches, and generally exclude highly degraded patches of less value (DEWHA, 2009a). The method for mapping Commonwealth-listed TECs aimed to ensure these criteria were considered to the greatest extent possible with the data available.

Several criteria in the conservation or listing advices can be assessed through desktop methods using data such as high definition aerial imagery and LiDAR, as well as GIS tools. However, this process is limited by the accuracy of the input data, including the underlying vegetation mapping. The limitations of the vegetation mapping that underpins the Commonwealth-listed TEC mapping within the nominated areas is summarised in Chapter 13.

Within the nominated areas the vegetation mapping is considered to be reasonably accurate, as mapping was undertaken based on detailed desktop analysis as well as on-ground validation (see section 11.3).

Outside the nominated areas, the mapping is based on vegetation modelling and has not undergone the same degree of validation. In these areas, the process to determine candidate TEC polygons was subject to several assumptions and limitations relating to the accuracy of the vegetation mapping, the age of the LiDAR data, and the angle and aspect of the

aerial imagery used. These limitations were addressed where possible by testing the models that generated the TEC mapping based on desktop validation and making iterative updates to the models.

Other criteria in the conservation or listing advices relating to the condition or floristic composition and structure of the patch, can only be accurately determined from on-ground surveys. Where surveys were undertaken, this data was used to provide an accurate determination about whether a patch comprised a TEC. However, due to the large size of the Strategic Assessment Area and limited land access, many candidate TEC patches could not be validated on-ground. To address this limitation, assumptions about the condition of a patch were made at a desktop level based on the size of the patch, its likely resilience to degradation, and its likelihood of being edge effected.

To address the lack of certainty around patches of candidate TEC that could not be validated through on-ground surveys, all non-validated candidate TEC patches were assigned to a category reflecting the potential of the patch to comprise the TEC. This was based on the assumption that larger and better condition patches of vegetation that have satisfied the criteria for Steps 3 to 7 are more likely to meet the listing criteria for the TEC. This step was undertaken to provide transparency around the level of certainty in the TEC mapping and to provide the highest level of assurance possible around the potential impacts of the project on Commonwealth-listed TECs. For the purposes of the assessment all 'known', 'high potential', 'moderate potential and 'low potential' polygons were considered to be the TEC.

It is important to note that the peer review (see Section 10.4) concluded that the Commonwealth-listed TEC mapping method is generally conservative and likely to over-predict the distribution of TECs in the Strategic Assessment Area.

RESULTS

Nine of the ten potentially relevant TECs were determined to be present in the Strategic Assessment Area. *Blue Gum High Forest in the Sydney Basin Bioregion* was found not to be present and was not assessed further.

The results of the mapping for Commonwealth-listed TECs are provided in Chapter 31.

Table 11-10: Rule set for mapping Commonwealth-listed TECs within the nominated areas

PCT no.	Commonwealth TEC	Distribution/ patch size class criteria (See Step 5 of the mapping method within the nominated areas)	Specific condition class criteria (See Steps 6 and 7 of the mapping method within the nominated areas)
883 958	*Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion*	Patch size ≥ 0.5 ha AND greater than 30 per cent (and less than 50 per cent) of the perennial understorey vegetation cover is made up of native species (field verification) AND the patch is contiguous with a native vegetation remnant > 1 ha in area AND Growing on tertiary sands and gravels of the Hawkesbury-Nepean river system	Greater than (or equal to) 50 per cent of the perennial understorey vegetation cover is made up of native species A low woodland, with canopy species reaching an average 15 m in height, but with some trees growing to around 20 m
		Patch size ≥ 0.5 ha AND Greater than (or equal to) 50 per cent of the perennial understorey vegetation cover is made up of native species (field verification) AND Patch is contiguous with a native vegetation remnant > 1 ha in area AND Elevations below 80 m AND Growing on tertiary sands and gravels of the Hawkesbury-Nepean river system AND greater than 30 per cent (and less than 50 per cent) of the perennial understorey vegetation cover is made up of native species	A low woodland, with canopy species reaching an average 15 m in height, but with some trees growing to around 20 m
1800	*Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*	Patch size ≥ 5 ha OR Patch size at least 2 ha and < 5 ha OR Patch is at least 0.5 ha and < 2 ha and is connected to a larger area of native vegetation of at least 5 ha AND Non-native species comprise less than 20 per cent of total understorey vegetation cover	Non-native species comprise less than 50 per cent of total understorey vegetation cover
		Patch size ≥ 5 ha OR Patch size at least 2 ha and < 5 ha OR Patch is at least 0.5 ha and < 2 ha and is connected to a larger area of native vegetation of at least 5 ha AND Non-native species comprise less than 50 per cent of total understorey vegetation cover	Non-native species comprise less than 50 per cent of total understorey vegetation cover AND transformer species* comprise less than 30 per cent of total understorey vegetation cover

PCT no.	Commonwealth TEC	Distribution/ patch size class criteria (See Step 5 of the mapping method within the nominated areas)	Specific condition class criteria (See Steps 6 and 7 of the mapping method within the nominated areas)
725	*Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	Patch size greater than or equal to 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone 150° 51′ 38″E) AND Greater than or equal to 30 per cent of the perennial understorey vegetation cover is made up of native species (field verification) AND Below 100 m elevation AND Rainfall 800-1000 mm pa AND Growing on Clay rich soils derived from tertiary alluvium and on Wianamatta derived shale soils found next to tertiary alluvium AND the patch is contiguous with a native vegetation remnant > 1ha OR the patch has at least one tree with hollows or at least one large locally indigenous tree (> 80 cm diameter at breast height) (field verification)	Greater than or equal to 50 per cent of the perennial understorey vegetation cover is made up of native species
		Patch size ≥ 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone 150 51′ 38″E) AND Greater than or equal to 50 per cent of the perennial understorey vegetation cover is made up of native species (field verification) AND Below 100 m elevation AND Rainfall 800-1000 mm pa AND Growing on clay rich soils derived from tertiary alluvium and on Wianamatta derived shale soils found next to tertiary alluvium	Consistent canopy, mid and ground strata layers in accordance with the listing advice species composition Greater than or equal to 30 per cent of the perennial understorey vegetation cover is made up of native species Where patch is not contiguous with a native vegetation remnant >1 ha, patch must have one tree with hollows or at least one large locally indigenous tree (>80 cm diameter at breast height)
724 849 850	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*	Patch size ≥ 0.5 ha AND > 50 per cent perennial understorey vegetation made up of natives (field verification) OR patch size ≥ 5 ha AND > 30 per cent perennial understorey made up of natives (field verification) AND Below 350 m elevation AND Growing on clay soils derived from Wianamatta	Canopy cover greater than 10 per cent For patches greater than 0.5 ha native understorey cover is greater than 50 per cent OR for patches greater than 5 ha, native understorey cover is greater than 30 per cent

PCT no.	Commonwealth TEC	Distribution/ patch size class criteria (See Step 5 of the mapping method within the nominated areas)	Specific condition class criteria (See Steps 6 and 7 of the mapping method within the nominated areas)
		Patch size ≥ 0.5 ha AND > 30 per cent native understorey (field verification) AND is contiguous with a native vegetation remnant ≥ 5 ha OR patch size ≥ 0.5 ha AND > 30 per cent perennial understorey vegetation made up of natives AND the patch has at least one tree with hollows per ha or at least one large tree (≥ 80 centimetre diameter at breast height) per ha (field verification). AND Below 350 m elevation AND Growing on clay soils derived from Wianamatta	Native understorey cover is greater than 30 per cent AND/OR at least one tree with at least one tree with hollow per ha or at least one large tree (≥ 80 centimetre diameter at breast height) per ha Consistent canopy, and either mid and/or ground strata layers in accordance with the listing advice species composition
774	*Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion*	Due to the very small size of patches and extent remaining and the nature of the threats, condition thresholds have not been applied to the Elderslie Banksia Scrub Forest ecological community. All remaining patches are considered critical to the survival of this ecological community (DAWE, 2020).	Based on the adjacent advice from the TEC's Conservation Advice no specific criteria have been used to map the occurrence of this community. The presence of the TEC has been mapped based on the presence of PCT 774 only.
835	*River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria*	Patch size ≥ 0.5 ha and not within a larger area of native vegetation' ≥5ha AND > 50 per cent perennial native understorey AND > 6 native ground cover species present AND > 10 large trees per hectare OR Patch size is ≥ 0.5ha is within a larger area of native vegetation ≥ 5ha OR patch size is > 2ha AND > 30 per cent perennial native understorey AND > 4 native ground cover species present	Native understorey cover is greater than 30 per cent (dependent on size of patch) AND/OR at least one tree with at least one large tree per plot AND/OR at least 4 native ground cover species present per plot (dependent on size of patch) Consistent canopy, and either mid and/or ground strata layers in accordance with the listing advice species composition

PCT no.	Commonwealth TEC	Distribution/ patch size class criteria (See Step 5 of the mapping method within the nominated areas)	Specific condition class criteria (See Steps 6 and 7 of the mapping method within the nominated areas)
1395 1281	*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*	Patch size ≥ 0.5 ha AND > 50 per cent of the perennial understorey vegetation cover is made up of native species (field verification) OR patch size ≥ 2 ha AND > 50 per cent of the perennial understorey vegetation cover is made up of native species (field verification) AND Rainfall 800-1100 mm pa AND Growing on Shale or sandstone soil substrates	Consistent canopy, mid and ground strata layers in accordance with the listing advice species composition Where patch size is 0.5–2 ha, native understorey cover is greater than 70 per cent OR where patch size is greater than 2 ha, native understorey cover is greater than 50 per cent
		Patch size ≥ 0.5 ha AND > 30 per cent perennial understorey vegetation made up of natives AND the patch has at least one tree with hollows per ha or at least one large tree (≥ 80 centimetre diameter at breast height) per ha OR the patch is contiguous with a native vegetation remnant ≥ 1 ha (field verification) OR patch size ≥ 0.5 ha and > 50 per cent perennial understorey vegetation made up of natives (field verification) AND Rainfall 800-1100 mm pa AND Growing on Shale or sandstone soil substrates Some areas of regrowth intact woodland	Where patch size is greater than 0.5 ha, native understorey cover is greater than 50 per cent OR where patch size is greater than 0.5 ha, native understorey cover is greater than 30 per cent and patch is not contiguous with another remnant greater than 1ha, at least one tree with hollows per ha or at least one large tree (≥ 80 cm diameter at breast height) per ha
830 877	*Western Sydney Dry Rainforest and Moist Woodland on Shale*	Patch size ≥ 0.1 ha AND at least 20 native species present in sample 0.04 ha plot AND non-native perennial plants no more than 50 per cent of total vegetation cover (field verification) AND Below 300 m elevation AND Growing on clay soils derived from Wianamatta	At least 20 native species present in sample 0.04 ha plot AND non-native perennial plants no more than 50 per cent of total vegetation cover

Table 11-11: Rule set for mapping Commonwealth-listed TECs outside the nominated areas

PCT no.	Commonwealth TEC	Condition Class	Distribution criteria – GIS
1237	*Blue Gum High Forest in the Sydney Basin Bioregion*	A or B Low and moderate	Patch size > 1 ha
			Patch size > 1 ha AND occurs in areas of native vegetation in excess of 5 ha
883 958	*Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion*	A or B Low and moderate	Patch size ≥ 0.5 ha AND Patch is contiguous with a native vegetation remnant > 1 ha in area
			Patch size ≥ 0.5 ha AND the patch is contiguous with a native vegetation remnant > 1 ha in area
1800	*Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*	A or B Low and moderate	Patch size ≥ 5 ha OR Patch size at least 2 ha and < 5 ha OR Patch is at least 0.5 ha and < 2 ha and is connected to a larger area of native vegetation of at least 5 ha
725	*Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	A or B Low and moderate	Patch size ≥ 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone (150◎ 51′ 38″E))
			Patch size greater than or equal to 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone (150° 51′ 38″E)) AND the patch is contiguous with a native vegetation remnant > 1ha OR the patch has at least one tree with hollows or at least one large locally indigenous tree (> 80 cm diameter at breast height) (field verification)
724 849 850	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*	A or B Low and moderate	Patch size ≥ 0.5 ha AND > 50 per cent perennial understorey vegetation made up of natives (field verification) OR patch size ≥ 5 ha AND > 30 per cent perennial understorey made up of natives (field verification)
			Patch size ≥ 0.5 ha AND > 30 per cent native understorey (field verification) AND is contiguous with a native vegetation remnant ≥ 5 ha OR patch size ≥ 0.5 ha

PCT no.	Commonwealth TEC	Condition Class	Distribution criteria – GIS
			AND > 30 per cent perennial understorey vegetation made up of natives AND the patch has at least one tree with hollows per ha or at least one large tree (≥ 80 cm diameter at breast height) per ha (field verification)
1395 1281	*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*	A or B Low and moderate	Patch size ≥ 0.5 ha AND > 70 per cent of the perennial understorey vegetation cover is made up of native species (field verification) OR patch size ≥ 2 ha AND > 50 per cent of the perennial understorey vegetation cover is made up of native species (field verification)
			Patch size ≥ 0.5 ha AND > 30 per cent perennial understorey vegetation made up of natives AND the patch has at least one tree with hollows per ha or at least one large tree (≥80 centimetre diameter at breast height) per ha OR the patch is contiguous with a native vegetation remnant ≥1 ha (field verification) OR patch size ≥ 0.5 ha and > 50 per cent perennial understorey vegetation made up of natives (field verification)
1281 1284	*Turpentine–Ironbark Forest of the Sydney Basin Bioregion*	A or B Low and moderate	Patch > 1 ha AND tree canopy cover > 10 per cent (field verification)
			Patch > 1 ha AND tree canopy cover < 10 per cent (field verification) AND part of a remnant of native vegetation > 5 ha
830 877	*Western Sydney Dry Rainforest and Moist Woodland on Shale*	A or B Low and moderate	Patch size ≥ 0.1 ha

*Transformer species (e.g. *Chrysanthemoides monilifera, Asparagus* spp, *Pennisetum* spp, *Ipomoea* spp. etc.) are non-native plant species with the potential to permanently change the character, condition, form or nature of patches of the ecological community.

11.5 THREATENED SPECIES

11.5.1 OVERALL APPROACH TO SPECIES MAPPING

To meet the requirements of the BAM and the ToR, species habitat maps have been prepared for all:

- NSW-listed candidate SCS within the nominated areas – these species habitat maps represent the 'species polygons' as required by the BAM
- Commonwealth-listed Category 1 species within the Strategic Assessment Area

The BAM does not require mapping of habitat for NSW-listed ECS, as these species are associated with specific PCTs and their presence in these PCTs is assumed for the purposes of the BAM.

Different mapping methods were applied within the nominated areas and outside the nominated areas within the Strategic Assessment Area, as well as to NSW-listed candidate SCS and Commonwealth-listed Category 1 species because of the different requirements of the BAM and ToR.

In some cases, a species habitat map was prepared for a Commonwealth-listed Category 1 species within the nominated areas in accordance with the requirements of the BAM because the Commonwealth species is also a NSW-listed species. In these cases, the nominated areas BAM species habitat map was integrated into the species habitat map for the remainder of the Strategic Assessment Area and formed the basis of the assessment of impacts on that species.

Table 11-12 summarises the species habitat mapping methods within and outside the nominated areas for NSW-listed candidate SCS and Commonwealth-listed Category 1 species.

Table 11-12: Summary of mapping approaches for NSW and Commonwealth-listed species

Species	Mapping area	Mapping method
NSW-listed candidate SCS	Nominated areas	Species polygons, either based on: • Expert reports, or • Assumed presence based on potential habitat maps created using a knowledge-based method, refined by ground validation surveys
Commonwealth-listed Category 1 species	Strategic Assessment Area	• Species Distribution Modelling, where species records are adequate, or • Assumed presence using a knowledge-based method (without refinement from ground-validation surveys), where species records are not adequate to generate a Species Distribution Model
		For Commonwealth-listed species that have habitat maps prepared within the nominated areas (because they are also NSW-listed), the maps incorporate the nominated area mapping (e.g. including any expert report polygons) to ensure use of best available data

11.5.2 NSW-LISTED SPECIES

PURPOSE

Section 6.4.1.26 of the BAM requires species polygons are prepared for each NSW-listed candidate SCS within the nominated areas, where either:

- A survey or expert report confirms a SCS is present or likely to use suitable habitat, or
- A SCS is assumed to be present

A species polygon must be used to identify:

- The location of suitable habitat for each species
- The area of suitable habitat, or number of individuals within suitable habitat, for each species
- The condition of the suitable habitat (for species assessed based on area of suitable habitat)

METHOD

Species polygons for NSW-listed candidate SCS were prepared using either:

- Expert reports, or
- Assumed presence, based on potential habitat maps created using a knowledge-based method, refined by ground validation species or habitat presence/absence surveys

It is important to note that both methods resulted in species polygons that reflect potential habitat within the nominated areas. Potential habitat represents areas where a species may occur, but is not necessarily known to occur.

These species polygons are based largely on data that has not been ground-validated due to very large size of the assessment area and land access constraints. As such, habitat associations are based on broad relationships between species and PCTs, vegetation condition, and other landscape scale features and cannot consider the presence of specific habitat components, or levels of habitat degradation, that may support/preclude the presence of actual species habitat.

These species polygons are therefore considered highly conservative in areas where ground-validation surveys were not possible and are likely to greatly overestimate the area of actual habitat for each species.

Table 11-13 summarises the mapping method used for each NSW-listed candidate SCS.

Table 11-13: Summary of mapping method used for NSW-listed candidate SCS

Species	Assumed presence refined using a knowledge-based method	Expert report	Expert report author
Acacia bynoeana	-	Yes	Dr Steven Douglas
Acacia pubescens	-	Yes	Dr Steven Douglas
Allocasuarina glareicola	Yes	-	-
Callocephalon fimbriatum	Yes	-	-
Calyptorhynchus lathami	Yes	-	-
Cercartetus nanus	Yes	-	-
Chalinolobus dwyeri	Yes	-	-
Dillwynia tenuifolia	-	Yes	Paul Rymer
Epacris purpurascens var. *purpurascens*	Yes	-	-
Eucalyptus benthamii	Yes	-	-
Grevillea juniperina subsp. *juniperina*	-	Yes	Peter Weston
Grevillea parviflora subsp. *parviflora*	Yes	-	-
Haliaeetus leucogaster	Yes	-	-
Heleioporus australiacus	Yes	-	-
Hibbertia fumana	-	Yes	Robert Miller
Hibbertia puberula	-	Yes	Robert Miller
Hieraaetus morphnoides	*Hieraaetus morphnoides*	Yes (WSA and GPEC)	Dr Tony Saunders and Dr Stephen Debus
*Lathamus discolor**	-	-	-
Litoria aurea	-	Yes	Dr Frank Lemckert
Lophoictinia isura	*Lophoictinia isura*	Yes (WSA and GPEC)	Dr Tony Saunders and Dr Stephen Debus

Species	Assumed presence refined using a knowledge-based method	Expert report	Expert report author
Marsdenia viridiflora subsp. *viridiflora* - endangered population	Yes	-	-
Maundia triglochinoides	Yes	-	-
Melaleuca deanei	-	Yes	Dr Steven Douglas
Meridolum corneovirens	-	Yes	Dr Stephanie Clark
Micromyrtus minutiflora	Yes	-	-
Myotis macropus	Yes	-	-
Ninox connivens	Yes	-	-
Ninox strenua	Yes	-	-
Persicaria elatior	Yes	-	-
Persoonia bargoensis	Yes	-	-
Persoonia nutans	-	Yes	Dr Steven Douglas
Petaurus norfolcensis	Yes	-	-
Phascolarctos cinereus	Yes	-	-
Pimelea curviflora var. *curviflora*	Yes	-	-
Pimelea spicata	-	Yes	Teresa James
Pomaderris brunnea	Yes	-	-
Pseudophryne australis	Yes	-	-
Pterostylis saxicola	-	Yes	Peter Weston
Pultenaea parviflora	Yes	-	-
Pultenaea pedunculata	Yes	-	-
Tyto novaehollandiae	Yes	-	-

* It should be noted that the species polygons for Swift Parrot are based on the species' Important areas mapping produced by DPIE, and as such the species was not subject to either "Assumed presence refined using a knowledge-based method" or the use of an "Expert report"

Expert reports

This method was used to prepare species polygons for species where expert reports were prepared. The expert reports were prepared in accordance with Section 6.5.2 of the BAM and are provided in Supporting Document C.

Expert reports were prepared for species that:

- Could not be sufficiently surveyed for due to either access restrictions, seasonality or their cryptic nature
- Had highly specific habitat requirements and restrictions, or highly generalist habitat associations, for which expert advice was required to accurately assess and map

Table 11-13 shows the NSW-listed candidate SCS for which expert reports were prepared and their author.

Initially a workshop was held with Biosis, Open Lines, and EcoPlanning to ascertain which candidate species required expert reports. This process was guided by regionally available vegetation mapping, BioNet records, and the candidate species lists generated for each of the nominated areas.

All available data on biodiversity values of the nominated areas was made available to the experts, including data on initial surveys undertaken by the consulting team in 2017-2018 (see under 'targeted surveys' below).

The experts conducted further surveys within the nominated areas where access was possible (this is outlined in each report). The methods and assumptions used to map species habitat for each species, and the credentials of the expert who prepared the report, is provided in each expert report (see Supporting Document C).

Final reports for all 14 species were provided by the experts to the Department and the consulting team by early 2019.

Updates to expert report species polygons

Following finalisation of the expert reports in 2019, several updates to baseline datasets were made, which meant that subsequent updates were required to the expert report species polygons. These updates to data were a result of:

- Ongoing fieldwork undertaken over the course of the project including the collection of BAM plots and detailed vegetation community surveys of areas where new access became available, which resulted in updates to the vegetation mapping
- Undertaking additional targeted species ground validation surveys within the nominated areas in winter and spring 2019 (see under 'targeted surveys' below) to confirm the presence or absence of threatened species, and/or suitable habitat, in locations where access had previously been limited
- Updating native vegetation mapping (see Section 11.3.2) following public exhibition. Native vegetation mapping in the nominated areas was updated where landholders provided evidence in submissions as part of the public consultation process to support changes to the mapped vegetation on their properties. These updates are relevant to species habitat mapping as the vegetation mapping forms the basis of the threatened species habitat mapping

Additional targeted species ground validation surveys were used to ground-truth and refine species polygons, including the expert report species polygons. Areas were excluded from the species polygons where either:

- For fauna and some flora – the specific habitat components or microhabitats required by the species were found not to be present or substantially degraded (in accordance with BAM Section 6.4) within the area surveyed, or
- For flora – the species was not detected (in accordance with BAM Section 6.5) within the area surveyed during the specific survey periods as outlined in BioNet

Further detail on how ground surveys were used to refine species polygons is provided below.

In relation to the updates to native vegetation mapping, Biosis ecologists re-applied the rule-sets detailed in the expert reports that identified the PCTs and any condition thresholds associated with habitat for a species, as well as any other relevant ecological data used. Where the updated native vegetation mapping changed the PCT and/or condition of an area mapped as potential habitat by the expert, the species polygon was changed to suit (for example, the species polygons were amended for a species where the PCT in a specific location changed to a PCT that is not associated with habitat for the species according to the rule-set in the expert report).

Following these updates to species survey data and native vegetation mapping, Biosis prepared initial draft updates to the expert report species polygons for consultation with the experts. Biosis engaged with each expert to outline the process undertaken to update the mapping. Experts were given the opportunity to review the additional species survey data and updated native vegetation mapping and the draft updated species polygons. Biosis liaised with the experts via phone calls and emails, as well as web portal and video-conference workshops in March 2021, to take each expert through the updates and rationale for changes to the species polygons. Species experts endorsed the changes made to their species polygons based on the process outlined above, with the exception of:

- *Acacia pubescens*
- *Acacia bynoeana*
- *Hibbertia fumana*
- *Hibbertia puberula*

It should be noted that the experts for these species did endorse updates to species polygons based on changes to the native vegetation mapping and evidence of habitat degradation.

No updates were made to species polygons developed for *Pimelea spicata* either as a result of targeted survey or following updates to vegetation mapping, as consultation with the species expert was not possible.

Assumed presence refined using a knowledge-based method

Description of knowledge-based method approach

All candidate SCS not subject to an expert report were assumed present under Section 6.4.1.21 of the BAM, as complete survey to determine species' presence/absence, and/or species' habitat constraints or habitat degradation, was not possible due to the very large size of the project area and associated land access constraints.

Species polygons were developed for all SCS assumed present as required by Section 6.4.1.26 of the BAM, which involved the application of a knowledge-based method. Section 6.4.1.30 of the BAM specifies that where a species is assumed to be present, the assessor must develop a species polygon which encompasses the entire vegetation zone/s within which the candidate species is predicted to use/occur, based on application of Step 1 to Step 4.

To ensure that species were not being assumed present over parts of the very large assessment area where they would not naturally occur, and to make use of best available ecological data, additional habitat parameters were considered to refine the species polygons. This inclusion of additional habitat parameters into the species polygons, coupled with ground validation surveys outlined below, has been termed the 'knowledge-based method'.

Developing species polygons using the knowledge-based method involved the following steps:

- Creating initial species polygons for each SCS assumed present based on BioNet PCT associations and the project specific vegetation condition states each species was considered likely to occur within (i.e. the vegetation zones within which each species was considered likely to occur, as per Section 6.4.1.30 of the BAM)
- Additional information about habitat parameters for each species drawn from information in BioNet or published, peer-reviewed literature as prescribed by Section 6.1.1.2 of the BAM was used to refine each species polygon
- Results of targeted surveys undertaken for the project (see section 'targeted surveys' below) to further refine several of the species polygons where the species (or its habitat) was/was not recorded within the mapped areas of habitat

The habitat parameters applied to the GIS model to refine the species polygons are provided in Attachment B.

For some species no data was available that could be used to refine the GIS models and several initial species polygons were based solely on PCT and vegetation condition association, including for Eastern Pygmy-possum and *Epacris purpurascens* var. *purpurascens*. Surveys were used to refine the final species polygons for these species. Several species were not able to be surveyed to a sufficient confidence level to refine species polygons based on the surveys (see below). These included Green and Golden Bell Frog, *Pimelea spicata* and Large-eared Pied Bat.

The four key steps in preparing species polygons were:

Step 1: Collate information on records and habitat parameters to establish species profiles for each species. The following information and datasets were used to collate species profiles:

- DAWE Protected Matters Search Tool and Species Profile and Threats Database
- BioNet Atlas and Threatened Biodiversity Data Collection
- PlantNET
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015
- BioNet Vegetation Classification database (OEH, 2018a)
- Remnant Vegetation of the Western Cumberland Subregion 2013 Update VIS_ID 4207 (OEH, 2013b)
- Native Vegetation of the Sydney Metropolitan Area VIS_ID 4489 (OEH, 2016b)
- Catchment Boundaries of New South Wales dataset
- NSW (Mitchell) Landscapes Version 3.0
- State Environmental Planning Policy (SEPP) Coastal Management
- NSW Soil and Land Information System (SALIS)
- Soil Landscapes of the Sydney, Penrith and Wollongong-Port Hacking 1:100 000 map sheets (Bannerman & Hazelton, 1990; Chapman & Murphy, 1989; Hazelton & Tille, 1990)

- Handbook of Australian, New Zealand and Antarctic Birds (Higgins, 1999)
- Conserving Koalas in Wollondilly and Campbelltown LGAs (DPIE, 2019)
- Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region Volume 2 (DECC, 2007)
- Cumberland Plain Recovery Plan (DECCW, 2011)
- Threatened ecological community determinations, conservation advices and listings
- BirdLife Australia shorebird data
- Topographic information
- Multiple species specific peer reviewed literature articles

Step 2: Prepare initial species polygons by assuming presence for each species based on the relevant PCT and condition class for the species identified in BioNet (i.e. all vegetation zones that the species is predicted to occur within under the BAM) and the updated native vegetation maps

Step 3: Refine initial species polygons prepared under step 2 based on the habitat parameters detailed within the species profiles collated in step 1, as well as data on species records, in approach that mirrors that prescribed in BAM Section 6.1.1.2. Habitat parameters included items that could be used to spatially restrict the GIS models used to develop the species polygons, and included items such as a restriction on patch size, proximity to waterways, associations with soil types/boundaries, tree heights (determined using LiDAR data - see Attachment B, Section B.5 for further details on the LiDAR data used for species polygons), etc. The habitat parameter rule-sets built from the species profiles used to refine the initial species polygons are provided for each species in Attachment B

Step 4: Integrate results from targeted ground validation surveys (see further detail below) within the nominated areas. The results of the ground validation surveys were used to further refine the species polygons prepared under Step 2 and Step 3. The species polygons were updated by excluding surveyed areas from the polygon where either:

- For fauna and some flora – the specific habitat components required by the species (tree hollows, leaf litter / woody debris, stick nests, undisturbed ground layer etc.) were found to be absent from the area surveyed, or
- For flora – the species was not detected within the area surveyed

It is important to note that where flora species were recorded or where species' specific habitat requirements were confirmed present, the species polygon was either maintained or increased if the species or their habitat requirements were found to occur in areas not previously mapped (either by the species experts or based on species polygons).

Flora surveys undertaken during winter and spring 2019 were undertaken along predetermined parallel transect lines separated by 30 m. Where parallel transect lines were not appropriate (for example in areas of non-linear or patchy/sporadic habitat), targeted meander surveys were undertaken, targeting specific areas of mapped habitat.

It is acknowledged that for some targeted species (those species with smaller plant growth forms, such as orchids and herbs), the separation distance between transects of 30 m was greater than that specified by the *NSW Guide to Surveying Threatened Plants* (OEH, 2016a) and *Surveying threatened plants and their habitats* (DPIE, 2020c). The *NSW Guide to Surveying Threatened Plants* requires transects to be separated from between 10 m for the smallest plant growth forms (in open vegetation) and 40 m for the largest growth form plants (in open vegetation).

Justification for using increased (30 m) transect separation widths is provided below.

The results of species surveys undertaken earlier in the project (November 2017 to November 2018) were also used to further refine species polygons as outlined above, however a slightly different rule set was applied to areas surveyed. This was done by classifying habitat into high, moderate or low quality for each species based on native vegetation condition, and applying the following buffers to survey tracks depending on the classification:

- Trees:
  - High (Intact): 40 m either side of the transect line
  - Moderate or Low (Thinned, Scattered Trees, DNG): 40 m either side of the transect line
- Shrubs, herbs, forbs, grasses, other:
  - High (Intact): 20 m either side of the transect line
  - Moderate or Low (Thinned, Scattered Trees, DNG): 40 m either side of the transect line

The final species polygons reflect the initial species polygons created in Step 2, refined by habitat parameters through the application of Step 3, and further refined by the results of ground validation surveys as outlined in Step 4. The final species polygons represent areas of habitat where either:

- In areas not subject to ground validation surveys, the species was assumed present based on the habitat parameters used to develop the species polygon in Step 3, or
- In areas subject to ground validation surveys, the species or its habitat was confirmed present

Justification for knowledge-based method approach

Preparing species polygons using a knowledge-based method approach was undertaken because of a desire to use the best available information for each species – PCT associations, habitat parameters where they can be justified based on BioNet or published, peer-reviewed literature, and targeted surveys – to ensure species polygons are as accurate and meaningful as possible. The approach was undertaken considering Section 6.1.1.2 of the BAM, which specifies that:

> *'An assessor may use additional information about a threatened species, in BioNet (e.g. the profile of a threatened species) or published, peer reviewed literature, when assessing the habitat suitability of a site*

This approach is considered appropriate in the context of the very large size of the assessment area. It was not possible to determine whether each species is likely to use suitable habitat over the entirity of on the subject land or specific vegetation zones (Section 6.4.1.21 of the BAM) or prepare species polygons based on surveys (Section 6.4.1.26 of the BAM) due to the size of the assessment area and land access constraints (see Chapter 14). Surveys were restricted to sites where access was granted by landholders and these limitations meant it was not possible to survey either all vegetation polygons within a vegetation zone, or the entire subject land to prepare a species polygon.

An alternative to this approach under the BAM is to assume presence for each species across all relevant vegetation zones within which the species is predicted to occur. This would have led to extremely precautionary species polygons that are not informed by the best available information. The species polygons would therefore be less meaningful in assessing the impacts of the development on each species and determining offsets as part of the conservation program.

Furthermore, assuming presence of species in parts of the assessment area where they would not naturally occur has the potential to undermine the effectiveness of the process for avoiding and minimising impacts (see Chapter 14) (it creates a risk that avoidance effort is focused on less important areas of habitat for a species).

The knowledge-based method approach is consistent with that used to develop the Koala species polygons, which uses a combination of PCT associations, habitat requirements and surveys, to map koala habitat within the nominated areas. It is also consistent with the principles and approach for developing species polygons for species credit bat species (OEH, 2018e), which requires the consideration of microhabitats and landscape features such as waterways, caves and cliffs, and well as certain soil/geology associations, and the NSW *Survey Guide for Threatened Frogs* (DPIE, 2020b), which prescribes buffers from watercourses. Furthermore, it is consistent with the approach taken by a number of species experts where their subject species are restricted to certain sub-components of habitats rather than just PCT associations, *Pterostylis saxicola*, Green and Golden Bell Frog, *Pimelea spicata*, are all examples of this.

The approach is also considered suitable for flora species with restricted distributions, or those that are listed as endangered populations, which are associated with wide ranging PCTs. *Allocasuarina glareicola* (PCT 1081) and *Persoonia bargoensis* (PCT 849) are examples of where the assumption of presence across entire vegetation zones would potentially result in assumed impacts well outside the species' range (*Allocasuarina glareicola* in the southern nominated areas, *Persoonia bargoensis* in the northern nominated areas). Furthermore, if *Marsdenia viridiflora* subsp. *viridiflora* was assumed present across the entire PCT 849 and PCT 850 vegetation zones then impacts would be assumed in local government areas (south of Campbelltown) where the species is not known to occur.

There are many examples of threatened species where habitat polygons require refinements based on microhabitats, as outlined in the Threatened Biodiversity Data Collection, such as breeding habitat for dual credit species, and other individual species such as *Aldrovanda vesiculosa*, *Tetratheca juncea*, Common Planigale, Bristle-faced Free-tailed Bat, where the use of best available ecological data is required to refine the species polygons and calculation of impacts.

Justification for survey separation distances

For some flora species targeted during winter and spring targeted ground validation surveys (those species with smaller plant growth forms, such as orchids and herbs), the separation distance between transects of 30 m was greater than that

specified by the *NSW Guide to Surveying Threatened Plants* (OEH, 2016a) and *Surveying threatened plants and their habitats* (DPIE, 2020c). This guideline requires transects to be separated from between 10 m for the smallest plant growth forms (in open vegetation) and 40 m for the largest growth form plants (in open vegetation).

Justification for using increased (30 m) transect separation widths in the context of this project includes:

- The very large size of the assessment area. Increased transect widths ensured greater survey coverage of mapped potential habitat. This was considered appropriate over an assessment area the size of this project
- Based on experience in the field for this project and the nature of the habitats being surveyed, the ecologists consider a high level of confidence has been achieved regarding targeted species presence/absence in surveyed areas, and that it likely that any larger populations were detected using transect widths of this size
- Species polygons were mapped based on assumed presence incorporating best available ecological data, or expert reports, and surveys were only used to refine species polygons by confirming presence / absence of species or habitats within the areas surveyed
- In areas of the species polygons not surveyed, the species presence remained assumed, and the conservative nature of the species polygons ensures that an underestimation of impacts to any species is highly unlikely, and that potential impacts to all potential populations have been adequately assessed under the BAM

Furthermore, when the 30 m transect widths are compared to the survey coverage prescribed in the 'Two-phase grid-based systematic survey approach for large areas' provided in *Surveying threatened plants and their habitats* (DPIE, 2020c) the method used covers substantially more area of potential habitat and can therefore be considered to achieve an equivalent or better outcome than that method. This is also the case when compared to surveying for plants that would usually require 10 m separated transects. For a 1 ha square (i.e. the internal square created by 4 x 100 m grid-intercept points), the grid method results in coverage of 1,600 m^2 (or 16% of 1 ha). When 3 x 10 m wide search areas are undertaken at 30 m separated transects, across a 100 m x 100 m (1 ha) square, 3,000 m^2 (30%) is covered. Coverage then increases for each larger growth form as the prescribed transect widths (and resultant search areas) increase.

Updates to species polygons

Following public exhibition of the assessment report, updates were made to native vegetation mapping (see Section 11.3.2) in the nominated areas. The mapping was updated where landholders provided evidence in submissions as part of the public consultation process to support changes to the mapped vegetation on their properties. Where the native vegetation mapping was updated following public consultation, Biosis updated the species polygons where relevant based on the process outlined in Step 2 and Step 3 above, and the habitat parameter rule-sets in Attachment B.

Targeted surveys

The BAM requires surveys for each candidate SCS in accordance with EES survey guidelines, including the *'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018e), *Threatened species survey guidelines for Amphibians* (DECC, 2009) and *NSW Guide to surveying threatened plants* (OEH, 2016a). Where no survey guidelines exist, surveys must be undertaken using best practice methods.

Targeted surveys were focused within initial species polygons (see section 'Assumed presence using a knowledge-based method' above) within the urban capable land and transport corridors of the nominated areas.

The purpose of the targeted surveys was to:

- Refine species polygons (see 'Assumed presence using a knowledge-based method' above)
- Confirm the presence or absence of species and/or species' habitat

A total of approximately 2,190 ha of combined threatened species habitat was surveyed.

The species recorded during the surveys are identified in Attachment A.

Surveys were undertaken on all land where access was granted by landholders, in accordance with relevant EES survey guidelines where possible. Not all surveys were able to be undertaken in accordance with survey guidelines due to lack of access to land or seasonal constraints. This was addressed by:

- Preparing expert reports
- Assuming presence (see section 'Assumed presence using a knowledge-based method' above)

Initial surveys – 2017 to 2018

Initial surveys for flora and fauna were undertaken across each nominated area over a period of one year, between November 2017 and November 2018, by Biosis and Ecoplanning ecologists.

Each survey team comprised of a minimum of two people, including one Accredited BAM Assessor.

Winter and spring surveys – 2019

Following analysis by the ecological consulting team and consultation with EES, it was decided that further surveys were required. The purpose of these surveys was to confirm the presence or absence of species habitat, particularly in locations where access had been limited in the past and refine the species habitat maps based on these surveys (see sections 'Expert reports' and 'Assumed presence using a knowledge-based method' above). For the species polygons prepared by expert report, this process was undertaken in consultation with the experts.

Pre-survey workshops were held between the ecological consulting team and the Department in June 2019 to determine an approach to the survey work, prioritise species for survey, determine which species could be surveyed for immediately, and the locations where targeted surveys should be undertaken.

The approach to gaining land access included targeted letter correspondence, phone calls (where available) and door knocking. It was determined that two additional survey periods would be undertaken, a winter 2019 survey and a spring 2019 survey in order to cover the defined survey periods of the included targeted species under the BAM. These surveys included targeted flora searches as well as targeted fauna habitat assessments.

The survey locations of the winter and spring surveys were determined and prioritised based on a combination of:

- Land access availability
- Total area of target species potential habitat mapped on a property
- Total number of species with potential habitat mapped on a property
- Distribution of properties across the nominated areas, to gain a broader coverage

Broad priority locations were determined based on the above criteria, and the Department contacted landowners to arrange access for targeted surveys. Once permission was obtained, each survey day was planned to ensure maximum coverage of the Plan Area by grouping sites supported by multiple survey teams across the nominated areas. In addition to the Department contacting landowners to arrange access, Biosis also undertook a number of doorknocking surveys in an attempt to gain access to additional private properties located within the Plan Area.

The winter 2019 targeted surveys were undertaken between 29 June and 02 August 2019 by both Biosis and Ecoplanning ecologists. The spring 2019 targeted surveys were undertaken between 17 October and 17 December 2019 by Biosis ecologists. Each survey team comprised of a minimum of two people, including one Accredited BAM Assessor.

Fauna surveys

Survey effort for the initial targeted fauna surveys undertaken within the nominated areas is summarised in Table 11-14. Survey effort for the targeted fauna habitat assessments undertaken during the winter 2019 and spring 2019 surveys is included in Table 11-15 (winter 2019), and Table 11-16 (spring 2019).

The weather conditions during the initial targeted fauna survey period are summarised in Table 11-17.

Map 11-1 shows the locations of targeted fauna surveys within the nominated areas.

Table 11-14: Initial targeted fauna survey effort

Nominated area	Date	Survey type	Person Hours/trap nights	Target species	Weather
Wilton	15/08/2018	2 ha bird transect	1.25	Regent Honeyeater and Little Lorikeet	Fine

Nominated area	Date	Survey type	Person Hours/trap nights	Target species	Weather
	15/08/2018	2 ha spotlight transect	2	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	15/08/2018	Anabat - targeted survey	1	Southern Myotis	Fine
	15/08/2018	Anabat - targeted survey	1	Large-eared Pied Bat	Fine
	5/09/2018	2 ha bird transect	1.2	Regent Honeyeater and Little Lorikeet	Fine
	5/09/2018	Songmeter	8	Koala	Fine
	5/09/2018	2 ha spotlight transect	2.5	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	3/10/2018	2 ha bird transect	2	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Overcast and rainy
GMAC	13/09/2018	Songmeter	5	Green and Golden Bell Frog	Fine
	2/08/2018	2 ha bird transect	1	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	2/08/2018	2 ha bird transect	1	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	13/09/2018	2 ha spotlight transect	2	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	13/09/2018	2 ha spotlight transect	1	Greater Glider, Squirrel Glider, Koala, Masked Owl, Powerful Owl and Barking Owl	Fine
	13/09/2018	2 ha bird transect	1	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	18/09/2018	2 ha bird transect	1	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine with slight cloud cover
	18/09/2018	2 ha spotlight transect	2	Masked Owl and Barking Owl	Fine with slight cloud cover
	18/09/2018	2 ha bird transect	0.75	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine with slight cloud cover

Nominated area	Date	Survey type	Person Hours/trap nights	Target species	Weather
	3/10/2018	2 ha bird transect	1	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Overcast and rainy
	3/10/2018	2 ha spotlight transect	0.5	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Overcast and rainy
	3/10/2018	Drive-by spotlight survey	0.75	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Overcast and rainy
GPEC	12/09/2018	Drive-by spotlight survey	1	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	12/09/2018	Drive-by spotlight survey	1	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	12/09/2018	2 ha bird transect	2	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	11/09/2018	2 ha spotlight transect	2.5	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	11/09/2018	Songmeter	2	Koala	Fine
	19/09/2018	Camera trapping	6	Squirrel Glider and Greater Glider	Fine
	12/09/2018	Anabat - targeted survey	7	Southern Myotis	Fine
	20/09/2018	2 ha bird transect	3	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	20/09/2018	2 ha bird transect	1	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	20/09/2018	2 ha bird transect	1	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	25/09/2018	2 ha spotlight transect	2	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
WSA	15/08/2018	2 ha spotlight transect	7	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	15/08/2018	Anabat - targeted survey	7	Southern Myotis	Fine
	4/09/2018	2 ha spotlight transect	1	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine

Nominated area	Date	Survey type	Person Hours/trap nights	Target species	Weather
	6/09/2018	Songmeter	4	Koala and GGBF	Fine
	4/09/2018	Anabat - targeted survey	2	Southern Myotis	Fine
	4/09/2018	2 ha spotlight transect	1	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	6/09/2018	Songmeter	4	Koala and GGBF	Fine
	4/09/2018	Anabat - targeted survey	2	Southern Myotis	Fine
	4/09/2018	2 ha spotlight transect	1	Masked Owl and Barking Owl	Fine
	17/08/2018	2 ha bird transect	1	Regent Honeyeater, Glossy Black-Cockatoo and Little Lorikeet	Fine
	6/09/2018	2 ha bird transect	1	Regent Honeyeater, Glossy Black-Cockatoo and Little Lorikeet	Fine
	6/09/2018	2 ha spotlight transect	3	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine
	19/09/2018	2 ha bird transect	1.5	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	19/09/2018	Anabat - targeted survey	6	Southern Myotis	Fine
	26/09/2018	2 ha bird transect	2.5	Regent Honeyeater, Swift Parrot, Glossy Black-Cockatoo and Little Lorikeet	Fine
	26/09/2018	2 ha spotlight transect	4	Greater Glider, Squirrel Glider, Masked Owl, Powerful Owl and Barking Owl	Fine

Table 11-15: Winter 2019 targeted fauna habitat assessment

Nominated area	Date	Survey type	Person hours	Target species	Weather
Wilton	29 June – 22 July 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch marks, and survey for breeding birds	24	Gang-gang Cockatoo, Glossy Black-Cockatoo, Eastern Pygmy-possum, White-bellied Sea-Eagle, Giant Burrowing Frog, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider, Koala and Red-crowned Toadlet	Fine
GMAC	29 June – 22 July 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch	24	Gang-gang Cockatoo, Glossy Black-Cockatoo, Eastern Pygmy-possum, White-bellied Sea-Eagle, Giant Burrowing Frog, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Barking Owl, Powerful Owl,	Fine

		marks, and survey for breeding birds		Masked Owl, Squirrel Glider, Koala and Red-crowned Toadlet	
GPEC	8 July - 02 August 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch marks, and survey for breeding birds	32	Gang-gang Cockatoo, Glossy Black-Cockatoo, Eastern Pygmy-possum, White-bellied Sea-Eagle, Giant Burrowing Frog, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider, Koala and Red-crowned Toadlet	Fine
WSA	19 July – 24 July 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch marks, and survey for breeding birds	32	Eastern Pygmy-possum, White-bellied Sea-Eagle, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Powerful Owl, and Koala	Fine

Table 11-16: Spring 2019 targeted fauna habitat assessment

Nominated area	Date	Survey type	Person hours	Target species	Weather
Wilton	27 November 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch marks, and survey for breeding birds	8	Gang-gang Cockatoo, Glossy Black-Cockatoo, Eastern Pygmy-possum, White-bellied Sea-Eagle, Giant Burrowing Frog, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider, Koala and Red-crowned Toadlet	Fine
GMAC	13 November – 17 December 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch marks, and survey for breeding birds	43.25	Gang-gang Cockatoo, Glossy Black-Cockatoo, Eastern Pygmy-possum, White-bellied Sea-Eagle, Giant Burrowing Frog, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider, Koala and Red-crowned Toadlet	Fine
GPEC	17 October – 12 December 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch marks, and survey for breeding birds	20	Gang-gang Cockatoo, Glossy Black-Cockatoo, Eastern Pygmy-possum, White-bellied Sea-Eagle, Giant Burrowing Frog, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider, Koala and Red-crowned Toadlet	Fine
WSA	11 December 2019	Habitat assessment Stick nest surveys, hollow-bearing trees, scat searches, trunk scratch marks, and survey for breeding birds	5.5	Eastern Pygmy-possum, White-bellied Sea-Eagle, Little Eagle, Square-tailed Kite, Cumberland Plain Land Snail, Powerful Owl and Koala	Fine

Table 11-17: Weather during initial targeted fauna survey period

Station	Date	Temps		Rain	9:00 AM				3:00 PM			
		Min.	Max.	Rain.	Temp.	Humidity	Wind	Speed	Temp.	Humidity	Wind	Speed
		°C	°C	mm	°C	%		km/h	°C	%		km/h
Penrith (067113)	11-Sep 2018	10.7	26.8	0	17.1	71	NNE	11	26.5	32	NE	20
	12-Sep 2018	8.6	32.1	0	17.3	66	N	4	31	21	NNW	19
	19-Sep 2018	7.7	29.7	0	18.7	46	ESE	2	27.7	14	WNW	33
	20-Sep 2018	6.1	20.3	0	12.9	51	ESE	6	18.4	39	E	13
	25-Sep 2018	10.5	20.6	0	14.6	63	WSW	4	19.7	40	ESE	15
	19-Jul 2019	0.4	20.4	0	7.2	77	N	4	19.8	36	ESE	6
	20-Jul 2019	2.0	20.4	0	6.8	98	calm	-	19.4	44	WSW	6
	23-Jul 2019	3.2	23.6	0	8.3	98	SW	2	23.6	26	WNW	11
	24-Jul 2019	8.4	21.6	0	16.6	47	S	9	20.8	27	WSW	9
Badgerys Creek (067108)	2-Aug 2018	5.1	19	0	11.7	60	WSW	2	18.2	44	NNE	17
	15-Aug 2018	1.8	25.3	0	18.1	25	WSW	22	24.4	14	WNW	31
	17-Aug 2018	0.2	18.9	0	11.4	48	NW	2	17.2	25	W	22
	4-Sep 2018	7.9	18.4	4	12.9	85	S	9	16.9	53	SE	24
	6-Sep 2018	5.9	20.8	2	11.5	100	Calm	1021.9	53		N	9
	19-Sep 2018	5.6	29.1	0	18.3	53	SE	9	25.9	15	WNW	41
	26-Sep 2018	10.2	16.3	8.2	12.2	91	NNW	13	11.4	88	SSW	15
	8-Jul 2019	8.7	19.5	0.4	11.3	100	N	4	18.1	68	NNW	6
	10-Jul 2019	2.5	17.1	0	8.4	80	NW	4	16.9	46	NNW	7
	19-Jul 2019	0.7	19.1	0	7.6	70	NNE	7	18.8	38	SW	7
	2-Aug 2019	5.3	19.3	0	11.6	73	SW	11	18.0	48	NNE	17
Campbelltown (Mt Annan 068257)	2-Aug 2018	3.9	18.9	0	11	61	WSW	7	18.6	35	NNE	9
	15-Aug 2018	2	25.1	0	16.3	25	NW	13	24.6	5	WNW	22
	5-Sep 2018	4.7	17.3	1.4	13.7	77	SSW	6	17.1	63	NNE	4
	13-Sep 2018	8.5	23.7	0	16.8	63	SSW	9	20.3	45	E	13
	29-June 2019	3.3	20.8	0.2	8.9	99	Calm	-	20.1	47	NNE	15
	1-Jul 2019	0.7	17.2	0	5.9	81	SSW	6	16	44	N	7
	3-Jul 2019	1.7	19.1	0	11.1	76	Calm	-	16.7	62.	S	11
	9-Jul 2019	4	17.6	0.2	11.6	78	Calm	-	16.6	43	WSW	15
	18-Jul 2019	9.9	20	0	14	54	WSW	7	19.2	21	SSW	13
	22-Jul 2019	6.8	23.4	0.2	12.3	62	S	2	22.2	30	NNE	15

Flora surveys

Targeted flora survey effort is summarised in Table 11-18 (initial targeted flora survey effort), Table 11-19 (winter 2019 targeted flora survey effort), and Table 11-20 (spring 2019 targeted flora survey effort).

Flora surveys were undertaken within each PCT and vegetation zone and extended up to 50 m into habitat adjacent to the edge of the urban capable land or transport corridors. Flora species included in winter and spring targeted surveys are detailed in Table 11-21.

Map 11-1 shows the locations of the targeted flora surveys within the nominated areas.

Table 11-18: Initial targeted flora survey effort

Nominated area	Date	Method	Combined area (ha) of habitat surveyed	Surveyor
Wilton	34 days, Nov 2017 - Sept 2018	Targeted meanders/transects in suitable habitat	445.76	Ecoplanning and Biosis
GMAC	51 days, Nov 2017 - Nov 2018	Targeted meanders/transects in suitable habitat	351.05	Ecoplanning and Biosis
GPEC	26 days, Apr - Nov 2018	Targeted meanders/transects in suitable habitat	43.08	Ecoplanning and Biosis
WSA	56 days, Feb - Nov 2018	Targeted meanders/transects in suitable habitat	94.08	Ecoplanning and Biosis

Table 11-19: Winter 2019 targeted flora survey effort

Nominated area	Date	Method	Combined area (ha) of habitat surveyed	Surveyor
Wilton	8 days, 29 June - 02 August 2019	Targeted meanders/transects in suitable habitat	442.1	Ecoplanning and Biosis
GMAC	8 days, 29 June - 02 August 2019	Targeted meanders/transects in suitable habitat	199.5	Ecoplanning and Biosis
GPEC	10 days, 29 June - 02 August 2019	Targeted meanders/transects in suitable habitat	178.1	Ecoplanning and Biosis
WSA	10 days, 29 June - 02 August 2019	Targeted meanders/transects in suitable habitat	181.4	Ecoplanning and Biosis

Table 11-20: Spring 2019 targeted flora survey effort

Nominated area	Date	Method	Combined area (ha) of habitat surveyed	Surveyor
Wilton	2 days, 27 November – 13 December 2019	Targeted meanders/transects in suitable habitat	101.8	Biosis
GMAC	7 days, 4 November – 17 December 2019	Targeted meanders/transects in suitable habitat	97.1	Biosis
GPEC	4 days, 17 October – 12 December 2019	Targeted meanders/transects in suitable habitat	47.0	Biosis
WSA	1 day, 11 December 2019	Targeted meanders/transects in suitable habitat	9.6	Biosis

Table 11-21: Flora species targeted during winter and spring surveys

Scientific name	Common name	Initial surveys*	Winter 2019 survey	Spring 2019 survey	Nominated area
Acacia bynoeana	Bynoe's Wattle	Yes	Yes	Yes	Wilton GMAC GPEC WSA
Acacia pubescens	Downy Wattle	Yes	Yes	Yes	Wilton GMAC GPEC WSA
Allocasuarina glareicola	-	Yes	Yes	Yes	GPEC
Dillwynia tenuifolia	-	Yes	Yes	Yes	WSA GPEC
Epacris purpurascens var. *purpurascens*	-		Yes	Yes	Wilton GMAC
Eucalyptus benthamii	Camden White Gum		Yes	Yes	Wilton GMAC
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea		Yes	Yes	WSA GMAC
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea		Yes	Yes	Wilton GMAC GPEC WSA
Hibbertia fumana	-	No	No	Yes	Wilton GMAC GPEC WSA
Hibbertia puberula	-	No	No	Yes	Wilton GMAC GPEC WSA
Marsdenia viridiflora subsp. *viridiflora* – endangered population	-	Yes	Yes	Yes	GMAC GPEC WSA
Maundia triglochinoides	-	No	Yes	Yes	GPEC WSA
Melaleuca deanei	Deane's Paperbark		Yes	Yes	Wilton GMAC
Micromyrtus minutiflora	-		Yes	Yes	GPEC WSA

Scientific name	Common name	Initial surveys*	Winter 2019 survey	Spring 2019 survey	Nominated area
Persicaria elatior	Tall Knotweed	No	Yes	Yes	GMAC GPEC WSA
Persoonia bargoensis	Bargo Geebung		Yes	Yes	Wilton GMAC
Persoonia nutans	Nodding Geebung		Yes	Yes	GPEC WSA
Pimelea curviflora var. *curviflora*	-		Yes	Yes	GPEC
Pimelea spicata	Spiked Rice-flower	No	Yes	Yes	Wilton GMAC GPEC WSA
Pomaderris brunnea	Brown Pomaderris		Yes	Yes	Wilton GMAC
Pterostylis saxicola	Sydney Plains Greenhood	No	No	Yes	Wilton GMAC GPEC WSA
Pultenaea parviflora	-		Yes	Yes	GPEC WSA
Pultenaea pedunculata	Matted Bush-pea		No	Yes	Wilton GMAC GPEC WSA

* The initial survey period occurred from November 2017 to November 2018 with targeted species surveys within this period occurring according to applicable species survey timeframes.

RESULTS

The habitat maps of each NSW-listed candidate SCS are provided in Chapter 21.

11.5.3 COMMONWEALTH-LISTED SPECIES

PURPOSE

Section 3.2 of the ToR requires the SAR to describe for the Strategic Assessment Area the protected matters that may be impacted directly, indirectly and cumulatively by actions taken under the Plan. This includes:

- Identification of key sites and habitats
- Identification of important populations

METHOD

Habitat for Commonwealth-listed Category 1 species was mapped within the Strategic Assessment Area using either:

- Species Distribution Modelling (SDM) where species data is adequate, or

- Assumed presence using a knowledge-based method

In some cases, a map has been prepared for a Commonwealth-listed Category 1 species within the nominated areas in accordance with the BAM because the Commonwealth species is also a NSW-listed candidate SCS. In these cases, that nominated areas species map was integrated into the Strategic Assessment Area species map and formed the basis of the assessment of impacts on that species within the nominated areas.

Table 11-22 summarises the mapping method used for each Commonwealth-listed Category 1 species, and shows where any nominated area mapping has been integrated into the Strategic Assessment Area map for a Commonwealth species.

Table 11-22: Summary of mapping method used for Commonwealth-listed Category 1 species

Scientific Name	Nominated areas		Strategic Assessment Area	
	Expert report	Assumed presence using a knowledge-based method	SDM	Assumed presence using a knowledge-based method
Acacia bynoeana	Yes		Yes	
Acacia pubescens	Yes		Yes	
Allocasuarina glareicola		Yes		Yes
Anthochaera phrygia				Yes
Botaurus poiciloptilus				Yes
Chalinolobus dwyeri		Yes		Yes
Commersonia prostrata				Yes
Cynanchum elegans				Yes
Dasyurus maculatus maculatus (SE mainland population)				Yes
Deyeuxia appressa				Yes
Eucalyptus benthamii		Yes	Yes	
Genoplesium baueri				Yes
Grevillea parviflora subsp. *parviflora*		Yes	Yes	
Heleioporus australiacus		Yes		Yes
Hibbertia puberula subsp. *glabrescens (Hibbertia* sp. Bankstown)				Yes
Hoplocephalus bungaroides				Yes
Lathamus discolor				Yes
Leucopogon exolasius				Yes
Litoria aurea	Yes		Yes	
Macquaria australasica				Yes
Melaleuca deanei	Yes			Yes
Micromyrtus minutiflora		Yes	Yes	
Persicaria elatior		Yes		Yes
Persoonia bargoensis		Yes	Yes	
Persoonia glaucescens				Yes

Scientific Name	Nominated areas		Strategic Assessment Area	
	Expert report	Assumed presence using a knowledge-based method	SDM	Assumed presence using a knowledge-based method
Persoonia hirsuta			Yes	
Persoonia nutans	Yes		Yes	
Petauroides volans				Yes
Phascolarctos cinereus		Yes	Yes	
Pimelea curviflora var. *curviflora*		Yes		Yes
Pimelea spicata	Yes		Yes	
Pomaderris brunnea		Yes	Yes	
Pommerhelix duralensis			Yes	
Pteropus poliocephalus			Yes	
Pterostylis saxicola	Yes			Yes
Pultenaea parviflora		Yes	Yes	
Rostratula australis				Yes

Species Distribution Modelling

SDM was undertaken for Commonwealth-listed Category 1 species within the Strategic Assessment Area where adequate species records were available to develop a model. SDMs were developed for 19 Commonwealth-listed Category 1 species (6 fauna species and 13 flora species).

SDMs are statistical models used to estimate the relationship between species records at sites and the environmental and/or spatial characteristics of those sites. Once this relationship has been estimated, the SDM can be used to predict other locations in the landscape where the species is likely to occur.

SDMs were developed using the software package 'Maxent'. Data required for the modelling included:

- Species records obtained from BioNet. During a review of the records, various errors were identified. Ecologists were engaged to review the records and amend or exclude those with errors.
- Twenty-one environmental predictors that were used to establish the relationships between species records at sites and the environmental and/or spatial characteristics of those sites. These included:
    - Native vegetation community (PCTs)
    - Soil type
    - Mean annual temperature
    - Mean annual radiation
    - Number of days per year with minimum temperature less than 2 degrees
    - Latitude
    - Distance to streams
    - Topographic position

An approach was developed to account for the different levels of bias likely to be present in the species records. This resulted in the development of three maps for each species with different assumptions regarding bias in the records, depicting the likelihood of occurrence for each species. These three maps were then combined to produce a single SDM for each species with three classes of occurrence for each species:

- Unlikely to occur – none of the three models predicted the species to occur
- Potential to occur – at least one of the three models predicted the species to occur
- Likely to occur – all three of the models predicted the species to occur

Details of the SDM method and the results of the mapping is provided in Supporting Document F.

Assumed presence using a knowledge-based method

Where adequate species records were not available, Commonwealth-listed Category 1 species within the Cumberland subregion were mapped on the basis of assumed presence using a knowledge-based method. This method is the same method applied to NSW-listed candidate SCS within the nominated areas (see Section 11.5.2). The habitat parameters for each species, including habitat associations with PCTs, are provided in Attachment B.

Important populations

The term 'important populations' refers to a concept applied under the EPBC Act to inform the assessment of impacts of actions, such as urban development, on matters of national environmental significance. Important populations are defined in the Commonwealth's Significant Impact Guidelines (Policy Statement 1.1) (DoE, 2013) as:

> *Any population of a vulnerable species which meets the definition of an important population in the Commonwealth's Significant Impact Guidelines (Policy Statement 1.1) as follows:*
>
> *'A population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:*
>
> - *key source populations either for breeding or dispersal*
> - *populations that are necessary for maintaining genetic diversity, and/or*
> - *populations that are near the limit of the species range'*

For the purposes of the SAR, important populations are also defined as including any population of an endangered or critically endangered species. Under the EPBC Act, all populations of an endangered or critically endangered species are considered to be important for the survival and recovery of the species.

The following steps were undertaken to identify and map important populations for critically endangered, endangered and vulnerable Commonwealth-listed Category 1 matters:

Step 1: Development of criteria for defining important populations for vulnerable Commonwealth-listed Category 1 matters. The criteria and rationale for each criterion is provided in Table 11-23.

Step 2: For each species, BioNet records were analysed to define biological populations of the species. This analysis was undertaken by senior ecologists with knowledge and expertise in the ecology of each species. Where gene flow between two records is considered likely, the records were assigned to the one population. The ecologists took the following factors into account in determining whether gene flow is likely between records:

- Distance between individual flora records
- The presence of features or barriers that might limit demographic or genetic exchange
- Pollinator type and seed dispersal mechanism (where known)
- The continuity of patches of vegetation

Attachment C sets out the assumptions made in defining biological populations for each species.

Step 3: For critically endangered and endangered Category 1 matters:

- Describe and map each population (including identifying population sizes)

Step 4: For vulnerable Category 1 species:

- Collate the required data on each species as per the data sources in Table 11-23
- Apply the criteria in Table 11-23 to each species, using GIS analysis where necessary
- Describe and map each population (including identifying population sizes)

RESULTS

The habitat and important population maps for each Commonwealth-listed Category 1 species are provided in Chapters 29 and 30.

Table 11-23: Criteria for identifying and mapping important populations of vulnerable Commonwealth-listed Category 1 species

	Criteria	Rationale	Data sources
1	Any population of a species identified as a Serious and Irreversible Impacts (SAII) entity under the NSW BC Act	SAII entities have been identified under the NSW BC Act and meet one or more of the following principles: • Species in rapid rate of decline • Very small population size • Very limited geographic distribution • Unlikely to respond to management and therefore irreplaceable Populations of SAII entities therefore make a significant contribution to the conservation of the species	• Threatened Biodiversity Data Collection
2	A population identified or inferred in a Commonwealth conservation advice, recovery plan, final determination, or other relevant policy document as being important	Consistent with the EPBC Act Policy Statement 1.1 (DoE, 2013)	• Recovery plans • Conservation advices • Final determinations
3	A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program	Species targeted by the Saving our Species program have been prioritised for conservation effort under a program that aims to maximise the chance of securing the greatest number of species in the wild. Therefore populations targeted under the NSW Saving our Species program could comply with the following EPBC important population criteria: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species' range	• Saving our Species program conservation projects database
4	A population associated with a commitment made under the Sydney growth centres conservation program	These populations have been previously identified for conservation, have had significant resources attributed to their conservation and are subject to existing commitments under the Sydney growth centres conservation program and should therefore be considered important	• Sydney Growth Centres Strategic Assessment: Program Report (DECCW & DOP, 2010) • NSW *Threatened Species Conservation Act 1995* Order to confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006

	Criteria	Rationale	Data sources
5	Any population of a species that contains more than 20 per cent of the total population (total number of mature individuals in the species) or 20 per cent of the Area of Occupancy (AOO)* of that species	Significant contribution to the conservation of the species. Loss of any population that contains 20 per cent or more of the total population or AOO is justification for change in status from Vulnerable to Endangered under IUCN and EPBC Act criteria (IUCN, 2012)	• BioNet, site specific surveys
6	Any population of a species where the species has less than 10 known subpopulations	These are species that have very few populations. All known populations therefore make a significant contribution to the conservation of the species. Loss of any population of such a species would be significant	• BioNet, site specific surveys
7	Any population of a species that is a large population in the context of the ecology of that species, in the opinion of senior ecologists	Large populations are important from a genetic perspective. They typically will have sufficient genetic diversity, increased evolutionary potential, reduced inbreeding effects and increased probability of long-term viability and persistence	• BioNet, site specific surveys
8	Any population of a species within a conservation reserve (regardless of the number of plants or size, etc.)	These populations are important because they are more likely to be effectively managed and have a greater chance of persistence due to their occurrence in a conservation reserve, and therefore make a significant contribution to the conservation and recovery of the species. Conservation reserve refers to those that meet IUCN protected area categories I-IV	• BioNet, site specific surveys • National parks estate data • BioBank and stewardship site data
9	Any population of a species that is important for maintaining the Extent of Occurrence (EOO)^ of that species	Maintaining the full range of a species has a greater chance of retaining the variation within the species (a primary aim of biodiversity conservation). Populations at the extent of occurrence or that are outliers to the more general distribution are likely to contain genetic difference or capacity to persist in different environmental conditions that will provide the species ability to cope and respond to changes in the environment, such as climate change	• BioNet, site specific survey • Commonwealth database profiles/distribution mapping

*AOO is defined as the area within a species 'extent of occurrence' which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats

^EOO is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species, excluding cases of vagrancy

11.5.4 KOALA

Specific habitat mapping was undertaken for the koala. Three forms of habitat mapping were undertaken. They include:

- An SDM for the species across the Cumberland subregion
- Corridor habitat mapping to identify the species polygons for koala as required by the BAM
- Mapping of habitat critical to the survival of the species

In addition, a connectivity analysis was undertaken for part of the Southern Sydney population.

SPECIES DISTRIBUTION MODEL FOR THE CUMBERLAND SUBREGION

RMIT University was engaged to prepare SDMs for a total of nineteen EPBC listed species found within the Cumberland subregion (see Supporting Document F). As part of this assessment, an SDM was prepared for koalas.

The overall purpose of preparing the SDMs was to (Gordon & Koshkina, 2018):

- Provide context for detailed environmental impact analysis being undertaken within the nominated areas, such as through providing information about the relative importance of different areas of habitat within each nominated area compared to the rest of the subregion
- Assist in evaluating commitments by providing indicative information about the amount of habitat available for biodiversity offsetting
- Enable indicative impact assessment of transport corridors

The SDM for koalas was prepared through the following process (Gordon & Koshkina, 2018):

1. Species records for koalas within the Cumberland subregion were sourced from BioNet and examined. The following records were removed:
    - Erroneous/inaccurate records
    - Records which were *not* associated with native vegetation were also removed, as records outside of native vegetation were taken to represent dispersing male koalas outside of regular habitat areas following the breeding season, or of records of areas that previously supported vegetation that is no longer there
2. A range of environmental parameters associated with koala records were tested for their capacity to predict koala occurrence across the subregion. The parameters which were selected for use in the SDM were those which:
    - Performed well in predicting koala occurrence
    - Did not increase the risk of introducing bias into the model
3. The selected environmental parameters, in addition to koala records, were used as inputs to generate three different SDMs. Each SDM adopted a different modelling methodology which accounted for different types of bias which were likely to be present within the input data
4. The outputs of each SDM were correlated, and a final SDM map was produced with the following categories:
    - 'Unlikely to occur' – Locations where none of the SDM models showed the species occurring
    - 'Potential to occur' – Locations where at least one of the SDM models showed the species occurring. These areas are the most appropriate for assessing potential impacts on the target species
    - 'Likely to occur' – Locations where all three of the SDM models showed the species occurring. These areas are the most appropriate for targeting conservation actions such as offsetting

The results of the SDM mapping are provided in Part 6. Results show the presence of higher quality ('likely to occur') koala habitat in the south of the Cumberland Plain, with small areas of lower quality habitat ('potential to occur') occurring elsewhere in the subregion (predominantly to the north-west and west). Overall, results indicate that there is likely to be very little koala habitat available within the Cumberland subregion.

Despite there being few koala records within the Cumberland subregion, it is recognised that there is an abundance of koala records in close proximity to the boundaries of the Cumberland subregion. For instance, Gordon & Koshkina (Gordon & Koshkina, 2018) recognise that there are over 2,700 records of koalas within a 10 km buffer distance of the subregion boundary.

It is important to recognise that the SDM mapping only shows areas where koalas are likely to be present based on environmental predictors. It does not take into account other key considerations, such as connectivity, habitat quality, and minimum habitat patch sizes for population viability or presence of threats. The mapping is therefore indicative, showing the extent and distribution of potential habitat available within the subregion; it does not necessarily indicate which areas of habitat are the most important locations to conserve a species (Gordon & Koshkina, 2018).

CORRIDOR HABITAT MAPPING

The corridor habitat mapping built on the work of EES in mapping habitat around Wilton and GMAC (DPIE, 2019) and applied a consistent approach. Mapping was undertaken separately for:

- Wilton Growth Area (Wilton), Greater Macarthur Growth Area (GMAC) and buffer area
- Greater Penrith to Eastern Creek Investigation Area (GPEC) and Western Sydney Aerotropolis (WSA)

The methods for these two regions are described below.

Mapping method for Wilton, GMAC and buffer area

The mapping method for Wilton and GMAC (and buffer area) is driven by the "long-established association between the presence of koalas and vegetation that grows on higher fertility soils, such as shale or shale-transition soils" (DPIE, 2019).

There are five steps in the mapping method:

1. Map Koala habitat
2. Identify principal and supporting habitat
3. Identify movement corridors
4. Categorise corridors into primary, secondary and tertiary
5. Define important habitat

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)

The first four steps in the corridor habitat mapping method for Wilton and GMAC are consistent with the approach taken by EES (see below for details). The minor differences were:

- This method is based on more detailed and updated vegetation mapping that was generated through the BAM process within the nominated areas
- Minor changes to the wording of this method were applied to provide greater clarity
- Aside from the use of records, validation of high-quality habitat was not repeated for this method

The fifth step about defining important habitat was required by the BAM and was in addition to the EES report.

Spatial scope of the mapping

The spatial scope of the mapping for Wilton and GMAC was:

- The two nominated areas
- Connected habitat between them
- Habitat to the east to the edge of the Strategic Assessment Area
- West to Bargo, Tahmoor and Thirlmere

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)

The spatial scope of the mapping was largely consistent with the approach taken by EES. The EES mapping extends further to the east, into the Holsworthy area which is outside the Strategic Assessment Area, and slightly further to the west of Thirlmere and Bargo. The mapping for this Assessment Report includes a few smaller areas that were not mapped as part of the EES mapping, including a small area at Buxton and Holsworthy.

Step 1: Map Koala habitat

Using PCTs (see Table 11-24), Koala habitat within the two nominated areas was mapped into three categories:

- High quality habitat (HQH) = all shale and shale-enriched vegetation types with a dominant eucalypt canopy
- Moderate quality habitat (MQH) = Eucalypt-dominated riparian sandstone communities, rainforest communities on shale with some eucalypts present, and regenerating *Acacia* scrubs on shale. Note: based on the vegetation within Wilton and GMAC and the surrounding land in the Plan Area there are no PCTs that meet this definition of moderate quality
- Low quality habitat (LQH) = Low-fertility sandstone vegetation communities including heaths, heathy woodlands, swamps, and rocky woodlands

Table 11-24: PCTs and Koala habitat in Wilton and GMAC

PCT	HQH	MQH	LQH
830 - Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Y		
835 - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Y		
849 - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Y		
850 - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Y		
877 - Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion		Y	
883 - Hard- leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Y		
1081 - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion.	Y		
1105 - River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion		Y	
1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Y		
1292 - Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion			Y
1395 - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion.	Y		
1790 - Red Bloodwood - Grey Gum - Stringybark open forest on enriched sandstone ridges of the western Woronora plateau and lower Blue Mountains	Y		
1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Y		

Within the buffer area (outside the nominated areas) the EES mapping was incorporated into the data layer without change. Some small areas around Buxton and Holsworthy were not mapped by EES but are within the Strategic Assessment Area. Within these small areas the best available vegetation mapping was used to map Koala habitat based on the PCTs mapped (Table 11-25).

Table 11-25: PCTs and Koala habitat in small buffer areas of Buxton and Holsworthy

PCT	HQH	MQH	LQH
724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Y		
830 - Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Y		
835 - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Y		
849 - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Y		
850 - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Y		
883 - Hard- leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Y		
941 - Mountain Blue Gum - Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion	Y		
1081 - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion.	Y		
1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion			Y
1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Y		
1292 - Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion			Y
1395 - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion.	Y		
1780 - Sydney Peppermint / Coachwood - Water Gum open forest in protected sandstone gullies around Sydney and the Central Coast			Y
1787 - Red Bloodwood - Scribbly Gum - Stringybark open forest on sandstone ridges along the western side of the Woronora and Hornsby plateaus			Y
1789 - Smooth-barked Apple - Blackbutt - Red Bloodwood open forest in enriched sandstone gullies of the western Woronora plateau		Y	
1790 - Red Bloodwood - Grey Gum - Stringybark open forest on enriched sandstone ridges of the western Woronora plateau and lower Blue Mountains	Y		
1803 - Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin			Y
1826 - Dwarf Apple - Banksia - Tea-tree - Hakea heath-woodland on the hinterland sandstone plateaus from southern Sydney to Mangrove Mountain			Y

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)

The EES report used vegetation communities to define habitat quality (refer to Section 3.3 of the EES report). The method used for this Assessment Report updates this by using PCT associations from the updated vegetation mapping (see Table 11-24 and Table 11-25 above).

Given the validation work that EES had done (refer to Section 3.4 of the EES report), further validation of high-quality habitat was not repeated as part of the process for this Assessment Report.

Step 2: Identify principal and supporting Koala habitat

Principal habitat is defined as HQH patches greater than 100 ha that contain Koala records.

The remainder of habitat is defined as "supporting".

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)

Step 2 of the method for this Assessment Report is included within a broader step of the EES report (refer to Section 3.5 of the EES report) relating to the delineation of koala movement corridors. It was separated in the method for this report for the sake of clarity.

The actual method in this Assessment Report for defining 'principal habitat' is the same as the EES report. However, the EES report uses different terminology and calls it 'core habitat'. This report does not use the term 'core' in order to avoid confusion with the Koala SEPP.

Step 3: Identify movement corridors

Movement corridors include:

- All principal habitat except for those patches of principal habitat that are separated by more than 1 km
- Smaller patches of HQH within 100 m of patches of principal habitat in corridors
- Patches of MQH or LQH that connect patches of principal habitat within corridors or are entirely within principal habitat in corridors
- Scattered trees where they are completely or largely contained within corridors

Movement corridors exclude:

- Patches of principal habitat that are separated by more than 1 km
- Patches of MQH or LQH peripheral to corridors
- Scattered trees peripheral to corridors

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)

Step 3 of the method for this Assessment Report is also included within a broader step of the EES report (refer to Section 3.5 of the EES report) relating to the delineation of koala movement corridors. It was separated in the method for this report for the sake of clarity.

The actual method in this Assessment Report for identifying movement corridors is the same as the EES report. However, some rewording has been done.

Step 4: Categorise corridors into primary, secondary and tertiary

Primary corridors are identified as:

- Movement corridors that include patches of principal habitat which are contiguous (gaps between trees <100 m) and together contain greater than 380 ha

Secondary corridors are identified as:

- Movement corridors that include patches of principal habitat separated by more than 100 m from scattered trees or other principal habitat
- Are narrow or have pinch points of less than 50 m wide
- Together contain between 100 ha and 380 ha of principal habitat
- Otherwise, if containing greater than 380 ha of habitat or are not narrow, secondary corridors are those that do not connect to primary corridors on both ends

Tertiary corridors are identified as:

- Patches of principal habitat not linked to primary corridors
- Together contain between 30 ha and 100 ha of principal habitat
- Do not connect to other corridors on both ends
- Otherwise, if containing greater than 100 ha of habitat, tertiary corridors are those that lead away from other corridors

After allocation of the above categories the mapping for the nominated areas was compared to the mapping completed by EES. Where discrepancies between the mapping were observed (due to the application of more subjective measures such as 'connecting at both ends') consideration was given to adopting the same categories as mapped by EES. In some circumstances the categorisation of the mapping within the nominated areas was updated to that applied by EES.

As stated above for areas outside the nominated areas the EES mapping was accepted without change, and the primary, secondary and tertiary corridors match those defined by EES. In addition, lands identified as potential restoration areas by EES were adopted within and outside the nominated areas.

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)Step 4 of the method for this Assessment Report is also included within a broader step of the EES report (refer to Section 3.5 of the EES report) relating to the delineation of koala movement corridors. It was separated in the method for this report for the sake of clarity.

The actual method in this Assessment Report for categorising corridors into primary, secondary and tertiary is the same as the EES report. However, some rewording has been done.

Step 5: Define important habitat

Important habitat comprises the species polygons for Koala. It is made up of primary, secondary and tertiary corridors.

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)

Step 5 of the method for this Assessment Report was required by the BAM and was in addition to the EES report.

The rationale for defining important habitat as primary, secondary and tertiary corridors is was considered appropriate as it identifies the areas that are critical to the long-term viability of koalas (primary corridors) and the areas (if enhanced) that would support the population (secondary corridors). Including tertiary corridors in important habitat ensures the mapping is precautionary and captures a broad definition of koala habitat.

This approach was discussed with EES at the time of preparing the method.

Mapping method for GPEC and WSA

The Koala habitat mapping method for GPEC and WSA is based on similar high-level concepts as the mapping for Wilton and GMAC. However, due to the general lack of records within the two nominated areas all habitat is mapped as 'supporting' habitat.

There are two steps in the mapping method:

1. Review Koala records to determine the importance of the two nominated areas for Koalas
2. Map supporting Koala habitat

Spatial scope of the mapping

The spatial scope of the mapping for this method included the GPEC and WSA boundaries.

Step 1: Review Koala records

The BioNet record database was examined to determine the likelihood that Koalas are present within GPEC and WSA. It is noted that there are high human population densities in both areas, particularly within GPEC, and therefore an absence of records likely reflects an absence of Koalas (as opposed to an absence of surveys). There are no records of Koalas within WSA, and only two Koala records within GPEC dated from 1990 (in Blackett and Oxley Park). A small number of records also occur in semi-rural areas north of GPEC, as follows:

- Two records dated from 1984/85 in the Londonderry locality
- One record is dated from 2006 and located in a biodiversity offset site near Colebee
- Three records are dated from 2018 and located to the west of Shanes Park

Further Koala records are located to the west of the GPEC and WSA, within and in proximity to areas of remnant vegetation associated with the eastern boundary of the Blue Mountains.

Whilst a small number of Koala records occur within and in the vicinity of GPEC and WSA, the scarcity of these records, and the length of time between sightings, suggests that Koalas are extremely rare within the locality, and that it is very unlikely that there is a persistent population in the locality. Instead, it is more likely that Koala sightings within these localities are of dispersing individuals travelling between areas of more suitable habitat.

Koala habitat mapping, consideration of threatening processes, and koala BioNet records all suggest that:

- It is very unlikely that suitable koala habitat is present within either GPEC or WSA
- It is likely that any koalas present within GPEC or WSA are dispersing between areas of more suitable habitat

It is therefore considered that any Koalas within the GPEC or WSA would likely constitute individuals which have dispersed from the Blue Mountains Koala population, as this is the closest habitat area which is known to support a self-sustaining and expanding population from which Koalas are known to disperse.

Based on this, it was determined that there was no principal habitat within the two nominated areas and any habitat that is present should be mapped as supporting.

Step 2: Map supporting Koala habitat

Supporting habitat within GPEC and WSA was mapped using the PCTs in Table 11-26. These PCTs were identified based on the presence of Koala feed trees and definition of HQH and MQH, as described above, or through the PCT associations listed in the TBDC.

Table 11-26: PCTs - Supporting Koala habitat GPEC and WSA

PCT No.	PCT Name
724	Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion

PCT No.	PCT Name
725	Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion
1105	River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

Consistency with *Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas* (DPIE, 2019)

Mapping of koala habitat in GPEC and WSA is not included in the EES report as the areas do not relate to the Wollondilly and Campbelltown LGAs.

The mapping that was applied for this Assessment Report for GPEC and WSA was generally based on similar high-level concepts to the EES report. However, due to the lack of records all habitat within the two nominated areas was mapped as 'supporting' habitat.

It should be noted that the koala was excluded as a candidate SCS in GPEC and WSA (see Section 11.1.1 for context). This was determined on the basis of:

- Habitat mapping
- Consideration of threatening processes
- Consideration of distribution of koala records

HABITAT CONNECTIVITY MAPPING – GAPCLOSR

Mapping of habitat connectivity was undertaken using a GIS-based spatial analytical framework known as the Generalised Approach to Planning Connectivity at Local and Regional Scales (GAPCLoSR) (Biolink, 2018). The text below provides a high level summary of that work, and the full report should be read to understand the project.

GAPCLoSR enables examination of issues associated with landscape connectivity and fragmentation. However, it is noted that the model only considers the length and arrangement of dispersal pathways; it does not consider other important factors which impact corridor usage (such as corridor width). The model is therefore useful as a support tool which enables more detailed analysis.

GAPCLoSR takes into account two key factors:

- The ecological needs and movement characteristics of the target species (e.g. the key characteristics of preferred habitat, the distribution and extent of preferred habitat, the greatest distance of open ground which can be crossed by the target species and the total distance which can be moved across the landscape by the species)
- The extent to which the existing landscape enables, influences and/or impedes movement of the target species

The program was used to investigate three different scenarios:

- **Baseline (*status quo*):** This constituted an analysis of the distribution of current habitat patches and connectivity through the Plan Area
- **Scenario 1:** This constituted analysis in which clearing occurred within the urban capable footprint, and where Appin Road was upgraded to a multi-lane dual carriageway with wildlife fencing on the eastern side of the road
- **Scenario 2:** This constituted analysis in which clearing occurred within the urban capable footprint, and where Appin Road was upgraded to a multi-lane dual carriageway with wildlife fencing on the eastern side of the road, with a wildlife crossing in place at the Ousedale-Mallaty corridor

Methodology

The basic model process involves inputting of key landscape features, determining the capacity for koala movement across each landscape feature, and then analysing the spatial distribution of the overall landscape to determine the degree of connectivity and fragmentation across the Plan Area.

Mapping landscape features

Key landscape features within the model included:

- Transport infrastructure (e.g. roads and railway lines)
- Hydrology (drainage lines, canals, etc.)
- Vegetation cover (including Preferred Koala Habitat)
- Mining and quarrying
- Agricultural areas (grazing and horticulture)
- Urban, commercial and industrial areas

Preferred Koala Habitat (PKH) was determined through the following process:

1. Vegetation mapping data was sourced from EES and from publicly available NSW Government databases
2. Vegetation maps were analysed, and the following areas were removed from analysis as being non-suitable for koala habitat:
    - Cleared areas
    - Highly-disturbed areas
    - Areas of scattered trees
    - Areas where satellite imagery did not match the vegetation type
3. Remaining vegetation layers are all considered to be Preferred Koala Habitat (PKH)
4. Areas of PKH were then classified into different sub-categories based on the availability of Preferred Koala Food Trees[1] (PKFTs). The following classes were made:
    - Primary Koala Habitat – where primary PKFTs comprise the dominant or co-dominant overstorey species
    - Secondary Koala Habitat (Class A) – where primary PKFTs are a sub-dominant component of the overstorey species
    - Secondary Koala Habitat (Class B) – primary PKFTs are absent, but the vegetation type is dominated by one or more 'secondary' PKFT
    - Secondary Koala Habitat (Class C) – primary PKFTs are absent, but one or more 'secondary' PKFTs are present as a sub-dominant component of the overstorey species
    - Other – does not contain PKFT
5. Each vegetation class was then assigned a different movement cost as follows:

[1] These include the following: *E. moluccana, E. longifolia, E. punctata, E. viminalis, E. tereticornis*

- Where PKH (of any class) is within a 'habitat patch' (i.e. area of habitat >10ha, an area defined by the authors), there are no movement costs
- When PKH is present as a corridor, Primary Koala Habitat has no movement cost, and Secondary Class Habitat has an increasing scale of movement cost (with the least movement cost for Class A, and the highest movement cost for Class C)

Allocating resistance values to landscape features

Each landscape feature was then assigned a Percentage Resistance Value (PRV). This value refers to the effort or cost it takes for a koala to cross a particular land-use type or class.

The resistance of the Plan Area to koala movement was then calculated as follows:

1. A rasterised surface was produced from land use layers of the Plan Area
2. Each pixel was then assigned a dispersal cost for koalas to cross at each point. Dispersal costs were calculated through considering each of the land use layers present for each pixel
3. In instances where multiple land use layers intersected at a particular point, it was important to define which data layer took precedence over the other. The following outlines the precedence in terms of their cost value:
   a) Connectivity structures spanning roads, train lines and aqueducts
   b) Train lines and aqueducts
   c) Roads
   d) Hydrology
   e) Vegetation cover (including PKH and non-PKH)
   f) Urban / commercial / industrial / agricultural land uses
4. A Gap Crossing Layer of 220 m was applied as a buffer around all vegetation, which was taken to be the maximum distance that a koala would travel across an open area (based on Euclidian distance of all koala records within the region from the nearest patch of mapped vegetation)

Mapping habitat connectivity

The locations and importance of connectivity corridors through the Plan Area were then modelled as follows:

a) The PRV of each pixel was examined
b) The cumulative PRV cost of any potential pathway between habitat patches was calculated
c) If the cumulative PRV cost of any potential pathway between habitat patches exceeded a threshold value, then a pathway would not be formed

It is noted that this method for identifying connectivity corridors does not rely on the Euclidian distance between habitat patches, but instead considers how hostile the landscape is to movement.

HABITAT CRITICAL TO THE SURVIVAL OF THE SPECIES MAPPING

In order to address the requirements of the EPBC Act referral guidelines for the vulnerable Koala (DoE, 2014) a map was prepared to identify habitat critical to the survival of the Koala. This mapping was prepared by adapting the method proposed in Koala Habitat Assessment Tool (KHAT) (Table 4, (DoE, 2014)) for use with the data available within the nominated areas and broader Strategic Assessment Area.

The KHAT scores five attributes related to the quality and extent of Koala habitat, with each attribute scored out of 2. A total score of 10 is possible, and habitat a score of five or greater is habitat critical to the survival of the Koala. The five attributes considered in the KHAT are:

- Koala occurrence
- Vegetation composition
- Habitat connectivity
- Key existing threats
- Recovery value

A number of data sets were compiled for use in the mapping of habitat critical to the survival of the Koala within the Strategic Assessment Area. A method was then prepared based on the KHAT for use in the Strategic Assessment Area.

As a first step the habitat units to be assessed were defined by combining a compilation vegetation data set (see table below) with the mapping of Koala corridors for this project. These units were then interrogated against several different data sets (Step 2 – Step 6) to identify habitat critical to the survival of the Koala. Data sets used to define habitat critical to the survival of the Koala include Koala sighting records (OEH, 2019), Koala corridor mapping, an assessment of connectivity and key existing threats (road kill records (OEH, 2019) and adjacency to urban areas).

The method applied is described in Table 11-27.

Table 11-27: Method used to map habitat critical to the survival of the Koala within the Strategic Assessment Area

Step	KHAT attribute	Approach	Score allocated	Data used
Step 1	N/A	Habitat units were defined by combining a compilation vegetation data set (see column 5) with the mapping of Koala corridors. Koala corridors were assigned to individual habitat units by Plant Community Type (PCT) and broad vegetation condition (intact, scattered etc.) All internal line work between habitat units was dissolved where PCT, condition and corridor rank were identical. In the case of a Koala corridor not being allocated a PCT or condition state due to the land not being identified as native vegetation: Polygons smaller than 0.5 ha were removed from the habitat units layer Polygons >0.5 ha were allocated a PCT of 9999 and a condition of Unknown The habitat units were used as the based layer for the assessment	N/A	Compilation vegetation data set (100 km buffer from Cumberland subregion). Layer includes Biosis nominated area vegetation mapping, and where this isn't available a compilation of the best available data sets, including: • Remnant Vegetation of the western Cumberland subregion, 2013. VIS_ID 4207 • The Native Vegetation of the Sydney Metropolitan Area - Version 3.1 (OEH, 2016b) VIS_ID 4489 • South East Local Land Services Biometric vegetation map, 2014. VIS_ID 4211 • Southeast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230 • Koala corridor mapping
Step 2	Koala occurrence	Koala occurrence was scored based on Koala records recorded within, and adjacent to, the Strategic Assessment Area over a five year period (2016 – 2021). Distance buffers were applied to allocate appropriate scores	2 - Within 1 km of a record 1 - Within 1-2 km from a record 0 - Beyond 2 km from a record	Koala BioNet species records (EES, 2021)
Step 3	Vegetation composition	Each habitat unit was allocated a vegetation composition score. The Koala corridors mapped for the Strategic Assessment Area were used as a surrogate for this score	2 - Primary and secondary corridors 1 - Tertiary corridors 0 - Supporting habitat	Koala corridor mapping

Step	KHAT attribute	Approach	Score allocated	Data used
Step 4	Habitat connectivity	A score for habitat connectivity was calculated for each habitat unit. This was done by, first, calculating the patch size of each habitat unit. Habitat units were considered to be part of the same patch where adjacent or within 100 m of another patch Patches were then separated where intersected by a major road or rail line as these features are likely to create barriers to the movement of corridors. The roads identified for this analysis include those classified as Arterial, Motorway or Primary Road	2 - >500 ha of contiguous habitat 1 - 300-500 ha of contiguous habitat 0 - <300ha of contiguous habitat	NSW Spatial Data Services (Six Clip and Ship) (2021) – Railway and Road Segment (where road = Arterial, Motorway or Primary Road)
Step 5	Key existing threats	Key existing threats were assessed, with the lower score taken for each habitat unit Threat from road kill was determined by calculating the distance from each road kill record to each habitat unit. The threat from existing urban development was determined by calculating the distance from existing urban areas to each habitat unit	The lowest of: Threat from road kill (road kill records from 2016 - 20121). 2 - >2 km from road kill record 1 - 1-2 km from road kill record 0 - 0-1 km from road kill record Threat from urban land use (adjacency to urban land): 2 - >2 km from existing urban area 1 - 1-2 km from existing urban area 0 - 0-1 km from existing urban area	Koala BioNet species records (observation type = roadkill) (EES, 2021) NSW Spatial Data Services (SiX Clip and Ship) (2021) – General cultural area (where area = Builtup)
Step 6	Recovery value	Each habitat unit was allocated a score based on whether the habitat is likely to be important for achieving the interim recovery objectives for the species. The Koala corridors mapped for the Strategic Assessment Area were used as a surrogate for this score	2 - Primary and secondary corridors 1 - Tertiary corridors 0 - Supporting habitat	Koala corridor mapping

11.6 OTHER MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The assessment considered all protected matters that may be impacted directly, indirectly and cumulatively by actions taken under the Plan and identified the following groups of protected matters as being relevant to the assessment in addition to listed threatened species and ecological communities:

- Commonwealth land
- Migratory species
- Wetlands of international importance (Ramsar wetlands)
- World and National Heritage

11.6.1 COMMONWEALTH LAND

PURPOSE

The Commonwealth land assessment considered the whole of the environment that might be affected over the life of the Plan. As required by Section 4.3 of the ToR, the assessment was undertaken to "describe and assess separately the likely impacts (if any) of actions taken under the Plan on the environment on Commonwealth land (as defined in section 528 of the EPBC Act)".

METHOD

All known areas of Commonwealth land within the Strategic Assessment Area were assessed. The location of these areas was identified with the help of DAWE and relevant NSW Government agencies. Consideration was also given to areas of Commonwealth land outside of the Strategic Assessment Area that may be affected indirectly by the classes of action.

Desktop information was used to understand the environment on Commonwealth land. Environmental values are presented in relation to soils, waterways and topography, vegetation, fauna, rare or sensitive values, heritage and information on the biodiversity landscape context of the site.

The assessment has been framed around the Commonwealth's 'Significant Impact Guidelines 1.2 – Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies'.

RESULTS

A profile of the environment on each of the Commonwealth land sites is provided in Chapter 35.

11.6.2 MIGRATORY SPECIES

PURPOSE

Section 3.2 of the ToR requires the SAR to describe for the Strategic Assessment Area the protected matters that may be impacted directly, indirectly and cumulatively by actions taken under the Plan. This includes:

- Identification of key sites and habitats
- Identification of important populations

METHOD

The migratory species relevant to the assessment include:

- Nine species addressed in the *Referral guideline for 14 migratory birds listed under the EPBC Act* (migratory bird referral guidelines), released in September 2015 (DoE, 2015)
- 21 species addressed in the *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (migratory shorebird referral guidelines), released in 2017 (DoEE, 2017)

The approach to understanding the values within the Strategic Assessment Area for each of these migratory species was framed around the key elements of these guidelines.

Migratory bird species

For the nine migratory bird species, the assessment drew on the concepts of important habitat and ecologically significant proportions of a population. Important habitat for each species was identified based on the PCTs that correspond to the important habitat descriptions set out in the passerine bird referral guidelines.

Ecologically significant proportions of a population of each of the species was determined using observation records from Birdlife Australia, the Atlas of Living Australia, and BioNet Atlas. The analysis used a conservative estimate of individuals based on the total recorded sightings of each species per year across the Cumberland subregion.

Migratory shorebird species

Habitat mapping was undertaken broadly in accordance with the approach outlined in the EPBC guidelines (DoEE, 2017). However, the method applied was more precautionary than required under the EPBC guidelines to ensure that no important habitat sites were missed.

The process involved the following steps:

Step 1: Analysis of records across the Cumberland subregion

Records were compiled and examined across the whole of the Cumberland subregion. The initial step considered the subregion as a single habitat unit to determine which species exceeded the thresholds for important habitat across the whole area (i.e. which species occur in numbers greater than the threshold when records in the subregion are summed).

Step 2: Identification of important migratory shorebird habitat sites

The spatial distribution of records was then assessed to identify the individual wetland and waterbody (or wetland mosaic) where the thresholds were exceeded at a site level. Each wetland that was identified as important for migratory shorebirds had its boundary marked and a 250 m buffer applied. This buffer distance is consistent with the guidelines which suggest buffer distances ranging from 165 to 255 m to mitigate against disturbance (DoEE, 2017).

For ephemeral wetlands the threshold was considered across every year where records were held.

For permanent wetlands, the guidelines suggest considering the last five years. The approach taken for this assessment was to look at records for the last 20 years (since 2000) for sites that were thought to be permanent. This acknowledges the uncertainty in determining if habitat sites are permanent or ephemeral across the Strategic Assessment Area.

Step 3: Identification of potential migratory shorebird habitat

The remaining potential migratory shorebird habitat in the subregion was determined based on the presence of suitable wetlands throughout the landscape that exceed 1.5 ha in area. This 1.5 ha threshold was used as a proxy for the minimum disturbance distance for shorebirds of 150 m.

Wetland mapping layers were interrogated from the Directory of Important Wetlands (DoEE, 2018) and the LPI topographical data Hydro Area layer (LPI, 2016) to identify areas of potential habitat.

RESULTS

The results of the migratory bird and migratory shorebird habitat assessment is provided in Chapter 32.

11.6.3 WETLANDS OF INTERNATIONAL IMPORTANCE (RAMSAR WETLANDS)

PURPOSE

Section 3.2 of the ToR requires the SAR to describe for the Strategic Assessment Area the protected matters that may be impacted directly, indirectly and cumulatively by actions taken under the Plan. This includes:

- Identification of key sites and habitats
- Condition of protected matters, including where relevant, seasonal and annual variability, and their likelihood to alter over time
- Key threatening processes

METHOD

Towra Point Nature Reserve Wetland is the only Ramsar wetland relevant to the assessment. It is located outside of the Strategic Assessment Area. Available desktop information was used to understand the environmental values at Towra Point Nature Reserve. The assessment focused on the ecological character of the wetland, which is a key concept under the Ramsar Convention and the main element for the consideration of significant impacts under the EPBC Act.

RESULTS

The description of the environmental values at Towra Point Nature Reserve is provided in Chapter 33.

11.6.4 WORLD AND NATIONAL HERITAGE

PURPOSE

Section 3.2 of the ToR requires the SAR to describe for the Strategic Assessment Area the protected matters that may be impacted directly, indirectly and cumulatively by actions taken under the Plan.

METHOD

A description of the World and National Heritage properties relevant to the assessment was developed based on available desktop information. For World Heritage, the assessment focused on the Outstanding Universal Value of the property, including an understanding of the attributes that meet the relevant listing criteria, how the property meets the conditions of integrity and the way in which the property is protected and managed.

For National Heritage, a description of each site focused on the heritage values that meet the criteria for listing.

RESULTS

A description of the World and National Heritage properties relevant to the assessment is provided in Chapter 34.

12 Approach to the impact assessment

The approach to analysing and assessing the impacts of the development under the Plan is set out in detail in each of the relevant Chapters of the Assessment Report, as follows:

- Avoiding and minimising impacts – see Chapter 14
- Addressing serious and irreversible impacts – see Chapter 25
- Assessing:
    - Direct impacts:
        - see Chapter 23 for the approach to NSW-listed matters
        - see Chapters 27-35 for the approach to Commonwealth-listed matters
    - Indirect impacts – see Chapter 15 for the approach to NSW and Commonwealth-listed matters
    - Prescribed impacts – see Chapter 24
    - Cumulative impacts – see Chapter 38
- Evaluation of the overall acceptability of the Plan – see Chapter 41

13 Data and limitations

This Chapter:

- Summarises the key types of information used in the Assessment Report
- Describes the key data sets on biodiversity values and how they were used
- Identifies the key limitations associated with:
  - Field surveys
  - Vegetation and species mapping
  - BAM credit calculations

The data and limitations associated with the preparation of specific reports that informed this Assessment Report, such as expert reports and the trend analysis, are described in these documents (see Supporting Documents C and D).

As described in Chapter 10, the technical methods for describing the EPBC protected matters impacted by the Plan were independently peer-reviewed to meet a requirement of the ToR. The peer review report (see Supporting Document B) concluded that in general:

- The data sets, methods for data collection and assumptions associated with the methods are appropriate for a large-scale strategic assessment process such as this project
- The methods used are generally conservative and are unlikely to under-represent the presence or distribution of any TEC or species (and are more likely to over-predict presence and distributions)

The peer review report recommended that further details associated with the input data and assumptions be provided in the Assessment Report to provide regulators and the public more complete understanding of limitations, including:

- Categorisation of EPBC species – further explain limitations associated with information sources used in the categorisation process, including whether they incorporate up to date information and their relevant scale
- TEC mapping method – provide further details associated with the input data, including details of the extent and dates of field validation undertaken for the source mapping
- Species Distribution Modelling – provide further details associated with the assumptions of the model to provide a more complete understanding of the factors affecting the outcomes of the model
- Assumed presence using a knowledge-based method – the exclusion of habitat based on patch size needs to be explained and justified
- Important populations – for the species that have been determined not to have important populations within the subregion and have had records excluded based on the lifespan of the species, discuss implications of this approach

These limitations are discussed in Section 13.3.

13.1 TYPES OF INFORMATION SOURCES

A wide variety of information sources and processes were used to prepare the Assessment Report, including:

- Data sets on biodiversity values
- Surveys and field verification
- Scientific literature
- Government strategies, plans, policies and guidelines
- Use of expert reports under the BAM
- Existing knowledge of ecological consultants
- Expert workshops, including technical representatives from EES
- Expert elicitation for the trend analysis (see Supporting Document D)

The information used in this Assessment Report is consistent with the requirements of the BAM and the ToR.

The data sets used across the nominated areas and broader Strategic Assessment Area represent the best available information on biodiversity and other values and were drawn from a wide variety of sources. Where land access was granted, field surveys and verification were undertaken to improve the data.

13.2 KEY DATA SETS

A large number of data sets were collated and generated for use in the Assessment Report. These are summarised in Table 13-1. The data sets cover a range of themes, including:

- Vegetation mapping
- Mapping of species distribution and habitat
- Mapping of protected lands and other conservation planning information
- Soil, geology and landscape mapping
- Mapping of topographic features such as water bodies and drainage lines

13.2.1 LIDAR DATA

LiDAR data was also used in the development of the native vegetation map and species polygons (see Attachment B, Section B.5 for further details on the LiDAR data used for species polygons).

The LiDAR metadata is as follows:

- Source: A Division of Department of Finance, Services and Innovation - PENRITH, 2kmx2km Point Cloud Metadata (https://s3-ap-southeast-2.amazonaws.com/nsw.elvis/z56/Metadata/Penrith201102-LID1-C3-AHD_2826250_56_0002_0002_Metadata.html#)
- Abstract: The coverage of this dataset is over the PENRITH region. Data of this specification (Spatial Services Category 1 LiDAR) contains point data in LAS format sourced from a LiDAR (Light Detection and Ranging) ALS50 (SN101) sensor. The processed data has been manually edited to achieve ICSM Classification Level 3 whereby the ground class contains minimal non-ground points such as vegetation, water, bridges, temporary features, jetties etc. This data has an accuracy of 0.3m (95% Confidence Interval) vertical and 0.8m (95% Confidence Interval) horizontal with a minimum point density of 1.05 points per square metre. For more information on the data accuracy, refer to the lineage provided in the data history
- Purpose: To provide fit-for-purpose elevation data for use in applications related to coastal vulnerability assessment, natural resource management (especially water and forests), transportation and urban planning
- Topic Category: location, elevation, geoscientific information
- Acquisition Start Date: 2011-02-24
- Acquisition End Date: 2011-02-24
- Spatial Accuracy Horizontal: +/-0.80@95% Confidence Interval
- Spatial Accuracy Vertical: +/-0.30 @95% Confidence Interval

Table 13-1: Sources of data used in the Assessment Report

Data set theme	Data set name	Custodian	Date	Details	Use on project
Drainage and water bodies	Directory of Important Wetlands	DAWE	2018	Data set containing boundaries for wetlands listed on the Directory of Important Wetlands	Used in determining the landscape context components of the BAM plus mapping for water dependant species
	NSW Digital Topgraphic Database - Hydro Areas Dataset	LPI	2019	Data set containing boundaries of hydrography feature types - water body areas and water courses	Used to inform the assessment of prescribed impacts for hydrology and water bodies
Land use	NSW land use polygons	EES	2013	NSW land use information including food production, forestry, nature conservation, infrastructure and urban development	Layer used in preparing native vegetation mapping for the nominated areas
Protected lands and conservation planning	Biobank sites	EES	2019	Data layer containing boundaries of Biobank sites	Layer used in determining the amount of protected land within the Plan Area
	Conservation agreements	EES	2018	Data layer containing boundaries of conservation agreements	Layer used in determining the amount of protected land within the Plan Area
	Cumberland subregion BIO Map	EES	2015	A map of core areas and corridors identified in western Sydney	Used to calculate impacts to, and protection of, important landscape features and as a surrogate for connectivity
	Metro Region biodiversity offsets	EES	2018	Data layer containing boundaries of known biodiversity offsets protected under relevant covenants governed by the relevant local Council, in the Sydney Metropolitan Region	Layer used in determining the amount of protected land within the Plan Area
	NCT Agreements	EES	2018	Data layer containing boundaries of Nature Conservation Trust Agreements	Layer used in determining the amount of protected land within the Plan Area
	NSW National Parks Estate	EES	2020	Data layer containing boundaries of National Parks, Nature Reserves and other NPWS estate	Layer used in determining the amount of protected land within the Plan Area
	Perpetual Lease Covenant	EES	2018	Data layer containing boundaries of Perpetual Lease Covenants	Layer used in determining the amount of protected land within the Plan Area

Data set theme	Data set name	Custodian	Date	Details	Use on project
	Registered Property Agreements	EES	2018	Data layer containing boundaries of Registered Property Agreements	Layer used in determining the amount of protected land within the Plan Area
Soils, geology and landscapes	NSW (Mitchell) Landscapes Version 3.1	EES	2002	Mapping of landscapes in NSW defined by landform, topography, geology, soil, climate and vegetation	Soil landscape assessment as part of the BAM assessment
	LiDAR data	New South Wales Spatial Services	2018	Layer containing LiDAR point cloud for nominated areas. LiDAR data used of varying currency, and is generally captured in 2011 across the nominated areas	Preparation of a Canopy Height Model (CHM) to assist vegetation mapping preparation within the nominated areas and identification of topographic features such as cliff lines etc.
	NSW Soil Landscapes	EES	2017	Mapping provides an inventory of soil and landscape properties and identifies major soil and landscape qualities and constraints	Soil hazard assessment as part of the BAM assessment, informed vegetation mapping
	Topographic data (Digital Topographic Database)	New South Wales Spatial Services	2019	A range of data sets which display topographic features, such as contours, drainage features and water bodies	Used for a number of project tasks including species polygons and distribution mapping, shorebird mapping and vegetation mapping
	Western Sydney Hydrogeological Landscapes	EES	2011	Spatial layer defining the areas of similar salt stores and pathways for salt mobilisation	Soil landscape assessment as part of the BAM assessment
Species sightings and habitat	BioNet (Wildlife Atlas) records of species sightings in western Sydney and surrounds – download of records provided by the Department	EES	2018, 2019, 2020 and 2021	Fauna and flora sightings records stored in the NSW BioNet database	Used for a number of project tasks including species habitat mapping, one input for species distribution models, an input into determining whether a species requires needs consideration under the EPBC Act, and an input into determining whether a species is a candidate species for the BAM assessment
	Conserving Koalas in Wollondilly and Campbelltown LGAs	EES	2019	Koala habitat and corridor mapping of the Appin, Wilton and Picton areas of Sydney	Data layer used to inform updated koala corridor mapping within the nominated areas. Layer accepted without modification outside nominated areas

Data set theme	Data set name	Custodian	Date	Details	Use on project
	New Atlas of Australian Birds	BirdLife Australia	1998-2015	Bird sightings database administered by BirdLife Australia	Used in the preparation of species polygons for bird species
Vegetation mapping	Remnant Vegetation of the western Cumberland subregion, 2013 Update. VIS_ID 4207	EES	2013	Vegetation data layer covering western Sydney. Update of the Remnant Vegetation Mapping of the Cumberland Plain (OEH, 2013b). Contains details on Plant Community Type (PCT), map unit and dated condition information	Used as part of a compilation vegetation data set outside the nominated areas. One of the inputs for species polygons outside the nominated areas
	South East Local Land Services Biometric vegetation map, 2014. VIS_ID 4211	EES	2015	A seamless standardised vegetation map, from a combination of existing available data, which covers the full extent of the South East Local Land Services (SE LLS) region. Compiled from best available data sets in the region. Contains information on PCTs and map units	Used as part of a compilation vegetation data set outside the nominated areas. One of the inputs for species polygons outside the nominated areas
	Southeast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230	EES	2010	Classification, descriptions and mapping of native vegetation types of southeast NSW (including the South Coast and parts of the eastern tablelands)	Used as part of a compilation vegetation data set outside the nominated areas. One of the inputs for species polygons outside the nominated areas
	The Native Vegetation of the Sydney Metropolitan Area - Version 3.1 VIS_ID 4489	EES	2016	Vegetation data layer covering the Sydney metropolitan area. Extends west to cover all of Georges and Parramatta River catchments. Contains details on PCT, map unit, TEC, and disturbance	Used as part of a compilation vegetation data set outside the nominated areas. One of the inputs for species polygons outside the nominated areas

13.3 LIMITATIONS

There are a number of limitations associated with the collection and use of data in this Assessment Report.

The limitations can be categorised into three main themes:

- Field survey limitations (i.e. land access, project scale, data and drought)
- Vegetation and species mapping limitations
- BAM credit calculation limitations

13.3.1 FIELD SURVEYS

Table 13-2 identifies limitations with field surveys and provides comment on the implications of these limitations or any precautionary measures that were taken to address these.

Table 13-2: Limitations of field surveys

Limitation	Comment
BAM native vegetation plots and threatened species surveys were only undertaken within the nominated areas, and were not undertaken within the transport corridors outside the nominated areas	While the best available data was used to assess impacts of the transport corridors outside the nominated areas, the assessment may be less accurate as it is based on existing data that has not been recently confirmed
Within the nominated areas, BAM native vegetation plots and threatened species surveys were restricted to sites where access was granted by landholders. While the number and distribution of BAM plots met BAM requirements, limited land access meant surveys were not possible across the entire urban capable land	The Department undertook an extensive program to seek approval from landholders for land access, involving: • Letter mailouts to landholders in the nominated areas • Follow-up emails or phone calls to public landholders and businesses such as developers where phone numbers were publicly available • Door knocking (Biosis) in high priority areas for surveys where no responses were received
Targeted species surveys were not always undertaken strictly in accordance with EES survey guidelines due to the very large scale of the Plan Area	Species were assumed to be present based on potential habitat maps created using a knowledge-based method, refined by ground validation species or habitat presence/absence surveys. See further justification related to surveys in Section 11.5.2
For some BAM plots, some BAM data components were based on existing BBAM plot data	In these cases, sites were re-visited and the additional BAM data components were captured to ensure the plot data was consistent with BAM
The survey period was exceptionally dry. Significant rainfall deficiencies occurred across eastern Australia and the eighth-lowest January to November rainfall since 1900 was recorded for NSW for 2018 Rainfall was in the lowest 10 per cent of all years for Western Sydney. NSW had its warmest January–November period on record for 2018, compounding the impact of low rainfall (BOM, 2019)	These conditions are likely to have affected the results of the field surveys – likely reducing vegetation integrity scores and the ability to detect some flora species

13.3.2 MAPPING AND OTHER METHODS

Table 13-3 identifies limitations with vegetation and species mapping and provides comment on the implications of these limitations or any precautionary measures that were taken to address these.

Table 13-3: Limitations of mapping and other methods

Limitation	Comment
The criteria used to categorise EPBC matters needing assessment was applied based largely on existing data	There may be limitations associated with the quality and accuracy of the existing data, such as DAWE's species distribution maps. However, the best available information was used in applying the criteria The criteria used to categorise EPBC matters is generally objective and does not involve subjective judgement. Where applying the criteria involved judgement (criteria 3), expert ecologists from Biosis were used
Mapping - general Native vegetation, TEC and species polygons were prepared based largely on existing data	The final outputs from the mapping and modelling will be limited by the input data. Poor quality (i.e. inaccurate species data, soil mapping or vegetation mapping) or missing data may result in the identification of conservation priorities or potential development impacts that do not align with the on-ground environment
On-ground validation of native vegetation, TEC and species mapping was only undertaken within the nominated areas where land access was granted. No validation of mapping was undertaken within the transport corridors outside the nominated areas	While the best available data was used to assess impacts of the transport corridors outside the nominated areas, the assessment may be less accurate as it is based on existing data that has not been recently confirmed
Assumptions were made about PCT types and condition for areas not surveyed. The type of PCT was assumed to be correct where native vegetation extent aligns with PCTs as mapped by EES (2013, 2016),soil/landscape mapping aligned with the PCT description, and assessment of all other datasets and aerial imagery did not provide a more likely alternative	At suitable vantage points in public areas, ecologists confirmed continuity of vegetation communities, assessed broad condition state and level of habitat degradation and verified existing vegetation mapping where access was unavailable
The vegetation mapping within the 1500 m buffer for the assessment under the BAM was undertaken using existing vegetation mapping only and therefore the native vegetation extent for derived grasslands is likely to be under-represented	
TEC mapping TEC mapping is based on the native vegetation mapping and is subject to the same limitations (discussed above) Due to data limitations, some assumptions were made to establish the rule-sets used to map Commonwealth and NSW listed TECs	Details of the rule-sets used to map EPBC TECs and the field validation undertaken for the TEC mapping within the nominated areas are provided in Chapter 11 The peer review concluded that the TEC mapping method used is generally conservative and is more likely to over-predict distribution of TECs
Post-submissions mapping updates Following submissions received from BAM Accredited Assessors, PCT mapping was updated in a number of locations across the nominated areas. This has resulted in both changes to vegetation type and condition, as well as extent (including polygon geometry)	Updates to PCT mapping has resulted in changes to dependent datasets including TECs and species polygons. Were updates were required to species polygons developed by species exerts, these changes were discusses with the experts and broadly accepted
Species polygons (mapping) Some candidate SCS were considered to be too cryptic for detection or difficult to map and model	These species were assigned to recognised experts for assessment (BAM expert reports)
Species polygons - Assumed presence using a knowledge-based method	The habitat parameter rule-sets used to map species were based on the best available information sourced

Limitation	Comment
Only potential habitat for species was able to be mapped due to the very large scale of the Plan Area. The species polygons are therefore likely to be precautionary and greatly overpredict actual habitat Due to data limitations, some assumptions were made to establish the habitat parameter rule-sets used to map species habitat For species with known patch size thresholds identified in scientific literature, the rule-set included exclusion of small patches of native vegetation from the species map to provide a more accurate prediction of potential habitat	from SPRAT and BioNet profiles, NSW Threatened Biodiversity Data Collection, conservation advices, recovery plans and scientific literature. Where judgement was needed to make a decision, expert ecologists from Biosis were used Details of the habitat parameter rule-sets used to prepare species polygons and the field validation undertaken for the this mapping within the nominated areas are provided in Chapter 11 The peer review concluded that this species polygons method used is generally conservative and is more likely to overpredict species habitat
Epacris purpurascens var. *purpurascens* impacts have been calculated based on assumed presence using a knowledge-based method to determine the area of potential habitat present for the species within the nominated areas. Impacts to this species are required to be presented as an impact to stems/individuals (a 'count' species) in accordance with the BAM. As generating a count of impacted stems/individuals is not possible using the KMB, an estimate of stems/individuals impacted was made based on existing BioNet data	The estimated impact to *Epacris purpurascens* var. *purpurascens* stems/individuals is based on all existing records for the species within 20 kms of the modelled habitat, and is considered to be a conservative overestimate of the level of actual impact to the species Details of the method used to estimate impacts is provided in Chapter 26
Species polygons – Species Distribution Modelling All data used for species distribution models was based on presence-only data, meaning it is data without any 'absence' records of species (i.e. where observers have not noted the absence of a species at surveyed sites)	Undertaking SDM modelling with presence-only data results in relative measures of habitat suitability. A location with a predicted high habitat suitability score is only high relative to other locations in the Plan Area, and not necessarily high-quality habitat in absolute terms
The study area for the SDM modelling was limited to a 10 km buffer around the Cumberland subregion. For some species, this comprises only a small part of their range, which may reduce the accuracy of the modelling	
SDM modelling does not account for factors such as historical accidents and competition with other species that may significantly drive species distributions	
SDM modelling may overpredict actual habitat in highly-modified landscapes such as the Cumberland subregion due to the standard assumptions regarding a species occupying its niche not applying in such landscapes	
There may be large amounts of bias in the species records	Species data used in the SDM modelling was cleaned (likely inaccurate records removed) and multiple bias layers were used in the modelling to address this bias
For some of the species, there may be false associations between records and PCTs due to spatial errors in the point locations and and/or the PCT maps	
Important populations The criteria used to identify important populations was applied based largely on existing data Due to data limitations, some assumptions were made in applying the criteria to identify important populations.	There may be limitations associated with the quality and accuracy of the existing data, such as information on species' Area of Occurrence. However, the best available information was used in applying the criteria Information was sourced from SPRAT/BioNet profiles,

Limitation	Comment
For some species, this included excluding records that were older than the lifespan of the species in some cases	Threatened Biodiversity Data Collection, conservation advices, recovery plans and scientific literature Where applying the criteria involved judgement (particularly criteria 7 and 9), expert ecologists from Biosis were used to inform decisions Excluding old records based on the lifespan of the species was undertaken for five fauna species. This was only done where few records existed and there were no recent records in the Cumberland subregion
Shorebird mapping Where count data has not been provided with a BioNet or Birds Australia record, each point has been assumed to represent one individual within the shorebird mapping	

13.3.3 BAM CREDIT CALCULATIONS

Table 13-4 identifies limitations with the BAM credit calculations and provides comment on the implications of these limitations or any precautionary measures that were taken to address these.

Table 13-4: Limitations of BAM credit calculations

Limitation	Comment
Some plot data collected in vegetation mapped as NOG has returned a Vegetation Integrity (VI) of >15 (the cut-off score for the requirement to offset endangered or critically endangered TECs)	This has occurred across a low proportion of the plots and is largely explained through either a high cover of a single native grass species in the ground layer (most often Common Couch *Cynodon dactylon*) or a high cover of "litter" as defined under the BAM (most often a result of dead and/or detached grass on the ground as a result of the unusually dry survey seasons)Furthermore, the majority of the BAM plot data shows the areas sampled to be of very low ecological condition All NOG vegetation zones were found to have a VI score of <15 when all collected plots are considered, as is required by the BAM
Where impacts to SCS were less than 0.005 ha (i.e. 0.00 when rounded to 2 decimal places), the impact was completely discounted and not entered into the BAM calculator	Such impacts typically relate to 'slivers' of slight mismatch between various spatial layers used to prepare the impact assessments
Impacts to candidate SCS were generally either allocated to a vegetation zone or NOG polygon for entry into the credit calculator. Where the habitat for the threatened species fell outside of these areas the impact was not entered into the BAM calculator and was identified as a prescribed impact	

Part 3 References

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CUMBERLAND PLAIN ASSESSMENT REPORT

PART 3: ATTACHMENTS

ATTACHMENT A - JUSTIFICATION FOR REMOVAL OF SPECIES CREDIT SPECIES

ATTACHMENT B - KNOWLEDGE-BASED METHOD PARAMETERS

ATTACHMENT C - BIOLOGICAL AND IMPORTANT POPULATION DEFINITIONS

ATTACHMENT D - ADDITIONAL DETAIL ON BAM PLOTS RECORDED WITHIN THE NOMINATED AREAS

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

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PREPARED BY:	
DATA:	N/A
CONTENT:	Calan Wharfe, Jane Raithby-Veall (Biosis) Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Mitchell Ross, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines) Darren James (DAJ Environmental)
REVIEWED BY:	
OPEN LINES:	Darren James (DAJ Environmental) Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor – BAAS18134
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VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 3 Attachment Contents

Part 3 Attachment List of Tables

A. Justification for removal of species credit species

This Attachment provides the justification for the removal of species credit species (SCS) from further assessment. Table A-1:

- Provides the full list of species identified using the BAM credit calculator in accordance with Step 1, Section 6.4 of the BAM
- Identifies the nominated areas in which the species is further assessed
- If relevant, justifies the removal of the species for needing further assessment in one or more of the nominated areas

As outlined in Section 11.1.1 of Chapter 11, relevant NSW-listed species were identified by application of the following three step process:

- Step A: Identification of an initial list of species (Step 1, Section 6.4 of the BAM)
- Step B: Initial exclusion of SCS (Steps 2 and 3, Section 6.4 of the BAM)
- Step C: Consideration of best available ecological data as provided by Section 6.1.1.2 of the BAM. This step involved:
    - Consideration of:
        - Best available ecological data
        - The Threatened Biodiversity Data Collection
        - Species records in BioNet
        - Published peer reviewed literature
    - Followed by application of the following factors for excluding SCS:
        - Geographic extent of a species occurring outside one or more of the nominated areas, or urban capable land
        - Lack of suitable habitat within one of more of the nominated areas or urban capable land
        - Lack of records in one or more of the nominated areas over the past 55 or more years (up to >200 years)

Please refer to Section 11.1.1 of Chapter 11 for a detailed discussion of the method and approach.

Given the complexity of information relating to Koala, a detailed standalone section is provided in Section A.2 (after Table A-1) that sets out the justification for excluding the species from GPEC and WSA.

A.1 JUSTIFICATION FOR REMOVAL OF SCS

Table A-1: Justification for removal of species credit species from requiring further assessment

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
Acacia bynoeana	Bynoe's Wattle	✓	✓	✓	✓	Yes	*Acacia bynoeana* is a shrub that occurs in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Habitat comprises heath or dry sclerophyll forest on sandy soils. It prefers open, sometimes slightly disturbed sites. Records occur in about 30 locations within the distribution of the species (OEH, 2019i). The closest records to the nominated areas occur immediately to the North East of Glenfield on sandy soils, outside the nominated areas The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.	Yes	No	N/A
Acacia gordonii	Gordon's wattle	R	X	X	X	No	*Acacia gordonii* is a shrub that is restricted to the north-west of Sydney. It has a disjunct distribution in the lower Blue Mountains and the Maroota/Glenorie area. Habitat comprises dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops. Records occur in only a few	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							locations in the lower Blue Mountains and Maroota/Glenorie area (OEH, 2019a). The species was removed as a candidate species in Wilton because: • Urban capable land is outside the geographic extent of the species • Associated PCTs do not occur within urban capable land			
Acacia prominens - endangered population	Gosford Wattle	R	X	R	R	No	*Acacia prominens* is a tree. The endangered population occurs outside the nominated areas in the Kogarah – Hurstville local government areas. This occurrence is disjunct from other occurrences of the population of the species and at the southern limit of the species range (NSW Scientific Committee, 1998a). The population was removed as a candidate species in Wilton, WSA, and GPEC due to the listed extent occurring outside urban capable land.	No	No	N/A
Acacia pubescens	Downy Wattle	✓	✓	✓	✓	Yes	*Acacia pubescens* is a shrub that occurs around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale, and Mountain Lagoon. Habitat comprises gravely soils, often with ironstone, within open woodland and forest in a variety of vegetation communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland	Yes	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							(OEH, 2019l). There are recent records of this species outside the nominated areas, and the species has the potential to occur within WSA. The other nominated areas contain mostly old records (from 1910 and 1960) with low spatial accuracy in areas that are now highly urbanised. This species is easily recognisable so is unlikely to be missed during surveys. The species was retained as a candidate species in all nominated areas due to suitable habitat that has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.			
Allocasuarina glareicola		X	X	R	✓	Yes	*Allocasuarina glareicola* is a shrub largely found in the vicinity of Castlereagh and Londonderry within an area of 27 km^2 (Fairley, 2004). An outlier population occurs on Commonwealth land at the Holsworthy Military Area, south-west of Sydney (French, Pellow et al., 2001). Habitat comprises open Castlereagh woodland, growing on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil (DEWHA, 2008a). Preferred soils for the species are found in GPEC around the Penrith Lakes area.	Yes	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							The species was retained as a candidate species in GPEC because suitable habitat has the potential to occur in urban capable land. The species was removed in WSA because of a lack of records and a lack of suitable habitat within urban capable land.			
*Anthochaera phrygia**	Regent Honeyeater	R	R	R	R	No	*Anthochaera phrygia* is a medium sized bird mainly confined to its two main breeding areas in NSW (at Capertee Valley and the Bundarra-Barraba region) and surrounding fragmented woodlands. Minor and sporadic breeding occurs in other areas such as Warrumbungle National Park, Pilliga forests, Mudgee-Wollar region, and the Hunter and Clarence Valleys (NSW Scientific Committee, 2010). Habitat comprises dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Until very recently, all records in the Cumberland subregion related to foraging birds. However, at the end of 2019 a pair was observed successfully breeding near Mulgoa at Fernhill Estate, just west of the boundary between the WSA and GPEC. The nest was recorded in vegetation mapped as Shale Sandstone Transition Forest. It is connected to the much broader areas of intact vegetation west of the Strategic Assessment Area; although the nest site itself is	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							towards the interface of this vegetation and cleared rural land. The site is protected and managed in perpetuity under a biobanking agreement. The species was removed as a candidate species from all nominated areas because EES confirmed mapped important habitat for the species does not occur within urban capable lands.			
Burhinus grallarius	Bush Stone-curlew	R	R	R	R	No	*Burhinus grallarius* is a large bird that occurs throughout much of Australia, although in the south-east it is rare or extinct throughout its former range. Habitat comprises open woodlands with few shrubs, and short, sparse grasses of less than 15 cm, with scattered fallen timber, leaf litter and bare ground present (NSW DEC, 2006). Habitat is associated with broad ground and understorey structural features and is not necessarily associated with any particular vegetation communities. Removal of fallen timber affects the suitability of habitat as this comprises foraging habitat and the species relies on it for camouflage when roosting (NSW DEC, 2006). Records occur across the Cumberland subregion, but there are few recent records and no records within WSA or Wilton. Records only occur within GPEC and GMAC, a total of four within GPEC, and five within GMAC. GPEC records are prior to 1996 from within the RAAF base at Orchard Hills. As no new BioNet records of the	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							species exist in that location for over the last 23 years, more than a generation's length for this species, the birds are considered no longer to be present, based on lack of sightings/records. The remaining records from GPEC are specimen records form the Australian Museum, dated as 1884 and 1895. GMAC records are prior to 1981, with a very low level of accuracy (10,000m), with limited location descriptions. Records from 1981 are noted as 'Appin', with the remainder being specimen records form the Australian Museum, dated as 1860/1861. A single record occurs from within the Cumberland subregion since 1996, noted as being from 2012 in Greystanes and associated with WIRES. No more information is provided in BioNet. Due to the isolated nature of this record, both temporally and spatially, it is considered a vagrant record, and not evidence of the species persistence in the subregion. The species was removed as a candidate species in all nominated areas because suitable micro-habitats have undergone a long history of degradation and are now considered scarce in urban capable land, and the substantial lack of recent records within the subregion. Considerable survey effort has been undertaken for the species across the Cumberland subregion since 1996			

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							and if present, it is considered likely that the species would have been positively recorded in that time.			
Caladenia tessellata	Thick Lip Spider Orchid	R	R	R	R	No	*Caladenia tessellata* is an orchid that is known within NSW from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast (NSW Scientific Committee, 2002). Habitat comprises grassy sclerophyll woodland in clay loam or quartz-rich sandier soil (OEH, 2019ak). The total population size is estimated to be less than 50 individuals. Old records occur in the Penshurst (recorded 1901) and Como (recorded 1930) areas. The species was removed as a candidate species in all nominated areas because of a lack of records and suitable habitat within urban capable lands.	No	No	N/A
*Calidris ferruginea**	Curlew sandpiper	X	X	R	X	No	*Calidris ferruginea* is a small bird that breeds in Siberia and migrates to Australia (as well as Africa and Asia) for the non-breeding period (NSW Scientific Committee, 2011). In NSW, the species occurs along the coast, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Foraging habitat in NSW mainly comprises intertidal mudflats. The species was removed as a candidate species in WSA because:	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							• Of a lack of suitable habitat within urban capable land • Important mapped areas do not occur within the nominated areas			
Callistemon linearifolius	Netted Bottle Brush	R	R	R	R	No	*Callistemon linearifolius* is a shrub that occurs from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Habitat comprises dry sclerophyll forest. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. There are currently only five or six known populations of the species remaining in the Sydney area, of the 22 populations recorded in the past. Three of these are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park (NSW Scientific Committee, 1999a). The species was removed as a candidate species in all nominated areas because urban capable lands are outside the geographic extent of the species.	No	No	N/A
*Callocephalon fimbriatum**	Gang-gang cockatoo	✓	✓	R	✓	Yes	*Callocephalon fimbriatum* is a bird restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes, south to and contiguous with the Victorian population. Habitat comprises eucalypt open forests	Yes	No	N/A

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							and woodlands with an acacia understorey (NSW Scientific Committee, 2008a, 2018). Breeding habitat includes remnant tall moist forest. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts (DPIE, 2020b). The species has been recorded within the vicinity of the nominated areas nesting in tall eucalypts within sandstone gullies (e.g. The Oaks area). The species was retained as a candidate species in Wilton, GMAC and GPEC because records occur in the vicinity of urban capable lands. The species was removed in WSA because: • Breeding microhabitats are considered substantially degraded within the WSA nominated area • It has never been recorded in the WSA nominated area (based on BioNet as-held data export) Targeted surveys during breeding season and habitat assessment surveys have been undertaken across the nominated areas for this species. The species was not recorded, however potential breeding habitat was found to be present.			
*Calyptorhynchus lathami**	Glossy black cockatoo	✓	✓	R	✓	Yes	*Calyptorhynchus lathami* is a bird that occurs mainly in the eastern part of NSW from the coast to the tablelands, with populations on the western slopes and	Yes	No	N/A

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							plains tenuously connected to those on the tablelands. Habitat comprises eucalypt open forest and woodland with hollow-bearing trees and a midstory of sheoaks. It nests in tree hollows, and forages exclusively in sheoak species (NSW Scientific Committee, 2008b). Favoured habitat occurs on richer soils and within gentle terrain, and where *Allocasuarina* species are present. Records occur in the vicinity of the nominated areas, mainly where there is better tree cover and *Allocasuarina* species. Hollow-bearing trees within these areas are potential breeding habitat. The species was retained as a candidate species in Wilton, GMAC and GPEC because records occur in the vicinity of urban capable lands. The species was removed in WSA because: • Breeding microhabitats are considered substantially degraded within the WSA nominated area • It has never been recorded in the WSA nominated area (based on BioNet as-held data export) Targeted surveys during breeding season and habitat assessment surveys have been undertaken across the nominated areas for this species. The species was not recorded, however potential breeding habitat was found to be present.			

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Cercartetus nanus	Eastern Pygmy-possum	✓	✓	✓	✓	Yes	*Cercartetus nanus* is a small marsupial that in NSW occurs from the coast inland as far as the Pilliga, Dubbo, Parkes, and Wagga Wagga on the western slopes. The species occurs within a broad range of habitats from rainforest through to sclerophyll forest (including Box-Ironbark) and woodland to heath (OEH, 2019n), generally in more intact forms of vegetation. Records occur to the south-east of Wilton and are all in intact vegetation on a different substrate generally to that of urban capable lands (sandstone rather than shale). Most records within the Cumberland subregion are either inaccurately located or are located in the Bargo River and not within urban capable lands. The record near Campbelltown is located to the north-east and is outside the Cumberland subregion. The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands. Targeted habitat assessment surveys have been undertaken across the Growth Ares for this species and potential habitat was found to be present.	No	No	N/A

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Chalinolobus dwyeri	Large-eared Pied Bat	✓	✓	R	✓	Yes	*Chalinolobus dwyeri* is a small to medium sized bat that is found from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. Habitat comprises areas with extensive cliffs and caves (OEH, 2019t). Potential habitat for the species within the nominated areas is likely to occur only in areas outside urban capable lands. The species was retained as a candidate species in Wilton, GMAC and GPEC because foraging habitat within 2 km of sandstone cliffs and caves (potential roosting/breeding habitat) occurs within the nominated areas. The species was removed as a candidate in WSA as no potential roosting / breeding habitat occurs within 2 km of the nominated areas.	Yes	No	N/A
Cynanchum elegans	White-flowered Wax Plant	R	R	R	R	No	*Cynanchum elegans* is a climbing vine that is restricted to eastern NSW and is found from Brunswick Heads in the north to Gerroa in the South. Habitat usually occurs on the edge of dry rainforest vegetation (OEH, 2019am). Within the nominated areas, the species is most likely to occur along streamlines and steeper shale lands. No records of the species occur in the nominated areas.	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							The species was removed as a candidate species in all nominated areas because: • Microhabitats are considered substantially degraded within the nominated areas • It has never been recorded in the nominated areas (based on BioNet as-held data export) The urban capable lands are generally avoiding streamlines and steeper shale lands containing native vegetation where this species is most likely to occur. No dry rainforest vegetation occurs within urban capable land.			
Darwinia biflora		R	X	X	X	No	*Darwinia biflora* is an erect spreading shrub that is restricted to NSW and found in Ku-ring-gai, Hornsby, Baulkham Hills, and Ryde Local Government Area (OEH, 2017b). This species occurs on the edges of weathered shale-capped ridges and the transition area with Hawkesbury Sandstone. Most sites occur on the Lucas Heights Soil Landscape and the transition with Gymea or the Hawkesbury Soil Landscapes (NPWS, 2003). These habitat characteristics tend to occur in the lower-slope areas where the Shale Sandstone Transition Forest intersects with the sandstone enriched gully forests (PCT 1081, PCT 1181). The species may also occur in coastal upland swamp communities, but these do not occur within the nominated areas.	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							The species has been removed as a candidate species in Wilton because: • Urban capable land is outside the geographic extent of the species • Associated PCTs do not occur within urban capable land			
Darwinia peduncularis		R	X	X	X	No	*Darwinia peduncularis* is a broad spreading shrub that has been recorded from Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland in NSW. The species occurs as local disjunct populations in coastal NSW with isolated populations in the Blue Mountains. Populations also occur within the Marramarra National Park, Wollemi National Park, Blue Mountains National Park and Berowra Valley Regional Park (NSW Scientific Committee, 1999b). Habitat comprises sandstone soils on either ridge crests or upper slopes and dry sclerophyll forest on sandstone hillsides and ridges. Potential habitat for the species within the nominated areas is likely to occur only in areas outside urban capable lands. The species has been removed as a candidate species in Wilton because: • Urban capable land is outside the geographic extent of the species	No	No	N/A

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							• Associated PCTs do not occur within urban capable land			
Deyeuxia appressa		R	X	R	X	No	*Deyeuxia appressa* an erect perennial grass that is a highly restricted in NSW. Habitat comprises wet ground in the Hornsby area (Royal Botanic Gardens & Domain Trust, 2019). The species is primarily found east of the Plan Area with records from Salt Pan Creek and Killara, and questionable records from Kellyville. The species is considered to be extinct in the wild as the areas confirmed to be formerly occupied are now well developed and the species has not been otherwise reliably recorded since 1942. The species favours wetter areas that will be excluded from urban capable land as major streams will be avoided. It is not known from the Wianamatta (South Creek) area in GPEC that may be potentially impacted by transport corridors. The species has been removed as a candidate species in WSA and Wilton because: • Microhabitats considered absent from urban capable lands • The species is considered extinct within the geographic extent of the nominated areas	No	No	N/A
Dillwynia tenuifolia		R	R	✓	✓	Yes	*Dillwynia tenuifolia* is a low spreading shrub that primarily occurs in the Cumberland Plain from Windsor and Penrith in the north to Dean Park and	Yes	Yes	WSA, GPEC

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							near Colebee in the east. Habitat comprises scrubby and dry heath areas that occur in Castlereagh Ironbark Forest and Shale Gravel Transition Forest. It can also be found in the transition areas between these communities and Castlereagh Scribbly Gum Woodland. Outside of its primary distribution, the species has been recorded from Voyager Point and Kemps Creek, Luddenham, and South Maroota (OEH, 2017c). The species is likely to occur in all areas of PCT 724 and most areas of PCT 725. The species was retained as a candidate species in WSA and GPEC because suitable habitat is likely to occur in urban capable lands. The species was removed in GMAC and Wilton because the nominated areas occur outside species' known geographic extent. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.			

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Dillwynia tenuifolia - endangered population		X	X	R	X	No	*Dillwynia tenuifolia* is a low spreading shrub. The endangered population occurs at Kemps Creek south of WSA (the population occurs within the existing South West Sydney Growth Area) (NSW Scientific Committee, 1997). The population was removed as a candidate species in WSA because it does not occur within urban capable land.	No	Yes	WSA
Epacris purpurascens var. purpurascens		✓	✓	R	R	Yes	*Epacris purpurascens* var. *purpurascens* is a shrub that is found in NSW from Gosford in the north, Narrabeen in the east, Silverdale in the west, and Avon Dam in the south (OEH, 2017d). Habitat comprises areas in the vicinity of creeks and swamps on sandstone in dry sclerophyll forest and scrub (NSW Scientific Committee, 1997). Surveys have been undertaken for this species within urban capable lands. The species was not recorded during surveys. Though common in the Bingara Gorge and St Marys Towers areas, the species appears to be absent from other areas. This includes adjacent properties that were assessed. The species was retained as a candidate species in Wilton and GMAC because suitable habitat is likely to occur in urban capable lands. The species was removed in WSA and GPEC because:	Yes	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							• The WSA and GPEC nominated areas occur outside species' known geographic extent • Species' microhabitats are considered absent from urban capable lands within WSA and GPEC nominated areas			
Eucalyptus benthamii	Camden White Gum	✓	✓	R	R	Yes	*Eucalyptus benthamii* is a tree that is restricted to the alluvial flats of the Nepean River and its tributaries (DoE, 2014; OEH, 2017a). Habitat comprises wet forest on sandy alluvial soils along valley floors (Royal Botanic Gardens & Domain Trust, 2019). The distribution of the species includes Wilton and GMAC and south of GPEC and WSA, including west of WSA in the Bents Basin/Wallacia area. The species was retained as a candidate species in Wilton and GMAC because suitable habitat may occur in urban capable lands, although habitat is most likely to occur only in areas outside urban capable lands. The species was removed in WSA and GPEC because • Species' microhabitats are considered absent from urban capable lands within WSA and GPEC nominated areas • The species has never been recorded in the WSA or GPEC nominated areas (based on BioNet as-held data export) of a lack of records within urban capable lands.	Yes	No	N/A

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Eucalyptus sp. Cattai		R	X	X	X	No	*Eucalyptus sp. Cattai* is a small tree that occurs between Colo Heights and Castle Hill. It is generally found outside the subregion and considered restricted to the Cattai - Glenhaven region. Historic records occur near the Royal Botanic Gardens, Sydney (NSW Scientific Committee, 1998b). Habitat comprises scrub, heath, and low woodland on sandy soils generally in flat areas and on ridge tops (OEH, 2018d). This species was removed as a candidate species in Wilton because: • The nominated areas occur outside species' known geographic extent • Associated PCTs do not occur within urban capable land	No	No	N/A
Grammitis stenophylla	Narrow-leaf Finger Fern	R	X	X	X	No	*Grammitis stenophylla* is a small fern that occurs in eastern Queensland and NSW as far west as Narrabri. Habitat comprises moist places in rainforest and moist eucalypt forests near streams on rocks or in trees (OEH, 2018k). A single record occurs in the Cumberland subregion at Parramatta. The location of the record is close to the subregion boundary (but occurs in much wetter habitats than occur in the nominated areas). This record is old, and its location is unreliable (Royal Botanic Gardens & Domain Trust, 2019).	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							This species was removed as a candidate species in Wilton because: • Urban capable land occurs outside the geographic extent of the species • Associated PCTs do not occur within urban capable land			
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	R	R	✓	✓	Yes	*Grevillea juniperina* subsp. *juniperina* is a shrub endemic to Western Sydney. It has a restricted range, occurring on red sandy to clay soils on Wianamatta Shale and Tertiary alluvium in Cumberland Plain Woodland and Castlereagh Woodland (NSW Scientific Committee, 2000). The species is likely to occur within WSA and GPEC. The species was retained as a candidate species in WSA and GPEC because suitable habitat is likely to occur in urban capable lands. The species was removed in Wilton and GMAC because the expert report confirmed a lack of suitable habitat within urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.	Yes	Yes	GPEC

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Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	✓	✓	✓	✓	Yes	*Grevillea parviflora* subsp. *parviflora* is a shrub that has a sporadic distribution throughout the Sydney Basin IBRA region (OEH, 2018e). Habitat comprises damper sandy or light clay soils, often with lateritic ironstone gravels and nodules, in a range of vegetation types from heath and shrubby woodland to open forest (OEH, 2018e). The species has been recorded during surveys undertaken for this project The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within inaccessible parts of urban capable lands.	Yes	No	Wilton
Grevillea parviflora subsp. *supplicans*		R	R	X	R	No	*Grevillea parviflora* subsp. *supplicans* is a shrub with a highly restricted distribution confined to approximately 8 x 10 km to the north-west of Sydney in the area near Arcadia and Maroota-Marramarra Creek. Habitat comprises heathy woodland associations on skeletal sandy soils over massive sandstones (OEH, 2017e). Most records occur in the Yengo and Pittwater subregions. The species was removed as a candidate species:	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							• In Wilton and Greater Macarthur nominated areas because they occur outside the species' TBDC listed 'Geographic constraints' • In GPEC because associated PCTs do not occur within urban capable land			
Gyrostemon thesioides		R	R	R	R	No	*Gyrostemon thesioides* is a shrub with a highly restricted distribution in NSW. Habitat comprises hillsides and riverbanks in riparian zones on sandy soils. It has only been recorded at three sites near the Colo, Georges, and Nepean Rivers (OEH, 2018g). Existing records are poorly geolocated, but all records of the species are located in riparian corridors of high order streams. As such all habitats have been avoided within urban capable lands in the Wilton, GMAC and WSA. No records of the species occur within the GPEC, and the closest records, more recent than 1967, are over 30kms away in the Wollemi and Blue Mountains NPs. Potential habitat for the species (riparian corridors) within the nominated areas is likely to occur only in areas outside urban capable lands This species was removed as a candidate species in all nominated areas because: • Microhabitats are considered absent from urban capable lands	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							• The species has not been recorded within the geographic extent of the nominated areas since 1967 along the Georges River			
*Haliaeetus leucogaster**	White-bellied Sea-Eagle	✓	✓	✓	✓	Yes	*Haliaeetus leucogaster* is a large bird that is widespread along the east coast of NSW and occurs along all major inland rivers and waterways. The species forages over large areas of open water, including swamps, lakes, larger rivers, and the sea. It breeds in tall, open forest and woodland, and swamp sclerophyll forest close to foraging areas. Nest trees typically comprise the tallest trees, often with emergent dead branches or large dead trees nearby which are used as 'guard roosts' (OEH, 2019al). The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. Targeted surveys for breeding habitat were undertaken within the nominated areas and potential habitat was recorded.	Yes	Yes	GMAC, WSA, Wilton
Haloragis exalata subsp. *exalata*	Square Raspwort	X	X	R	X	No	*Haloragis exalata* subsp. *exalata* is a shrub that occurs in four scattered localities in eastern NSW within the Central Coast, South Coast and North Western Slopes regions. Habitat comprises wet and shaded parts of riparian corridors (Miles & Cameron, 2007). It is not known the Cumberland subregion. Populations	No	No	N/A

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							recorded historically from Western Sydney are thought to no longer exist (NSW Scientific Committee, 2009b). The closest records occur at Marramarra Creek and in the Kiama area. Surveys have not been undertaken for this species within urban capable lands. The species was removed as a candidate species in WSA as urban capable land occurs outside the geographic extent of the species. Wet riparian habitats have been excluded from urban capable lands through stream buffers, and as such microhabitats for the species are considered absent from urban capable lands.			
Haloragodendron lucasii		R	X	X	X	No	*Haloragodendron lucasii* is a shrub found in a very narrow distribution spanning a 10 km range in the northern suburbs of Sydney (OEH, 2019p). Habitat comprises moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland (OEH, 2019p). Records occur in nine sites in the Hornsby-Gordon area (DEWHA, 2008b; Hogbin, Peakall et al., 2000). The species has been removed as a candidate species in Wilton because: • Associated PCTs do not occur within urban capable land	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							• Nominated areas occur outside species' known geographic extent			
Heleioporus australiacus	Giant Burrowing Frog	✓	✓	X	✓	Yes	*Heleioporus australiacus* is a large frog found in south-eastern NSW and Victoria. In NSW. It appears to be largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla (DPIE, 2019b). Habitat comprises heath, woodland and open dry sclerophyll forest on a variety of soil types except clay soils. Breeding habitat comprises soaks or pools within first or second order streams. The species has been added as a candidate species in GPEC as it has the potential to occur within urban capable land in the Penrith Lakes area. Targeted habitat assessments were undertaken for this species, the species was not recorded however suitable habitat was found to occur.	No	No	N/A
Hibbertia fumana		✓	✓	✓	✓	Yes	*Hibbertia fumana* is a shrub found only in the Sydney basin (OEH, 2020b). Habitat comprises intergrade sand-clay soils primarily in areas with a scribbly gum-dominated overstorey which may also have some ironbarks. The species is only known from the Moorebank and Bankstown areas. The species is recently described and if present, could have been recorded under a different name in previous studies.	Yes	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							Within urban capable lands, habitat may occur in the Kemps Creek area. The species was retained as a candidate species in WSA and GPEC because suitable habitat may occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.			
Hibbertia puberula		✓	✓	✓	✓	Yes	*Hibbertia puberula* is a shrub found from Wollemi National Park south to Morton National Park and the south coast near Nowra. Habitat comprises sandy soil often associated with sandstone, or on clay within dry sclerophyll woodland communities (OEH, 2019q). One of the recently (2012) described subspecies also favours upland swamps. Within urban capable lands, habitat may occur in the Kemps Creek and Glenfield areas and the margins of Wilton. The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.	Yes	No	N/A
Hibbertia sp. Bankstown		X	R	R	R	No	*Hibbertia* sp. *Bankstown* is a shrub known to occur in only one population at Bankstown Airport in Sydney.	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							Habitat comprises tertiary alluvial soil along Airport Creek within an area likely to have comprised Cooks River/Castlereagh Ironbark Forest. The species does not occur in areas where fill has been deposited (OEH, 2019r). The species is not known to occur in the Plan Area (although it occurs in the Cumberland subregion). Surveys for *H. fumana* and *H. puberula* have not identified this species within urban capable lands. The species has been removed as a candidate species in GMAC, WSA and GPEC because species' microhabitats are considered absent from urban capable lands. Potential habitat within the nominated areas is only likely to occur outside urban capable lands. Species is also known to be highly restricted in distribution to a single known population.			
Hibbertia spanantha	Julian's Hibbertia	R	R	X	R	No	*Hibbertia spanantha* is a shrub restricted to the Turramurra - Beecroft - Macquarie Park region. Habitat comprises forest with canopy species including *Eucalyptus pilularis, E. resinifera, Corymbia gummifera,* and *Angophora costata* (OEH, 2019s). The species is known from three populations (in three proximate Sydney suburbs within the Lane Cove River catchment (DoE, 2016a; Toelken & Robinson, 2015)).	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							The species was removed as a candidate species in Wilton, GMAC, and GPEC as urban capable lands occur outside the geographic extent of the species.			
Hibbertia superans		R	R	X	R	No	*Hibbertia superans* is a shrub in the north-west Sydney region between Baulkham Hills and Wisemans Ferry and near Blaxland in the lower Blue Mountains. It is also known from a disjunct occurrence near Mt Boss (inland from Kempsey). Habitat comprises dry sclerophyll forest on sandstone ridgetops (Royal Botanic Gardens & Domain Trust, 2019). All records of the species are to the north and east of the Plan Area. The species was removed as a candidate species in Wilton, GMAC, and GPEC as urban capable lands occur outside the geographic extent of the species.	No	No	N/A
*Hieraaetus morphnoides**	Little Eagle	✓	✓	✓	✓	Yes	*Hieraaetus morphnoides* is a bird found throughout the Australian mainland except the most densely forested parts of the Dividing Range escarpment. Habitat comprises open eucalypt forest, woodland or open woodland (OEH, 2019w). The species requires tall trees within a remnant patch in which to build a large stick nest. Stick nests have been recorded during surveys undertaken for this project. The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands.	No	Yes	GPEC, GMAC, WSA

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		Wilton	GMAC	WSA	GPEC					
							An expert report has been prepared to confirm whether suitable habitat exists for this species within Wilton and GMAC. Targeted surveys for breeding habitat were undertaken within the nominated areas, however no potential habitat was recorded.			
*Hoplocephalus bungaroides**	Broad-headed Snake	R	R	X	X	No	*Hoplocephalus bungaroides* is largely confined to sandstones, including the Hawkesbury, Narrabeen, and Shoalhaven groups, in an area within approximately 250 km of Sydney. Habitat comprises rock crevices and sandstone rock areas on exposed cliff edges. The species moves from sandstone rocks to shelters in crevices or hollows in large trees within 500m of escarpments in summer (OEH, 2019g). There is a single record from Appin in the Plan Area (1970), and a few other records in other parts of the Cumberland subregion. The records are poorly geolocated. The species was removed as a candidate species in Wilton and GMAC because species breeding habitat constraints (as listed in TBDC) do not occur within urban capable lands.	No	No	N/A
Lasiopetalum joyceae		R	X	X	X	No	*Lasiopetalum joyceae* is a shrub with a restricted range. It is found on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. Habitat comprises heath areas on sandstone (OEH, 2019u). It is	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							known from 34 sites between Berrilee and Duffys Forest (NSW Scientific Committee, 1999c). The species was removed as a candidate species in Wilton because: • Associated PCTs do not occur within urban capable land • Nominated areas occur outside species' known geographic extent			
*Lathamus discolor**	Swift parrot*	R	R	R	✓	Yes	*Lathamus discolor* is a small bird that breeds in Tasmania during the summer and migrates north to mainland Australia for the winter (TSSC, 2016). The species was removed as a candidate species in Wilton, GMAC and WSA, but maintained as a candidate in GPEC, based on the presence/absence of Mapped Important Areas for the species in urban capable lands.	No	Yes	Wilton
Leucopogon exolasius		R	X	R	R	No	*Leucopogon exolasius* is a shrub restricted to the Woronora and Grose Rivers and Stokes Creek, Royal National Park. Habitat comprises sandy alluvium and rocky sandstone hillsides near creeks, on low nutrient soils (Royal Botanic Gardens & Domain Trust, 2019).The descriptive text for many of the records within the Cumberland subregion suggest the records are inaccurately geolocated and unlikely to occur	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							within the subregion (apart from the few records near Jordan Pass, south of Appin). Potential habitat for the species within the nominated areas is likely to occur only in areas outside urban capable lands. The species was removed as a candidate species in Wilton, WSA and GPEC because associated PCTs do not occur in urban capable land.			
Leucopogon fletcheri subsp. *fletcheri*		R	R	X	R	No	*Leucopogon fletcheri* subsp. *fletcheri* is a shrub endemic to north-western Sydney and is found between St Albans in the north and Annangrove in the south (OEH, 2017g). Habitat comprises dry eucalypt woodland or shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs (OEH, 2017g). There are four records from the area east and north-east from Kentlyn in the sandstone ridge terrain and the species is found elsewhere in similar terrain. Despite the potential to occur in Wilton and southern part of GMAC, the habitat has been well surveyed previously and no additional records were located. The species was removed as a candidate species in Wilton, GMAC and GPEC because: • Species' microhabitats considered absent from urban capable lands	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							• The species has only ever been recorded in the far northern portion of the Cumberland IBRA subregion, and records occur as historic and highly inaccurate records (based on BioNet as-held data export)			
Limicola falcinellus	Broad-billed Sandpiper	X	X	R	X	No	*Limicola falcinellus* is a small migratory bird that breeds in northern Siberia and overwinters in Australia (OEH, 2019f). The species does not breed in Australia and there is no breeding habitat or important habitat within the Plan Area. Foraging habitat significant to the species primarily comprises coastal wetlands and mudflats. The species was removed as a candidate species in WSA as important mapped areas do not occur within the nominated areas.	No	No	N/A
*Limosa limosa**	Black-tailed Godwit*	X	X	R	X	No	*Limosa limosa* is a migratory wading bird that breeds in Mongolia and eastern Siberia and spends the southern summer in Australia. In NSW, it has been recorded at Kooragang Island. The species does not breed in Australia and there is no breeding habitat within the Plan Area. Non-breeding habitat is predominantly coastal areas including sheltered bays, estuaries, and lagoons. It can also be found further inland on mudflats and around muddy lakes and swamps (OEH, 2019e). There are 10 records in the Cumberland subregion	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							mostly from between 1980 and 1992. Sighting locations include lagoons in the northern parts of the Plan Area (e.g. Bakers Lagoon) outside urban capable lands. The species was removed as a candidate species in WSA as important mapped areas do not occur within the nominated areas.			
Litoria aurea	Green and Golden Bell Frog	✓	✓	✓	✓	Yes	*Litoria aurea* is a large frog formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria (OEH, 2019o). Habitat comprises marshes, dams and stream-sides, particularly those containing bulrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Primary habitat includes waterbodies that are unshaded, free of predatory fish, and have a grassy area nearby. Records of the species within the nominated areas are scattered and generally old or poorly geolocated. Two recent records (2013, 2015) in the Blair Athol area near Campbelltown suggest that the species can persist in heavily impacted environments. The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							Targeted habitat assessments have not been undertaken for this species.			
*Lophoictinia isura**	Square-tailed kite	✓	✓	✓	✓	Yes	*Lophoictinia isura* is a medium-sized bird found in coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. It is known to occur in the Cumberland subregion. Habitat comprises dry woodlands and open forests, in particular timbered watercourses (OEH, 2017j). Stick nests that may be associated with this species have been recorded during field surveys for this project The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within Wilton and GMAC. Targeted surveys for breeding habitat were undertaken within the nominated areas and potential habitat was recorded.	Yes	Yes	GMAC, GPEC
Marsdenia viridiflora subsp. *viridiflora - endangered population*		X	✓	✓	✓	Yes	*Marsdenia viridiflora* subsp. *viridiflora* is a climbing plant. The distribution of the population within the relevant local government areas described in the final determination is not clearly defined. Habitat comprises vine thickets and open shale woodland (OEH, 2019x). Recent records occur in Narellan, Mt Annan Botanic	Yes	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							Gardens, and the Western Sydney Airport. Recent survey in the Menangle area did not record the species. The species may occur in the Gilead area of GMAC. Habitat for the species will be modelled to determine impacts. The species was retained as a candidate species in all GMAC, WSA and GPEC because suitable habitat has the potential to occur in urban capable lands.			
Maundia triglochinoides		X	X	✓	✓	Yes	*Maundia triglochinoides* is a water plant restricted to coastal NSW and extending into southern Queensland. Habitat comprises swamps, lagoons, dams, channels, creeks or shallow freshwater 30 to 60 cm deep on heavy clay with low nutrients (OEH, 2019z).There is a single record in the Cumberland subregion that is highly questionable as it occurs in very weedy habitat. Other records in the Sydney area are from coastal sites and wetlands that occur outside urban capable lands. Detailed habitat assessments have been undertaken. The species was retained as a candidate species in WSA and GPEC due to the presence of high Strahler order streams (e.g. Wianamatta (South Creek)) in suitable PCTs.	No	No	N/A
Melaleuca deanei	Deane's Paperbark	✓	✓	X	R	Yes	*Melaleuca deanei* is a shrub found in two distinct areas – in the north (Ku-ring-gai/Berowra area) and south (Holsworthy/Wedderburn area) of Sydney. There are	Yes	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							also more isolated occurrences in the Blue Mountains, Nowra and Central Coast areas" (NSW Scientific Committee, 1999d). Habitat mostly comprises ridgetop woodland, with about 5 per cent of sites located in heath on sandstone (OEH, 2019k). The species was retained as a candidate species in Wilton and GMAC because suitable habitat has the potential to occur in urban capable lands. The species was removed in GPEC as the expert report concluded species unlikely to be present in GPEC nominated area. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.			
Meridolum corneovirens	Cumberland Plain Land Snail	✓	✓	✓	✓	Yes	*Meridolum corneovirens* is a snail that is found on the Cumberland Plain from Richmond and Windsor south to Picton, and from Liverpool west to the Hawkesbury and Nepean Rivers. Habitat comprises the litter of bark, leaves and logs, or shelters in loose soil around grass clumps within Cumberland Plain Woodland and Shale Gravel Transition Forest, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest (OEH, 2019j). The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands.	Yes	Yes	GPEC, GMAC

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		Wilton	GMAC	WSA	GPEC					
							An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands.			
Micromyrtus minutiflora		X	X	✓	✓	Yes	*Micromyrtus minutiflora* is a shrub restricted to the area between Richmond and Penrith. Habitat comprises Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest and open forest on tertiary alluvium and consolidated river sediments (OEH, 2019aa). Records to the south-east of Wilton and Appin are likely to be misidentifications of the very similar species *M. blakelyi* and *M. ciliata.* The species was retained as a candidate species in WSA and GPEC because suitable habitat has the potential to occur in urban capable lands.	Yes	No	N/A
*Miniopterus australis**	Little Bent-wing Bat	R	R	R	R	No	*Miniopterus australis* is a micro-bat found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Habitat comprises moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests, and Banksia scrub. Roosting habitat includes caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and buildings (OEH, 2019v). Breeding habitat occurs within steep and rocky areas.	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							The species was removed as a candidate species in all nominated areas species' breeding microhabitats considered absent from urban capable lands. Potential breeding habitat within the nominated areas occurs only outside urban capable lands.			
*Miniopterus orianae oceanensis**	Large Bent-winged Bat	R	R	R	R	No	*Miniopterus orianae oceanensis* is a micro-bat found along the east and north-west coasts of Australia. Roosting habitat comprises caves, but also derelict mines, storm-water tunnels, buildings and other man-made structures (OEH, 2019m). Potential breeding habitat for the species (caves) within the nominated areas is likely to only occur outside urban capable lands. There are no records of any significant human-made breeding habitat within urban capable lands. The species was removed as a candidate species in all nominated areas as species' breeding microhabitats considered absent from urban capable lands.	No	No	N/A
Myotis macropus	Southern Myotis	✓	✓	✓	✓	Yes	*Myotis Macropus* is a micro-bat in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Habitat comprises caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (OEH, 2019ah). Records occur throughout the	Yes	Yes	GMAC, WSA

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		Wilton	GMAC	WSA	GPEC					
							Cumberland subregion. There have been 72 sightings of the species in the subregion since 2012. The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands.			
*Ninox connivens**	Barking owl	✓	✓	R	✓	Yes	*Ninox connivens* is a medium-sized owl that occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests (OEH, 2019c). Habitat comprises woodland and open forest, including fragmented remnants and partly cleared farmland. Breeding habitat comprises hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (NSW NPWS, 2003b). The species was retained as a candidate species in Wilton, GMAC and GPEC because suitable habitat has the potential to occur in urban capable lands. The species was removed in WSA because • Species' breeding microhabitats considered substantially degraded within the WSA nominated area • Species has never been recorded in the WSA nominated area (based on BioNet as-held data export)	Yes	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							Habitat assessment surveys have been undertaken across the Growth Ares for this species. Potential breeding habitat was found to be present.			
*Ninox strenua**	Powerful owl	✓	✓	✓	✓	Yes	*Ninox strenua* is a large owl that is occurs in eastern and south-eastern Australia, from Mackay down to Victoria. Habitat comprises a range of vegetation types, including woodland, open sclerophyll forest, tall wet open forest, and rainforest. While this species typically requires large tracts of intact woodland, it is also known to occur in fragmented landscapes. The species nests in large tree hollows (OEH, 2017h). The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. Habitat assessment surveys have been undertaken across the nominated areas for this species. Potential breeding habitat was found to be present.	Yes	Yes	GMAC
*Pandion cristatus**	Eastern Osprey	X	R	R	R	No	*Pandion cristatus* is a bird of prey that is found around the Australian coastline, except for Victoria and Tasmania, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. Habitat comprises coastal areas, particularly large coastal river mouths, lakes and lagoons (DPIE, 2020a). The species	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							nests in tall trees in coastal woodland to forest habitat (NSW Scientific Committee, 2009a). The breeding population of this species in NSW spans from the Queensland border to Ulladulla in south-eastern NSW. Vagrants have been recorded as far south as Victoria (NSW Scientific Committee, 2009a). There are four records in the Cumberland subregion. Three occur in Milperra in 2014 (two have the same coordinates), while the last record is from North Ryde. The species was removed as a candidate species in GMAC, WSA and GPEC because of breeding microhabitats are considered absent from urban capable lands.			
Persicaria elatior	Tall Knotweed	X	✓	✓	✓	Yes	*Persicaria elatior* is an herb found in south-eastern and northern NSW and Queensland. It is known from the Cumberland subregion. Habitat comprises damp places, particularly beside streams and lakes. The species is occasionally found in swamp forest or associated with disturbance (OEH, 2020d). There are a few records within and nearby the Plan Area. The 1949 record from 'Picton Lakes' refers to Thirlmere Lakes (at that time being called Picton Lakes), and more recent (2010) records occur there. There is an unverified record from 2018. The species has been retained as a candidate in GMAC, WSA and GPEC because it may be subject to prescribed	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							impacts (hydrology) and the transport corridors may have a direct impact on the species in WSA and GPEC. Targeted surveys have not been undertaken for this species within urban capable lands. However, habitat assessments have been completed.			
Persoonia bargoensis	Bargo Geebung	✓	✓	R	R	Yes	*Persoonia bargoensis* is a shrub that is restricted to a small area south-west of Sydney bounded by Picton, Douglas Park, Yanderra, and Cataract River. Habitat comprises woodland or dry sclerophyll forest on sandstone and shale soils. The species can be found adjacent to disturbed areas such as roadsides (OEH, 2019b). Many of the records in Wilton and GMAC have very low reliability and are not recent records. The species was retained as a candidate species in Wilton and GMAC because records occur within urban capable lands and suitable habitat has the potential to occur. The species was removed in WSA and GPEC because the two nominated areas occur outside the species' known geographic extent.	Yes	No	N/A
Persoonia glaucescens	Mittagong Geebung	R	X	X	X	No	*Persoonia glaucescens* is a shrub that is found in the Southern Highlands area, roughly between Picton and Berrima (OEH, 2002). Recent surveys have indicted this distribution has contracted (OEH, 2019ab). Habitat includes woodland to dry sclerophyll forest, mostly on	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							ridge tops, plateaux, and upper slopes (OEH, 2019ab). Records occur to the south of the Plan Area, with the northernmost records at Tahmoor. Surveys have been undertaken for this species within urban capable lands. The species was not recorded during surveys. The species was removed as a candidate species in Wilton because: • Associated PCTs do not occur within urban capable land • Nominated areas occur outside species' known geographic extent			
Persoonia hirsuta	Hairy Geebung	R	R	R	R	No	*Persoonia hirsuta* is a shrub that has a scattered distribution around Sydney, and is found in the area bounded by Bargo to the south, Singleton to the north and the Blue Mountains to the west (OEH, 2017f). Habitat comprises sandstone and sandstone-derived soils in dry sclerophyll open forest, woodland, and heath (OEH, 2017f). There are no records of the species within the Plan Area. The sole record within the Plan Area is a specimen that is misplaced and should correctly be located in 'Long Point, Macquarie Fields', approx. 3 km south-east of the mapped location. The species was removed as a candidate species in all nominated areas because:	No	No	N/A

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		Wilton	GMAC	WSA	GPEC					
							• Species' microhabitats considered absent from urban capable lands • Nominated areas occur outside species' known geographic extent			
Persoonia mollis subsp. *maxima*	Soft Geebung	R	X	X	X	No	*Persoonia mollis* subsp. *maxima* is a tall shrub with a restricted distribution and is known from the Hornsby Heights - Mt Colah area north of Sydney (OEH, 2019ae). Habitat comprises sheltered, deep Hawkesbury sandstone gullies and upper steep hillsides (OEH, 2019ae). These habitats often support relatively moist, tall forest vegetation communities, often with warm temperate rainforest influences (OEH, 2019ae). There 11 records within the Cumberland subregion. All records occur outside the nominated areas. The most recent record is 2005. The species was removed as a candidate species in Wilton because: • Associated PCTs do not occur within urban capable land • Nominated areas occur outside species' known geographic extent	No	No	N/A
Persoonia nutans	Nodding Geebung	R	R	✓	✓	Yes	*Persoonia nutans* is a shrub that is found on the Cumberland Plain, between Richmond in the north and Macquarie Fields in the south. Core distribution occurs in Penrith, and to a lesser extent the Hawkesbury area.	Yes	Yes	GPEC

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		Wilton	GMAC	WSA	GPEC					
							Northern populations are found on aeolian and alluvial sediments, while southern populations occur on alluvial sediments and shale/sandstone transition zones. Habitat comprises a range of sclerophyll forest and woodland vegetation communities (OEH, 2019ac). Records in the northern end of GMAC are poorly geolocated. More accurate records occur in the Simmos Beach and Moorebank area The species was retained as a candidate species in WSA and GPEC because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands. The species was removed as a candidate species in Wilton and GMAC because the expert report confirmed a lack of suitable habitat within urban capable lands.			
Petaurus norfolcensis	Squirrel Glider	✓	✓	R	✓	Yes	*Petaurus norfolcensis* is a small possum that is found in eastern Australia from northern Queensland to western Victoria. Habitat comprises blackbutt-bloodwood forest with heath understorey in coastal areas, and box, box-ironbark, and river red gum woodlands further inland (OEH, 2017k). The species prefers mature or old growth woodland and requires abundant tree hollows for	Yes	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							refuge and nesting sites (OEH, 2017k). Records occur within Wilton in areas outside urban capable lands. The species was retained as a candidate species in Wilton, GMAC and GPEC because suitable habitat has the potential to occur in urban capable lands. The species was removed in WSA because: • Species' microhabitats considered substantially degraded within the WSA nominated area • Species has never been recorded in the WSA nominated area (based on BioNet as-held data export) Habitat assessment surveys have been undertaken across the nominated areas for this species. Potential habitat was found to be present.			
*Phascolarctos cinereus**	Koala	✓	✓	R	R	Yes	*Phascolarctos cinereus* is an arboreal marsupial that has a fragmented distribution throughout eastern Australia. In NSW, it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Habitat comprises eucalypt woodlands and forests. Koalas feed on over 70 species of Eucalyptus and over 30 non-Eucalyptus species (OEH, 2018a). There are a significant number of recent Koala records present within and adjacent to Wilton and GMAC. Breeding habitat occurs through the eastern portion of GMAC and around Wilton (DPIE,	Yes	Yes	GMAC, Wilton

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							2019a). Records further indicate the presence of Koalas within the Blue Mountains, particularly in the district of Kurrajong, with very few records occurring east of these areas within the urban matrix. The TBDC says the following in relation to important habitat for Koalas: "'Important' habitat (however this is not a mapped important habitat area) is defined by the density of Koalas and quality of habitat determined by on-site survey - contact OEH for more information". Important habitat for the species was identified in GMAC and Wilton and is represented by the mapping of primary, second, and tertiary corridors. See Section 11.5.4 in Chapter 11 for a description of the mapping methods for Koala and the The species was retained as a candidate species in Wilton and GMAC because of the high density of records and the presence of important habitat. The species was removed in WSA and GPEC because of limited records and a lack of important habitat within these nominated areas. See Section A.2 below this table for a detailed discussion about the justification for excluding koalas from WSA and GPEC.			
Pilularia novae-hollandiae	Austral Pillwort	X	R	R	R	No	*Pilularia novae-hollandiae* is a semi-aquatic fern that has a scattered distribution in NSW. Habitat comprises shallow swamps and waterways, often amongst grasses	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							and sedges. The species is probably ephemeral, growing in moist soils following rain events, and is often recorded in drying mud (OEH, 2018b). Despite the high occurrence and coverage of botanical surveys across the Cumberland subregion the species has not been recorded since a single record from 1966 in Doonside. It is expected that more recent records would exist if the species natural range included the Cumberland subregion. Potential habitat for the species (high order Strahler streams) within the nominated areas is likely to only occur in areas outside urban capable lands, with all mapped creek lines above Strahler order one, being excluded from the footprint. The species has been removed as a candidate in all nominated areas because: • Species' microhabitats considered absent from urban capable lands • Species considered extinct within the geographic extent of the nominated areas			
Pimelea curviflora var. *curviflora*		R	R	R	✓	Yes	*Pimelea curviflora* var. *curviflora* is a shrub found in the coastal area of Sydney and the Illawarra regions (OEH, 2019af).The species is known from approximately 20 locations in the Baulkham Hills, Blacktown, Hornsby, Parramatta and Warringah Local Government Areas	Yes	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							(NSW NPWS, 1999) and the Shellharbour area. The species was formerly recorded around the Parramatta River and Port Jackson areas. Habitat comprises shale, sandstone, and lateritic soils, on ridgetops and upper slopes in woodlands (OEH, 2019af). Records (dated 2000) occur in only two locations in the vicinity of the nominated areas. Despite extensive surveys at Bingara Gorge in suitable habitat, the species was not recorded, suggesting that the two records in the vicinity of the nominated areas may be misapplications for *P. curviflora* var. *sericea* which is recorded in that area. The species was retained as a candidate species in GPEC because records or suitable habitat potentially occur in the vicinity of urban capable lands. The species was removed in Wilton, GMAC and WSA because the nominated areas occur outside species' known geographic extent.			
Pimelea spicata	Spiked Rice-flower	✓	✓	✓	✓	Yes	*Pimelea spicata* is a shrub that occurs in two disjunct areas; the Cumberland Plain (Marayong and Prospect Reservoir south to Narellan and Douglas Park) and the Illawarra (Lansdowne to Shellharbour to northern Kiama) (OEH, 2019ai). Habitat comprises Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark on well-structured clay soils (OEH, 2019ai). Nearest records to the nominated areas are	Yes	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							around Douglas Park. It is likely that the species no longer occurs in the parts of the nominated areas due to a history of intensive grazing and other land uses. The species was retained as a candidate species in all nominated areas because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands. While the species was not recorded during surveys for this project, suitable habitat was recorded.			
Pomaderris brunnea	Brown Pomaderris	✓	✓	R	R	Yes	*Pomaderris brunnea* is a shrub that is found in restricted areas near the Colo, Nepean, and Hawkesbury rivers in NSW, in addition to areas near Bargo and Camden. It is also known near Walcha in the New England Tablelands, and from Gippsland in Victoria. Habitat comprises moist woodland or forest on clay and alluvial soils of flood plains and creek lines (OEH, 2019h). Records occur in several areas within the GMAC, particularly to the south of Menangle Creek in the Gilead area and on Beulah Biobank site. One of the records adjacent to Wilton appears to be poorly geolocated. The species was retained as a candidate species in Wilton and GMAC because records or suitable habitat	Yes	Yes	GMAC

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							occurs in the vicinity of urban capable lands. The species was removed in WSA and GPEC because: • The nominated areas occur outside species' known geographic extent • Of a lack of records and suitable clay and alluvial soils within urban capable lands			
Pomaderris prunifolia - endangered population		R	X	R	R	No	*Pomaderris prunifolia* is a shrub that occurs uncommonly on the tablelands and slopes of NSW. A population of the species within the Parramatta, Auburn, Strathfield, and Bankstown Local Government Areas is listed as endangered. The population is known from only three sites – at Rydalmere on a road reserve, within Rookwood Cemetery and at The Crest of Bankstown (OEH, 2019ad). The species was removed as a candidate species in Wilton, WSA and GPEC because the extent of the population does not occur within urban capable lands.	No	Yes	GMAC
Pommerhelix duralensis	Dural Land Snail	R	R	R	R	No	*Pommerhelix duralensis* is a medium sized snail endemic to NSW where it occurs on the northwest fringes of the Cumberland subregion. Habitat comprises shale-sandstone transitional landscapes. Most of the records for the species occur around the towns of Wisemans Ferry, Maraylya, Glenorie, and Dural (DoE, 2015a). The species occurs primarily northwards from Lake Parramatta through Dural and Kentlyn towards the	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							Hawkesbury River. Records from west and south of the GPEC are likely errors (S. Clark pers. comm.) or relate to different taxa (C. Allen pers. comm.). The species was removed as a candidate species in all nominated areas as urban capable lands are outside the geographic extent of the species.			
Pseudophryne australis	Red-crowned Toadlet	✓	✓	X	✓	Yes	*Pseudophryne australis* is small frog that occurs in the Sydney Basin. Habitat comprises periodically wet drainage lines in open forests on Hawkesbury and Narrabeen Sandstones (OEH, 2019ag). There are a number of records of the species within the vicinity of three of the nominated areas. The species was retained as a candidate species in Wilton, GMAC and GPEC because suitable habitat has the potential to occur in urban capable lands. Targeted habitat assessments were undertaken for this species, the species was not recorded however suitable habitat was found to occur.	No	No	N/A
*Pteropus poliocephalus**	Grey-headed flying fox	R	R	R	R	No	*Pteropus poliocephalus* is a large bat that is found along the eastern coast of Australia. Habitat comprises a range of forests, woodlands, heaths, and swamps as well as urban gardens and fruit crops (OEH, 2018f). The location of breeding and roosting sites within the Cumberland subregion has been monitored since 2012 as part of a national program (DAWE, 2021).	Yes	Yes	GMAC, GPEC

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							The species was removed as a candidate species in in all nominated areas because there are no known breeding sites in urban capable lands.			
Pterostylis saxicola	Sydney Plains Greenhood	✓	✓	R	✓	Yes	*Pterostylis saxicola* is an orchid that is restricted to western Sydney between Freemans Reach in the north and Picton in the south. Habitat comprises sandstone outcrop areas in shale-sandstone transition forest, although it is occasionally found on clay-rich sites (OEH, 2018j). There are a number of records in the vicinity of the nominated areas. Some of these are thought to have low reliability in terms of their location. The species was retained as a candidate species in Wilton, GMAC and GPEC because suitable habitat has the potential to occur in urban capable lands. An expert report has been prepared to confirm whether suitable habitat exists for this species within urban capable lands. The species was removed as a candidate species in WSA because the expert report concluded the species unlikely to be present.	Yes	No	N/A
Pultenaea parviflora		X	X	✓	✓	Yes	*Pultenaea parviflora* is a small shrub that is endemic to the Cumberland Subregion. The species primarily occurs in areas of Shale Gravel Transition Forest and Cooks River/ Castlereagh Ironbark Forest, with some	Yes	Yes	WSA, GPEC

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							potential in Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Forest (OEH, 2017i). The species was retained as a candidate species in WSA and GPEC because records occur in the vicinity of the nominated areas and suitable habitat has the potential to occur in urban capable lands.			
Pultenaea pedunculata	Matted Bush-pea	✓	✓	✓	✓	Yes	*Pultenaea pedunculata* is a shrub that occurs in NSW, Victoria, and Tasmania. In NSW it occurs in three locations including the Cumberland Subregion. The species occurs in a range of habitats and in the Cumberland Subregion it favours clay or sandy-clay soils that have a lateritic influence with ironstone gravel (nodules) present (OEH, 2018h). The species has been recorded in several places in the vicinity of the nominated areas. The species was retained as a candidate species in all nominated areas because records occur in the vicinity of the nominated areas and suitable habitat has the potential to occur in urban capable lands.	Yes	No	N/A
Tetratheca glandulosa		R	R	X	R	No	*Tetratheca glandulosa* is a small shrub that is restricted to the following Local Government Areas (LGAs): Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong (the nominated areas do not occur in these LGAs). The	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
							species has a strong association with shale-sandstone soils (OEH, 2017l). The nearest substantiated records to the nominated areas are to the west of Thirlmere lakes where they occur on sandstone communities outside urban capable lands. The species was removed as a candidate species in Wilton, GMAC and GPEC because urban capable lands are outside the geographic range of the species and no records of the species occur within the vicinity.			
Thesium australe	Austral Toadflax	R	R	R	R	No	*Thesium australe* is a small herb that is found in small populations along the coast of NSW. The species occurs in grasslands on the coast, and grassland or grassy woodland further inland (OEH, 2018c). The species is distinctive in survey (sprawling yellow-grey-green herb) and has only a single old record (1803) from the Cumberland subregion (which is also the type collection). It is currently considered to be extinct in the subregion (OEH, 2018c). The species was removed as a candidate species in all nominated areas because urban capable lands are outside the geographic range of the species and no reliable records of the species occur within the vicinity.	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
Tyto novaehollandiae (breeding)	Masked Owl	✓	✓	R	✓	Yes	*Tyto novaehollandiae* is a medium-sized owl which occurs over 90 per cent of NSW and is most abundant on the coast. Roosting and breeding habitat for the species comprises moist eucalypt forested gullies, and it uses large tree hollows or caves for nesting (OEH, 2019y). The large-scale breeding habitat and the fairly specific requirements of large, hollowed trees (and especially hollowed stag trees) are scarce on the Cumberland subregion. The species was removed as a candidate species in WSA because: • Species' breeding microhabitats considered substantially degraded within the WSA nominated area • Species has never been recorded in the WSA nominated area (based on BioNet as-held data export) The species was retained as a candidate species in Wilton, GMAC and GPEC because known sites occur within the vicinity of the nominated areas. Habitat assessment surveys have been undertaken across the Growth Ares for this species. Potential breeding habitat was found to be present.	Yes	No	N/A
Wahlenbergia multicaulis -	Tadgell's Bluebell	R	R	R	R	No	*Wahlenbergia multicaulis* is a perennial herb that is found in 13 known sites in northern Sydney and Western	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
endangered population							Sydney (Rookwood, Chullora, Bass Hill, Bankstown, Georges Hall, Campsie, South Granville and Greenacre) (OEH, 2019aj). In Western Sydney, habitat is associated with the Villawood Soil Series, which is a poorly drained, yellow podsolic extensively permeated with fine, concretionary ironstone (laterite). The species was removed as a candidate species in all nominated areas because the population does not occur within urban capable lands.			
Zannichellia palustris	Horned Pondweed	X	X	R	X	No	*Zannichellia palustris* is a submerged aquatic plant. In NSW it is only known from the lower Hunter region and Sydney Olympic Park. It occurs in fresh or slightly saline stationary or slowly flowing water (OEH, 2017m). The species was removed as a candidate species in WSA because urban capable land is outside the geographic extent of the species.	No	No	N/A

Scientific name	Common name	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species	Justification for removal of species from further assessment	Targeted for survey for this project (y/n)	Recorded during survey (y/n)	Location of record
		Wilton	GMAC	WSA	GPEC					
Zieria involucrata		R	X	X	X	No	*Zieria involucrata* is a small shrub that occurs to the north and west of Sydney in the Baulkham Hills, Hawkesbury, Hornsby, and Blue Mountains Local Government Areas. The species is associated with Hawkesbury sandstone, as well as Narrabeen Group sandstone and Quaternary alluvium (OEH, 2017n). The Cumberland subregion occurs within the predicted distribution of the species (OEH, 2017n), and there is one old record from Kurrajong in 1959. The species was removed as a candidate species in Wilton because urban capable land is outside the geographic extent of the species.	No	No	N/A

* These species are SCS in relation to breeding habitat or mapped "important habitat" only

A.2 JUSTIFICATION FOR EXCLUDING KOALA IN GPEC AND WSA

As identified in Table A-1 above, Koala was excluded as a candidate SCS in Greater Penrith to Eastern Creek Investigation Area (GPEC) and Western Sydney Aerotropolis (WSA). This was determined based on consideration of best available ecological data as provided by Section 6.1.1.2 of the BAM, and:

- The context for assessing Koalas under the BAM
- Habitat mapping for the species
- Consideration of threatening processes
- Consideration of distribution of Koala records

A.2.1 CONTEXT FOR ASSESSING KOALAS UNDER THE BAM

The NSW Threatened Biodiversity Data Collection says the following in relation to important habitat for Koalas: "'Important' habitat (however this is not a mapped important habitat area) is defined by the density of Koalas and quality of habitat determined by on-site survey - contact OEH for more information".

A.2.2 HABITAT MAPPING WITHIN GPEC AND WSA

While Koala was excluded as a candidate species in GPEC and WSA, mapping was undertaken for the species within these nominated areas. This mapping informed the decision to exclude Koala as a candidate species from these areas.

Three methods of mapping (see Section 11.5.4) were conducted to determine the availability and importance of Koala habitat within GPEC and WSA as follows:

- The first method, known as a Species Distribution Model (SDM), did not find any areas of potential Koala habitat within either GPEC or WSA. See Supporting Document F for further information
- The second method, known as corridor mapping, was based on the same approach for mapping Koala habitat as developed and used in GMAC and Wilton. This mapping found only scattered areas of supporting Koala habitat within GPEC or WSA and did not identify any 'important habitat' (defined as primary, secondary, or tertiary corridors – see Section 11.5.4). A key driver of this result was the general lack of Koala records within and around GPEC and WSA (see Section A.2.4 below). The lack of important habitat is a key justification for excluding the species from GPEC and WSA
- The third method, known as habitat critical to the survival mapping, did not map any habitat critical in GPEC or WSA

A.2.3 CONSIDERATION OF THREATENING PROCESSES

GPEC already contains large areas of existing urban development. Urban environments pose significant threats to Koalas, through factors including high road and traffic densities, high densities of predators such as domestic dogs, landscape hazards such as swimming pools and barriers to movement such as fences. Whilst Koalas may very occasionally occur within areas of vegetation within GPEC, it is considered highly unlikely that a breeding and persisting population of Koalas would be able to permanently reside in habitat within GPEC, as it is likely that the mortality rates of Koalas due to the high threat pressures would be greater than the breeding rate.

WSA does not currently have such a high density of urban development, and therefore is less likely to have threat densities which are as significant as those in GPEC. However, the scarcity of native vegetation within the nominated area would require Koalas to cross large areas of open habitat whilst traversing between vegetation, which would increase the vulnerability of Koalas to threats such as predation by dogs.

Overall, it is considered that significant threats would be present within both GPEC and WSA.

A.2.4 CONSIDERATION OF KOALA RECORD DISTRIBUTION

The BioNet record database was examined to determine the likelihood that Koalas are present within GPEC and WSA. An area encompassing the two nominated areas and 2 km around each nominated area was investigated. It is noted that there are high human population densities in both areas, particularly within GPEC, and therefore an absence of records would be likely to accurately reflect an absence of Koalas (as opposed to an absence of surveys).

For context there are:

- 2,228 records within 2 km of Greater Macarthur GA
- 479 records within 2 km of Wilton GA

RECORDS WITHIN 2 KM OF WSA

There are no records of Koalas within 2 km of WSA. This supports the species being excluded and does not support Koalas occurring in sufficient 'density' (as referenced by the TBDC) for there to be 'important habitat' within the nominated area.

RECORDS WITHIN 2 KM OF GPEC

There are 14 records within 2 km of GPEC. These are shown in Figure A-1 and described in Table A-2. The table has the attributes from the records, with additional comments in the last column.

Of the 14 records within 2 km of GPEC, two occur within the nominated area (#s 13 and 14). Both records occur in highly developed areas of GPEC and are questionable in their relevance:

- Record 13 is 30+ years old, and is possibly a north coast record as the animal was taken to Coffs Harbour Koala Park
- Record 14 is 5 years old, has a low level of accuracy (suburb only), and may also possibly be a north coast record as Oxley Park may refer to Port Macquarie (records in western Sydney have been corrected to Port Macquarie in the past)

Four of the records occur to the north of GPEC. They are #s 9-12:

- Records 9 and 10 occur 1 week apart in 2018 and may be the same animal. Record 9 is of a Koala trapped in a yard by a domestic dog which was rescued by WIRES, and record 10 is of a Koala that was killed on Stony Creek Road
- Record 11 is from the same date as record 10 and has a low level of accuracy (suburb only). This is a wildlife rehabilitation record, indicating it is likely to be associated with an injured Koala. It may be related to records 9 and 10
- Record 12 is of a scat from 2006

Eight of the records occur to the west of GPEC. They are #s 1-8:

- Records 1 and 2 are from 2018 and occur 1.1km to the west of GPEC. They have a high level of accuracy
- Records 3, 4 & 5 are more than 20 years old. Record 3 has very poor accuracy, and record 5 occurs to the west of the Nepean
- Record 6 is 3 years old but is suburb only
- Records 7 and 8 are more than 20 years old and occur to the west of the Nepean River

In summary, based on this review of records:

- The number and quality of records does not support Koalas occurring in sufficient 'density' (as referenced by the TBDC) for there to be 'important habitat' within GPEC
- It appears highly unlikely that Koalas occur regularly (if at all) in GPEC. There are no records with a reasonable level of confidence in the nominated area, there are no records from Wianamatta Regional Park, and no records from Mulgoa Nature Reserve (just outside GPEC). These areas are near urban areas and are well traversed, so it is unlikely that there are present yet unrecorded Koalas
- There are very few records to the north, and the three records from 2018 may be the same animal. All these records indicate a Koala in distress (being attacked by a dog, a roadkill record, and a wildlife rehabilitation record). Note that this animal apparently did not survive for long in this environment
- There are only 2 records to the west of GPEC that have a reasonable level of confidence that also occur to the east of the Nepean. The Nepean is likely to represent a significant barrier to dispersal

A.2.5 CONCLUSION

The review of records and habitat, and the high level of existing threats supports the conclusion that Koalas should be excluded as candidate species credit species within both GPEC and WSA. This is consistent with the TBDC reference to important habitat relating to the density of Koalas (low to nil in both nominated areas) and quality of habitat (mapped as supporting only with high levels of threat

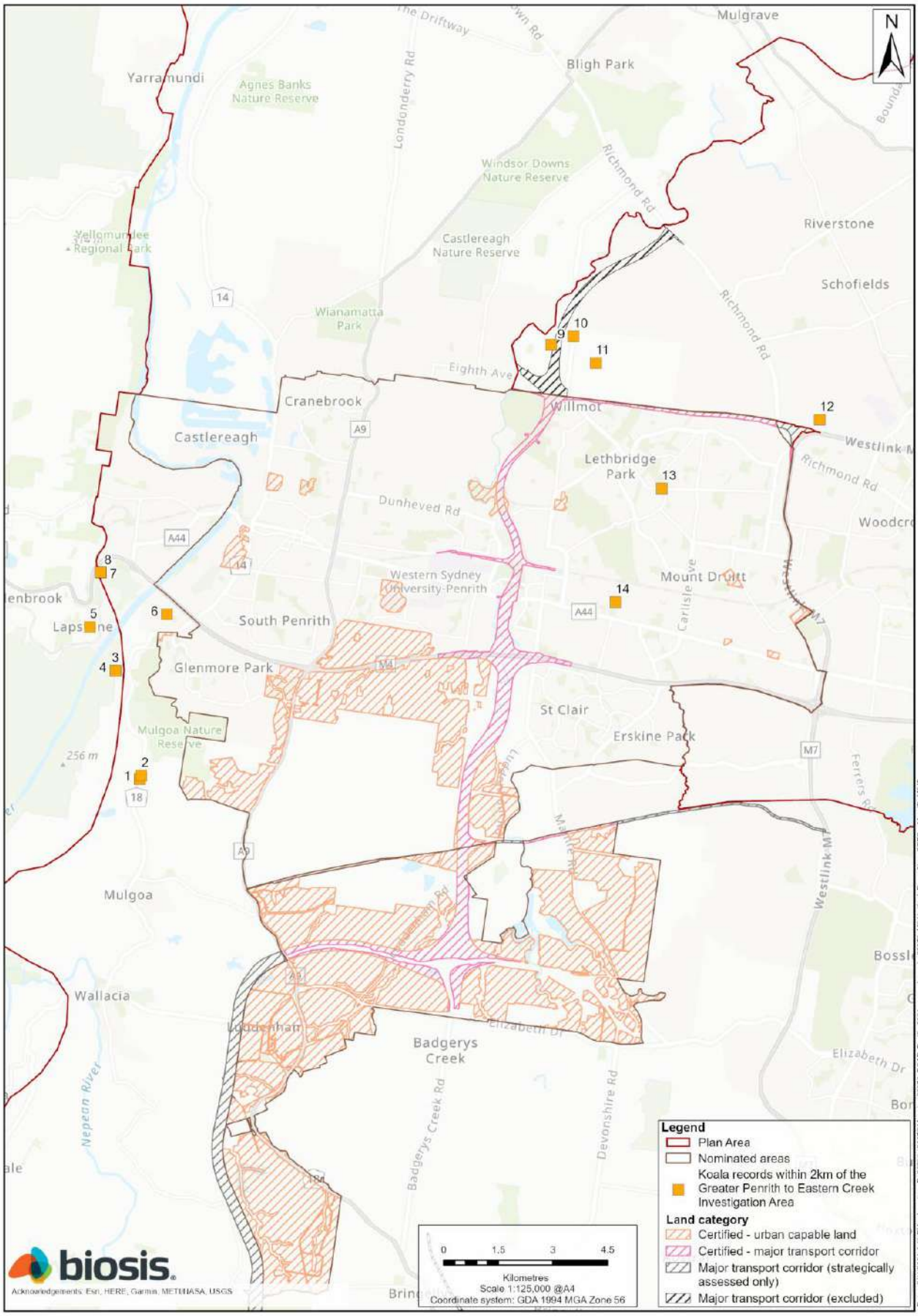

Figure A-1: Koala records within 2 km of GPEC

Table A-2: Description of BioNet Koala records within 2 km of GPEC

ID	First Date	Last Date	Number of Individuals	Observation	Description	Accuracy	Sighting Notes	Location Notes	Notes
1	22/4/18	22/4/18	0	O - Seen	Mulgoa Road, Mulgoa running beside safety barrier just south of 750 Mulgoa Road heading east; later observed again on Mulgoa Road	100			Record 3.5 years old High level of accuracy Record lies 1.1 km to the west of GPEC
2	24/6/18	24/6/18	1	O - Seen	Mulgoa road - in between Nepean Christian school and Notre Dame, on the left-hand side of the road if you are heading towards Wallacia Mulgoa	1000			Record 3 years old High level of accuracy (description provided) Record lies 1.1 km to the west of GPEC
3	1/11/99	31/12/99	0	O - Seen		10000			Record 20+ years old Very poor accuracy
4	1/12/99	1/12/99	1	O - Seen	Glenbrook Specified Map No: 9030	1000	Saw Koala in a tree. Observer a participant in the Lower Blue Mountains Koala Survey May 2000		Record 20+ years old
5	19/9/98	19/9/98	1	T - Trapped or netted	Caley Crescent, Lapstone Specified Map No: 9030-3-N	100			Record 20+ years old Located on western side of Nepean River
6	30/8/18	30/8/18	0	WR - Wildlife Rehabilitation Record	Suburb only provided: Regentville, 2745	616	Encounter broad: Stranded/Unsuitable environment; Encounter narrow:		Record 3 years old Low level of accuracy (suburb only)

ID	First Date	Last Date	Number of Individuals	Observation	Description	Accuracy	Sighting Notes	Location Notes	Notes
							Unsuitable environment		
7	2/5/00	1/7/00	0	O - Seen		500			Record 20+ years old Located on western side of Nepean River
8	2/6/00	2/6/00	2	O - Seen	Lapstone Specified Map No: 9030	100	Saw 2 Koalas together on median strip of highway, some bush present. At first thought they were possums. Slowed down to have a good look and are positive of ID. Participant in a community Koala survey.		Record 20+ years old Located on western side of Nepean River
9	10/4/18	10/4/18	0	O - Seen	Private property, Shane Park Road, Llandilo, in Palm tree and later Eucalyptus moluccana. Bailed up by domestic dog in yard. WIRES called	100			Record 3.5 years old High level of accuracy Record lies 1.4 km to the north of GPEC
10	17/4/18	17/4/18	0	R - Roadkill	Stony Creek Road, Llandilo south of weir. Killed on road	100			Record 3.5 years old High level of accuracy Record lies 1.7 km to the north of GPEC

ID	First Date	Last Date	Number of Individuals	Observation	Description	Accuracy	Sighting Notes	Location Notes	Notes
11	17/4/18	17/4/18	0	WR - Wildlife Rehabilitation Record	Suburb only provided: Shanes Park, 2760	1669	Encounter broad: Collision; Encounter narrow: Collision - Other		Record 3.5 years old Low level of accuracy. Date may indicate the record is related to animal identified in records 9 and 10? Record lies 1 km to the north of GPEC
12	12/4/06	12/4/06	0	X - In scat	Castlereagh Candidate Area - Eastern section of Colebee Land Specified Map No: 9030-1-S	10		Regenerating upper slope open forest dominated by E. *fibrosa,* with some *E. moluccana.* Moderate tall shrub layer dominated by *Allocasuarina* sp. and *Melaleuca* sp. Few hollows.	Record 15+ years old Scat recorded in an area of woodland in Colebee
13	16/7/90	16/7/90	1	T - Trapped or netted	52 Franklin Crescent, Blackett Specified Map No: 9030-1-S	1000	Specimen seen in tree in backyard. WIRES voucher no. 26517. animal later sent to Coffs Harbour Koala Park. This recording transcribed by Lachlan Laurie via WIRES information supplied by Dr		Record 30+ years old Possibly a north coast record as animal taken to Coffs Harbour Koala Park

ID	First Date	Last Date	Number of Individuals	Observation	Description	Accuracy	Sighting Notes	Location Notes	Notes
							Robert Close, UWSyd.		
14	18/11/16	18/11/16	0	WR - Wildlife Rehabilitation Record	Suburb only provided: Oxley Park, NSW, 2760	636	Encounter broad: Unknown; Encounter narrow: Unknown		Record 5 years old Low level of accuracy (suburb only) Possibly a north coast record as Oxley Park may refer to Port Macquarie (records in western Sydney have been corrected to Port Macquarie in the past)

B. Knowledge-based Method parameters

All candidate SCS not subject to an expert report were assumed present under Section 6.4.1.21 of the BAM, as complete survey to determine species' presence/absence, and/or species' habitat constraints or habitat degradation, was not possible due to the very large size of the project area and associated land access constraints.

Species polygons were developed for all SCS assumed present as required by Section 6.4.1.26 of the BAM, which involved the application of a knowledge-based method (KBM).

Developing species polygons using the knowledge-based method involved the following steps:

a) Creating initial species polygons for each SCS assumed present based on BioNet PCT associations and the project specific vegetation condition states each species was considered likely to occur within (i.e. the vegetation zones within which each species was considered likely to occur, as per Section 6.4.1.30 of the BAM)
b) Additional information about habitat parameters for each species drawn from information in BioNet or published, peer-reviewed literature as prescribed by Section 6.1.1.2 of the BAM was used to refine each species polygon
c) Results of targeted surveys undertaken for the project to further refine several of the species' polygons where the species (or its habitat) was/was not recorded within the mapped areas of habitat

The habitat parameters used in the GIS model to refine the species polygons as part of Step (b) are provided in:

- Section B.1 – Table B-1 shows habitat parameters for species within the nominated areas
- Section B.2 – Table B-2 shows habitat parameters for species outside the nominated areas

The species polygons developed using these parameters are considered to be conservative, suitable to capture impacts to the species habitat using best available data, and appropriate for the scale of the project.

Information about how LiDAR was used in preparing the species polygons is provided at Section B.3.

Please refer to Section 11.5.2 of Chapter 11 for details about the method and approach.

B.1 HABITAT PARAMETERS FOR SPECIES WITHIN THE NOMINATED AREAS

Table B-1: Habitat parameters used in the GIS model to refine species polygons for species within the nominated areas, and justifications for their use

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
Allocasuarina glareicola	BioNet PCT associations: Intact, Thinned	-	-	SOILS: (Blacktown, Agnes Banks, Berkshire Park, Gymea) **Justification:** Existing records occur within these soils	-	-	-	• Removal of Scattered Trees condition state was applied largely to exclude isolated trees throughout suburban areas in GPEC which do not support habitat for the species. It is acknowledged that in doing so there is a small risk that areas of scattered trees in more natural situations (i.e. 'paddock trees'), which may provide potential habitat for the species, were excluded. However, the precautionary nature of mapping all intact and thinned condition vegetation as habitat mitigates the risk that the species' habitat has been under-mapped • The total area of the Scattered Trees condition of associated PCTs in GPEC is 43 ha, of which a single 28 ha polygon occurs on one site that was mapped as such post public submission. This site was surveyed by a BAM accredited assessor and the species was not recorded. Of the remainder, 9.5 ha occurs throughout suburban areas and is not considered habitat for the species • TBDC states 'grows in Castlereagh woodland on lateritic soil'. The soil landscapes selected represent lateritic soils in the assessment area

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								• Soil restriction is justified by SPRAT profile: this species grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. These soils are low in fertility and are strongly to very strongly acidic… (Matthes, Robertson et al., 1996; Wilson & Johnson, 1989) • The vast majority of associated PCTs occur on these soils, and where suitable habitat spanned the mapped change in soils the species habitat was mapped as present
Callocephalon fimbriatum	BioNet PCT associations: Intact	> 25 ha **Justification:** Medium BAM patch size. Favours old growth forest and woodland attributes for nesting and roosting (OEH, 2019d)	-	-	-	-	Tree height >20 m (CHM) **Justification:** Breeding habitat information (Higgins, 1999b)	• TBDC patch size relates to minimum patch size to be included as a predicted (ecosystem credit) and potential candidate (species credit) species. The habitat model is only looking to map breeding (species credit) habitat, therefore an increase in patch size is justified as the species will forage in much smaller patches than it will breed • Within the assessment area patches of vegetation that could be considered similar to 'old growth forest' would occur in larger patches of vegetation, and as such a medium sized BAM patch size was used to differentiate suitable potential breeding habitat • Higgins (1999a) states: Breeds in hollows, often near water, usually within tall mature sclerophyll forest

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								with dense shrubby understorey, often in secluded valleys, which is not represented by small patches of vegetation in the assessment area • The restriction of trees to 20 m high complements the TBDC requirement for hollows 9m above the ground, as it is not possible to model hollow height, and 10cm hollows do not occur at the top of tree canopies (which is the required parameter to be used in a GIS model)
Calyptorhynchus lathami	BioNet PCT associations: Intact	> 25 ha **Justification:** Medium BAM patch size. Breed in hollows, often near water, usually within tall mature sclerophyll forest with dense shrubby understorey, often in secluded valleys (Higgins, 1999b)	-	-	-	-	Tree height >15 m (CHM) **Justification:** Breeding habitat information (Higgins, 1999b)	• TBDC patch size relates to minimum patch size to be included as a predicted (ecosystem credit) and potential candidate (species credit) species. The habitat model only maps breeding (species credit) habitat, therefore an increase in patch size is justified as the species will forage in much smaller patches than it will breed within • Within the assessment area patches of vegetation that could be considered close to 'secluded' would occur in larger patches of vegetation, as such a medium sized BAM patch size was used to differentiate suitable potential breeding habitat • Garnett, Pedlar et al. (1999) states nest trees on Kangaroo Island were an average of 300 m from the 'habitat edge', which based on a circular area

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								with a 300 m radius equates to a patch of approximately 28 ha • LiDAR was used to refine existing vegetation polygons to trees with canopy over 15m. A 1m buffer was applied to all >15m polygons to increase canopy. These polygons were then merged and used to clip the vegetation polygons to determine suitable habitat. Information on LiDAR is presented below in Section B.3 • Species does not breed in paddock trees, although paddock trees may be essential refuge/stepping-stones. Therefore the removal of Scattered Trees condition form breeding habitat polygons is justified
Cercartetus nanus	BioNet PCT associations: Intact	-	-	-	-	-	-	• Thinned and scattered tree vegetation zones lack an intact shrub layer, and thus the species' preferred food resources • As at 07/07/21 only one record exists for the species within the assessment area (and relates to a WIRES record) despite substantial survey coverage over the past decades. If this species occurs within the assessment area as conservatively assessed it is only likely to occur in the highest quality, undisturbed, intact habitats • Records of the species are heavily skewed towards large intact areas of

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								habitat. For example, nearly 300 records (<20 years old) occur within the drinking water catchment to the east of GMAC. Similar conclusions can be made for other areas where the species has been recorded
Chalinolobus dwyeri	BioNet PCT associations: Intact, Thinned, Scattered Trees	-	-	ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury Sandstone')	-	-	Habitat restricted to within a 2000 m buffer on "Cliffline" DEM layer **Justification:** Species roost predominantly in caves and overhangs in sandstone cliffs and forage in nearby high-fertility forest or woodland near watercourses (DERM, 2011)	• Clifflines located in sandstone geologies have been used as the basis for the 2 km habitat buffer. Information on the clifflines DEM layer is presented in Section B.3
Epacris purpurascens	BioNet PCT associations:	-	-	-	-	-	-	• While the species is known to benefit from some disturbance, the Scattered Trees condition state is considered

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
var. *purpurascens*	Intact, Thinned							not to provide suitable habitat for the species
Eucalyptus benthamii	BioNet PCT associations: Intact, Thinned, Scattered Trees	-	Habitat restricted to within a 350 m buffer of the 'NEPEAN RIVER' Hydro Area **Justification:** Requires a combination of deep alluvial sands and a flooding regime to recruit seedlings (OEH, 2019d) and captures extent of species records	ROCK UNIT: ('Alluvium', 'Bringelly Shale', 'Hawkesbury Sandstone')	Between 25 to 300 m (OEH, 2019d)	-	-	• The assessment area in the vicinity of certified land does not support the species' characteristic riverbank and alluvial floodplain habitat (required to facilitate seedling recruitment) • Certified land occurs within 800 m of Mulgoa Creek and a species record; however the certified land occurs 30-40 m higher in elevation than the watercourse, and vegetation in that area is mapped as PCT 850, illustrating the non-floodplain nature of the habitat • Certified land occurs near Manangle Park but this is over 1.5km from the watercourse and is surrounded by unsuitable PCT 850 habitat • A 350 m buffer was determined as appropriate through numerous iterations of the habitat model and is considered suitable to represent an area supporting 'a combination of deep alluvial sands and a flooding regime to recruit seedlings' • It is acknowledged that BioNet records do not represent complete presence/absence data for the species, however the 763 records dataset represents best available information and its use is considered appropriate

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
Grevillea parviflora subsp. *Parviflora*	BioNet PCT associations: Intact, Thinned	-	-	SOILS: ('Berkshire Park', 'Lucas Heights', ' Wianamatta (South Creek) ROCK UNIT: ('Alluvial channel deposits- in-channel bar', 'Alluvial floodplain deposits', 'Alluvium', 'Mittagong Formation', 'Alluvial terrace deposits') **Justification:** Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or	Between 25 to 300 m (OEH, 2019d)	-	-	• TBDC notes the species o*ften occurs in open, slightly disturbed sites such as along tracks*. Scattered trees vegetation zones are highly disturbed (and often not representing 'paddock trees') and this condition state is not therefore considered to provide suitable habitat for the species • TBDC states that Sydney region occurrences of the species are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park. The soil / geology restriction applied is based on interpretation of information in the TBDC to model the species transitional soil habitat requirements in a way that can be used in a GIS habitat model • It is acknowledged that BioNet records do not represent complete presence/absence data for the species, however the >1400 records dataset (within the vicinity of the assessment area) represents best available information and its application and use is considered appropriate

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
				Berkshire Park (OEH, 2020c) Habitat also present where PCTs occur on or within 200 m of Hawkesbury soils AND sandstone geology (Hawkesbury Sandstone) (i.e. must satisfy both criteria) **Justification:** at least 80 of the 97 records of the species that occur outside Lucas Heights soils (around Wilton and GMAC) meet the above criteria				
Haliaeetus leucogaster	BioNet PCT associations: Intact	>5 ha **Justification:** Exclude small, isolated patches of vegetation	Habitat restricted to within 350 m around Strahler order >3 or any waterbody including hydronametype IN	-	-	-	-	• TBDC patch size relates to minimum patch size to be included as a predicted (ecosystem credit) and potential candidate (species credit) species. The habitat model only maps breeding (species credit) habitat, therefore an increase in patch size is justified as the species

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
		from habitat model	('BRANCH', 'DAM', 'LAKE', 'LAKES', 'RESERVOIR', 'RIVER', 'ARM') **Justification:** Selection of nest site data (Dennis, McIntosh et al., 2011)					will forage in much smaller patches than it will breed within • Dennis, McIntosh et al. (2011) is used to justify an appropriate buffer from watercourses. The study notes all but one nest (~350 m) was within 250 m of the coastline. This data in combination with Debus (2008), which states the nests monitored in that study were all within 425 m of a watercourse, was used to derive 350 m as a realistic breeding habitat buffer in the context of the assessment area • TBDC breeding constraint refers to living or dead mature trees within suitable vegetation within 1km of rivers, lakes, large dams or creeks, wetlands and coastlines. Paddock trees are not considered important for breeding, but for essential refuge/stepping stones. Therefore, the removal of the Scattered Trees condition state from breeding habitat polygons is considered justified • No wetlands were excluded based on the GIS selection of waterbodies. 'Coastal areas' do not occur within or near the assessment area
Heleioporus australiacus	BioNet PCT associations: Intact	>5 ha **Justification:** Exclude small,	Habitat restricted to within 300 m of 1st, 2nd, and 3rd order	ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury	-	-	-	• Breeding habitat is generally soaks or pools within first or second order streams, and the species spends more than 95% of its time in non-

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
		isolated patches of vegetation from habitat model	watercourses, excluding overlapping areas within 300 m from a 4th (or higher) order watercourse **Justification:** Burrows in the creek bank. Eggs are laid in burrows or under vegetation in small pools. Breeding habitat is generally soaks or pools within first or second order streams. (up to 300 metres from breeding site (first and second order streams) (OEH, 2019d)	Sandstone'), and SOILS: NOT in ('Blacktown', 'Glenorie', 'Luddenham', 'Picton', 'West Pennant Hills') **Justification:** Found in vegetation on a variety of soil types except those that are clay based (OEH, 2019d)				breeding habitat in areas up to 300 m from breeding sites • Areas within 300m of 4th or higher watercourses associated with non-clay-based soils within the assessment area represent steep slopes not characteristic of the species preferred habitat of 'small slow flowing clear water courses, broad upland gullies, stream headwaters and permanently moist soaks and pondages' (NPWS, 2001) • No certified land occurs within 300 m of >4th order streams, no dams occur within suitable vegetation, no other waterbodies are relevant • Soil restrictions represent non-clay soils within the assessment area

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
Hieraaetus morphnoides	BioNet PCT associations: Intact, Thinned	>5 ha **Justification:** Excludes small, isolated patches of vegetation as habitat	-	-	-	Habitat excluded from within 215 m of a dwelling and 65 m from industrial building **Justification:** Little Eagle expert report for WGA and GMAC (Saunders & Debus, 2018)	Minimum tree height restricted to 20m **Justification:** Nest trees height determined in WSA and GMAC expert report (Saunders & Debus, 2018)	• Relevant parameters detailed in the export report prepared for Wilton and GMAC have been used in the preparation of this habitat model • It is acknowledged that the expert report states the 'species will nest in tall living eucalypts between 5 and 30 m tall in open forest, woodland, and remnant woodland in farmland', however this is considered to be background context. The expert report sets out minimum nesting requirements in Table 1 and 2 of the report, which identify setbacks from development and minimum criteria for nest site characteristics. The report states 'the minimum nesting requirements for Canberra in Table 1 are more relevant to this study'. Table 1 was used for setbacks from development, Table 2 was used for nest tree height • TBDC patch size relates to minimum patch size to be included as a predicted (ecosystem credit) and potential candidate (species credit) species. The habitat model only maps breeding (species credit) habitat, therefore an increase in patch size is justified as species will forage in much smaller patches than it will breed within • The expert report states nests are typically in an emergent eucalypt,

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								the tallest in the stand and often with the largest girth, in woodland patches at least 4.8 ha in size (average 85 ha). This 4.8 ha criteria was rounded up to 5 ha, but is still well below the average size noted in the report • It is acknowledged that the TBDC states 'paddock trees can provide important breeding habitat', however this is considered to be a generic statement relevant to the species' range across all of NSW and is not supported by the expert report prepared for the assessment area. Therefore, the removal of the Scattered Trees condition state from breeding habitat polygons is considered justified
Lophoictinia isura	BioNet PCT associations: Intact	>5 ha **Justification:** Exclude small, isolated patches of vegetation from habitat model	Habitat restricted to within 350 m around Strahler order 3+ watercourses or any waterbody including hydronametype IN ('BRANCH', 'DAM', 'LAKE', 'LAKES', 'RESERVOIR', 'RIVER', 'ARM')	-	-	-	-	• TBDC patch size relates to minimum patch size to be included as a predicted (ecosystem credit) and potential candidate (species credit) species. The habitat model only maps breeding (species credit) habitat, therefore an increase in patch size is justified as species will forage in much smaller patches than it will breed within • Furthermore Table 2 of the expert report states the minimum requirement for forest/woodland patch size is 5 ha and 'in fragmented

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
			Justification: Species shows a particular preference for timbered watercourses, with nest sites generally located along or near watercourses (OEH, 2019d)					landscapes with much larger patches nearby' • 'Timbered watercourses' present within GPEC and WSA are generally represented by Strahler order 3+ watercourses. While there are a limited number of 2nd order streams in Orchard Hills and Wianamatta Regional Park, these areas not to be certified • A 350 m setback was developed through the iterative development of the GIS model process and with reference to the habitat requirements outlined in the expert report
Marsdenia viridiflora subsp. *viridiflora - endangered population*	BioNet PCT associations: Intact, Thinned	-	-	-	-	LGAs IN ('BANKSTOWN','BLACKTOWN', 'CAMDEN', 'CAMPBELLTOWN', 'FAIRFIELD', 'HOLROYD', 'LIVERPOOL', 'PENRITH')	-	• Removal of Scattered Trees condition state was applied largely to exclude isolated trees throughout suburban areas in GPEC which do not support habitat for the species. It is acknowledged that in doing so there is a small risk that areas of scattered trees in more natural situations (i.e. 'paddock trees'), that do provide potential habitat for the species were excluded, but the precautionary nature of mapping all intact and thinned condition vegetation as habitat mitigates the risk that the species' habitat has been under-mapped. It is considered that inclusion of Scattered Trees would have over-mapped the species' habitat by approximately 120 ha

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
Maundia triglochinoides	BioNet PCT associations: Intact, Thinned	-		SOILS: (Berkshire Park, Birrong, Blacktown, Deep Creek, Freemans Reach, Glenorie, Lane Cove, Monkey Creek, Picton, Richmond, Wianamatta (South Creek), Teresa Park, Upper Castlereagh) **Justification:** Grows on heavy clay (OEH, 2019d)	-	-	-	• The soils restriction is considered to be consistent with information in the TBDC that says the species "Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients" • The GIS model accounts for potential unpredictability by applying broad parameters around PCT and soil associations only, and is considered to be conservative and likely to map all areas of potential habitat
Micromyrtus minutiflora	BioNet PCT associations: Intact, Thinned	-	-	-	Up to 50 m (Doug & Lyn, 1998)	-	-	• A review of an as-held BioNet extract from 07/07/21 shows all records within, and to the north of, the assessment area occurring at ~50 m elevation or less (470 of the total 472 BioNet records), with records in the Richmond area generally siting at around 20 m elevation • It is acknowledged that two records of the species occur at higher elevations near Fairlight Rd, Mulgoa, however these were considered outliers, and the published literature referenced, combined with 99.5% of

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								BioNet records, were considered suitable to support the use of elevation as a habitat parameter • Removal of Scattered Trees condition state was applied largely to exclude isolated trees throughout suburban areas in GPEC which do not support habitat for the species. It is acknowledged that in doing so there is a small risk that areas of Scattered Trees in more natural situations (i.e. 'paddock trees'), that do provide potential habitat for the species were excluded, but the precautionary nature of mapping all intact and thinned condition vegetation as habitat mitigates the risk that the species' habitat has been under-mapped
Myotis macropus	BioNet PCT associations: Intact, Thinned, Scattered Trees	-	All waterbodies in the Plan Area with pools/reaches of water 3 m or wider and areas of habitat within 200 m of these waterbodies where they coincide with the relevant PCTs (OEH, 2019d)	-	-	-	-	• Species polygon prepared in accordance with 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (OEH, 2018i)

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
Ninox connivens	BioNet PCT associations: Intact	>25 ha **Justification:** Moderate BAM patch size, removes isolated patches	Restricted to within 100 m of a watercourse **Justification:** Breeding habitat known to be similar and more restrictive than Powerful Owl (DEC, 2006)	-	-	-	Vegetation within "Gullies" DEM layer **Justification:** Breeding habitat known to be similar and more restrictive than Powerful Owl (DEC, 2006)	• The species typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (NSW NPWS, 2003b). The species appears most abundant in the largest remnants but also occurs at low density in fragmented habitat, where it uses healthy riparian woodland or gallery forest amid extensive, diverse woodland supporting a diversity of native prey (Debus, 2001). Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils (DPIE, 2021). Barking Owl habitat has a strong spatial association with hydrological features such as rivers and wetlands (Kirsten & Taylor, 1999) • Information on the DEM "gullies" layer is provided in Section B.3. The layer was able to accurately map the occurrence of gullies and a GIS process was then used to capture those gullies that occur within 100m of mapped watercourses • Species use of paddock trees considered to be for essential refuge/stepping stones, not breeding. Therefore, the removal of the Scattered Trees condition state from

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								breeding habitat polygons is considered justified
Ninox strenua	'BioNet PCT associations: Intact'	-	Restricted to within 100 m of a watercourse **Justification:** Nests in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (DEC, 2006)	-	-	-	Vegetation within "Gullies" DEM layer **Justification:** Nests in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (DEC, 2006)	• (DEC, 2006) states the species breeds in hollow eucalypts in unlogged, unburnt gullies. The Intact vegetation condition is considered to represent this requirement • Information on the DEM "gullies" layer is provided in Section B.3
Persicaria elatior	BioNet PCT associations: Intact, Thinned, Scattered Trees, DNG	-	Habitat mapped within vegetation polygons occurring within 50m of the following hydro areas: Anabranch, Backwater, Billabong,	SOILS: ('Wianamatta (South Creek), 'Richmond', 'Freemans Reach', 'Berkshire Park', 'Upper Castlereagh)	-	-	-	• No condition restriction has been applied, so when combined with associated PCTs, proximity to waterbodies and sandy/alluvial soil restriction (based on soils occurring in the assessment area) the habitat model reflects the requirements as listed in the TBDC and publish information on the species

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
			Branch, Cowal, Creek, Pond, River, Stream, Swamp, Watercourse, Waterway **Justification:** Species grows in damp places, especially beside streams and lakes, occasionally in swamp forest (OEH, 2019d)	**Justification:** Species grows on sandy, alluvial soil (DEWHA, 2008c)				• 'Hydro layer' refers to the NSW Water Theme of the Foundation Spatial Data Framework (FSDF) - Hydro Line © Spatial Services 2021 and NSW Water Theme of the Foundation Spatial Data Framework (FSDF) – Hydro Area © Spatial Services 2021. This is part of the LPI set of topography spatial layers
Persoonia bargoensis	BioNet PCT associations: Intact, Thinned	-	-	ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury Sandstone', 'Mount Hercules Sandstone Member', 'Razorback Sandstone Member') AND Blacktown, Glenorie, Picton, Luddenham soil landscapes within 80 m of the edge of the	0 - 450 m **Justification:** As detailed in Cunninghamia Vol. 6(4): 2000, increased based on records around Bargo (Doug & Lyn, 1998)	-	-	• Soil restrictions as detailed were those relevant to the assessment area and were used to constrain the GIS model to map habitat in the area of transition between/surrounding mapped soil types (as referred to in the TBDC). This restriction was necessary due to the species being associated with several PCTs that occur away from this transitional zone (as well as on/near it), PCT 849 for example. The restriction of 80 m was selected as a result of multiple iterations of the model outputs • It is acknowledged that the TBDC states the 'species seems to benefit from the reduced competition and increased light available on disturbance margins including

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
				sandstone geology **Justification:** Species favours interface soil landscapes such as between the Blacktown Soil Landscape and the complex Mittagong Formation soils (Lucas Heights Soil Landscape) with the underlying sandstone (OEH, 2019d)				roadsides'. This is considered to represent the level of disturbance present within the Thinned condition state not the Scattered Trees condition state. The Scattered Trees condition state vegetation has generally undergone significant historical and/or ongoing disturbance such as urbanisation, slashing, grazing and other farming activities, which is considered more intensive than disturbance that occurs on roadside margins. Furthermore, repeated slashing of roadside margins would prevent the species' seedbank establishment (NPWS, 2000) • It is expected that the TBDC noting Paddock Trees as important to the species is likely to reflect the species tolerance to some disturbance, however substantial and/or ongoing disturbance will negatively impact upon the species occurrence, and this level is considered to be occurring within Scattered Trees condition vegetation
Petaurus norfolcensis	BioNet PCT associations: Intact, Thinned, Scattered Trees	>4 ha **Justification:** Expected home range within the Plan Area	-	-	-	-	Vegetation 10 m tall and higher, buffer all polygons by 12.5 m (to establish	• The assessment area is considered a 'coastal area' and not an 'inland forest fragment'; and as such a home range of 4 ha is considered appropriate to select suitable connected vegetation

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
		(NSWSC, 2008)					connected habitat within glide ratio of 1:2.5 for 10 m trees), clip the buffered polygons back to vegetation polygons, select patches that are 4 hectares and greater **Justification:** Connected habitats are those which the animals can reach by gliding, 10m tall trees are the minimum expected height for glide launch (Jackson, 2000; Vernes, 2001)	• NSWSC (2008) notes Squirrel Gliders have limited ability to disperse across urban or agricultural land. Although capable and willing to cross open habitat on occasion (e.g. to reach heavily flowering trees), they more typically require sufficient connectivity of tree cover within their maximum gliding distance (70 m: (Van der Ree, 2002; Van der Ree, Bennet et al., 2003)). They are therefore susceptible to habitat fragmentation and hence population fragmentation. Based on this the model parameter of connected habitat being patches separated by 25 m (12.5 m buffer surrounding polygons) is consider highly conservative • LiDAR was used to select >10m height polygons within associated PCTs. These polygons were then buffered by 12.5 m to select all 'connected' vegetation polygons within 25 m of each other. Buffered polygons were then merged and used to clip the original vegetation mapping polygons. If the resultant clipped vegetation polygons were part of a >4 ha patch, the patch was mapped as habitat for the species. The buffering allows for areas of vegetation <10m in height to be captured in the species polygons and

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								captures the species ability to "run short distances across open ground"
Pimelea curviflora var. *curviflora*	BioNet PCT associations: Intact, Thinned	-	-	ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury Sandstone') AND All Blacktown soil landscape within a 500m buffer on Wianamatta (South Creek), plus all Berkshire Park soil landscape **Justification:** Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils (OEH, 2019af)	Less than 300 m (Doug & Lyn, 2001)	-	Sandstone units selected only within a 100 m buffer on "Ridge and Crest" DEM layer **Justification:** Occurs on shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (OEH, 2019d)	• TBDC states that the species occurs on 'shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands geology'. Soil and DEM layers have been used to constrain the GIS model to map habitat in the area of transition between/surrounding mapped soil types (as referred to in the TBDC). This restriction was necessary due to the species being associated with several PCTs that occur away from this transitional zone (as well as on/near it), for example PCT 849. The restriction of 80 m was selected as a result of multiple iterations of the model outputs • Removal of Scattered Trees condition state was applied largely to exclude isolated trees throughout suburban areas in GPEC which do not support habitat for the species. It is acknowledged that in doing so there is a small risk that areas of scattered trees in more natural situations (i.e. 'paddock trees'), that do provide potential habitat for the species were excluded, but the precautionary nature of mapping all

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								intact and thinned condition vegetation as habitat mitigates the risk that the species' habitat has been under-mapped. It is considered that inclusion of Scattered Trees would have over-mapped the species' habitat by approximately 100 ha • Note that the DEM layer and 'sandstone units' was ultimately not applied as the species was removed as a candidate from Wilton and GMAC
Pomaderris brunnea	BioNet PCT associations: Intact, Thinned	-	100 m around waterways **Justification:** Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines (OEH, 2019d)	SOILS: ('Blacktown', 'Lucas Heights') **Justification:** Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines (OEH, 2019d)	Up to 450 m (BioNet records)	-	-	• It is considered that the 100m around waterways restriction represents the 'moist woodland or forest on clay and alluvial soils of flood plains and creek lines' within the assessment area • Elevation justification is confirmed as appropriate by (Benson & McDougall, 2000) • Following a review of available literature, it was concluded that intact and thinned condition state PCTs were most representative of the species' potential habitat within the assessment area
Pseudophryne australis	BioNet PCT associations: Intact	-	Restricted to 1st and 2nd order watercourses (OEH, 2019d)	ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury Sandstone')	-	-	Habitat buffered to 50m above and 100m below "Ridge and	• Habitat restricted to 100m from 1st and 2nd order watercourses, where those watercourses occur in association with the stated geologies as mapped in NSW Seamless Surface

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
				inside Ridge and Crest **Justification:** Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones (OEH, 2019d)			Crest" DEM layer **Justification:** Species usually restricted to within 100 m of a ridgetop (NPWS, 2001)	Geology Rock Units (Colquhoun, Hughes et al., 2020) • DEM layer (information is detailed in Section B.3.) was used to refine habitat to within 50-100m of ridgetops as outlined in (NPWS, 2001)
Pultenaea parviflora	BioNet PCT associations: Intact, Thinned	-	-	-	Less than 120 m (Doug & Lyn, 1996)	-	-	• Elevation criteria is taken from published literature (Doug & Lyn, 1996). Furthermore, all BioNet records of the species with and proximal to the assessment area occur well below 120 m, with most occurring below 70 m • It is acknowledged that BioNet records do not represent complete presence/absence data for the species, however the ~1,000 records dataset (proximal to the assessment area) represents best available information and its application and use in this instance is considered appropriate • Removal of Scattered Trees condition state was applied largely to exclude isolated trees throughout suburban areas in GPEC which do not support habitat for the species. It is acknowledged that in doing so there is a small risk that areas of scattered trees in more natural

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
								situations i.e. ('paddock trees'), that do provide potential habitat for the species were excluded, but the precautionary nature of mapping all intact and thinned condition vegetation as habitat mitigates the risk that the species' habitat has been under-mapped
Pultenaea pedunculata	BioNet PCT associations: Intact, Thinned, Scattered Trees	-	-	Occurs on Blacktown, Wianamatta (South Creek), Berkshire Park soil landscapes AND On, or within a 600 m buffer from, "Alluvium" in "GRPSUITE" field OR Within 500 m buffer from boundaries sandstone derived soil landscapes **Justification:** Favours sites in clay or sandy-clay soils on Wianamatta Shale-derived	Less than 150 m (Doug & Lyn, 1996)	-	-	• Soil restrictions as detailed were those relevant to the assessment area. They were used to constrain the GIS model to map habitat in the area of clay or sandy-clay soils on Wianamatta Shale-derived soils, usually close to patches of Tertiary Alluvium, or at or near the Shale-Sandstone interface, with all sites having a lateritic influence (as referred to in the TBDC). Buffers of 500 m and 600 m were used based on multiple iterations of the GIS model process and were determined to best represent the species habitat. This restriction was necessary due to the species being associated with several PCTs that occur away from these soil transitional zones (as well as on/near it), for example PCT 849 and 850 • "GRPSUITE" field relates to in NSW Seamless Surface Geology Rock Units (refer to reference above) • Sandstone derived soil landscapes include: Faulconbridge, Gymea, Gymea/Lambert, Hawkesbury,

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
				soils, usually close to patches of Tertiary Alluvium, or at or near the Shale-Sandstone interface. All sites have a lateritic influence (OEH, 2019d)				Lambert, Oxford Falls (incl. Var a and Var. b) soil landscapes • Including Intact, Thinned, Scattered Trees vegetation conditions is considered appropriate based on the statement in the TBDC that the species is a good coloniser of bare ground. The only condition excluded from the GIS model is DNG which is not considered to represent the 'bare ground' habitat referred to in the TBDC descriptions. Coloniser of bare ground relates to disturbed edges such as those surrounding Thinned and Scattered tree condition vegetation. Where DNG may occur immediately adjacent to these areas the plant has some potential to occur, however the assumption of presence across all other condition states is considered to result in conservative species polygons
Tyto novaehollandiae	Intact, Thinned	All "Intact" Vegetation or "Thinned" patches over 10 ha in area **Justification:** Removed scattered and isolated occurrences of 'Thinned' vegetation	-	-	-	-	Vegetation within "Gullies" DEM layer **Justification:** Roosts and breeds in moist eucalypt forested gullies, using large	• DEM "gullies" layer has been used to map suitable breeding habitat for the species within the project area. • TBDC patch size relates to minimum patch size to be included as a predicted (ecosystem credit) and potential candidate (species credit) species, across the species entire NSW range. The habitat model is only looking to map breeding (species credit) habitat within the project area, therefore an increase in

Scientific name	Vegetation condition	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	LiDAR	Further comments to justify parameters used to prepare species polygons
		not suitable for breeding habitat					tree hollows or sometimes caves for nesting (OEH, 2019d)	patch size to captured potential breeding habitat within 'Thinned' condition vegetation was required to map suitable habitat patches and is considered justified. • The inclusion of Intact and Thinned condition vegetation accounts for the species' (DEC, 2006)

B.2 HABITAT PARAMETERS FOR SPECIES OUTSIDE THE NOMINATED AREAS

Table B-2: Habitat parameters used in the GIS model to refine habitat mapping for species outside the nominated areas within the Cumberland subregion

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
Allocasuarina glareicola	Intact, thinned	BioNet PCT associations	>40 ha **Justification:** Exclusion of small patches of vegetation not meeting the known geographic extent of the species	-	-	Below 50 metres (Doug & Lyn, 1995)	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool (DAWE, 2020)	>800 mm (Doug & Lyn, 1995)
Anthochaera phrygia	Intact, Thinned, Scattered Trees	BioNet PCT associations	-	-	-	-	-	-
Botaurus poiciloptilus	Intact, thinned	BioNet PCT associations	-	40 m buffer applied to hydrolines **Justification:** Preferred habitat is comprised of wetlands, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water (DAWE, 2020).	-	-	-	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
Chalinolobus dwyeri	Intact, thinned	BioNet PCT associations	-	-	Habitat restricted to within 2 kms of Rock Units ('Hawkesbury Sandstone', 'Minchinbury Sandstone', 'Mount Hercules Sandstone Member', 'Razorback Sandstone Member') **Justification:** species primarily roosts in caves and overhangs in sandstone cliffs and forage in nearby high-fertility forest or woodland near watercourses (DECC, 2007; Pennay, 2008; Pennay & Gosper, 2002)	-	-	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
Commersonia prostrata	Intact, Thinned, Scattered Trees	BioNet PCT associations	-	-	SOILS: ('Berkshire Park', 'Freemans Reach', 'Hawkesbury', 'Monkey Creek', 'Richmond', ' Wianamatta (South Creek), 'Theresa Park', 'Upper Castlereagh', 'Bakers Lagoon', 'Ettalong') ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury Sandstone') Justification: Sandy/peat soils (OEH, 2020a)	-	-	-
Cynanchum elegans	Intact, thinned	BioNet PCT associations	-	-	-	Below 600 metres (DAWE, 2020)	All occurrences of PCT 830, 835, 849 and 850 within 1km of PCT 877, and all PCT 877 patches **Justification:** Species occurs in ecotonal areas of dry rainforest and surrounding	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
							drier forest / woodland	
Dasyurus maculatus maculatus	Intact, thinned	BioNet PCT associations	>1000 ha **Justification:** Restrict habitat to areas of very large intact bushland remnants around, and connected to, the edges of the Cumberland sub-region	-	-	-	-	>600 mm (DAWE, 2020)
Deyeuxia appressa	Intact, thinned	BioNet PCT associations	-	-	-	-	-	-
Genoplesium baueri	Intact	BioNet PCT associations	-	-	-	Below 500 metres (Doug & Lyn, 2005)	-	-
Heleioporus australiacus	Intact	BioNet PCT associations	>5 ha **Justification:** Exclude small, isolated patches of vegetation from habitat model	Habitat restricted to all PCTs within 300 m of 1st, 2nd, and 3rd order watercourses, excluding overlapping areas within 300	ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury Sandstone') and SOILS not in ('Blacktown', 'Glenorie',	-	Northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
				m from a 4th (or higher) order watercourse And wetland PCTs within 300m of watercourse irrespective of Strahler order. **Justification:** Burrows in the creek bank. Eggs are laid in burrows or under vegetation in small pools. Breeding habitat of this species is generally soaks or pools within first or second order streams. (up to 300 metres from breeding site (first and second order streams) (OEH, 2019d)	'Luddenham', 'Picton', 'West Pennant Hills') **Justification:** Found in vegetation on a variety of soil types except those that are clay based (OEH, 2019d)		Ulladulla (OEH, 2019d)	
Hibbertia puberula subsp. *glabrescens (also known as Hibbertia sp. Bankstown)*	-	BioNet PCT associations	-	-	-	-	1 km around records **Justification:** Restrict habitat to known geographic	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
							extent of the species	
Hoplocephalus bungaroides	Intact	BioNet PCT associations	>5 ha **Justification:** Excluded small, isolated patches of vegetation from habitat model	-	-	-	-	-
Lathamus discolor	Intact, Thinned, Scattered Trees	BioNet PCT associations	-	-	-	-	-	-
Leucopogon exolasius	Intact, thinned	BioNet PCT associations	-	200 m buffer applied to Cataract River and Georges River: **Justification:** Restrict to known area of occurrence of the species, and the species' inhabits woodland on sandstone (and sandy alluvium) and prefers rocky hillsides along creek banks - prefers rocky hillsides along creek	SOILS: ('Berkshire Park', 'Freemans Reach', 'Hawkesbury', 'Monkey Creek', 'Richmond', Wianamatta (South Creek), 'Theresa Park', 'Upper Castlereagh') ROCK UNIT: ('Alluvial channel deposits- in-channel bar', 'Alluvial floodplain deposits',	Below 400 metres (DAWE, 2020)	-	1000-1400 mm (DAWE, 2020)

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
				banks (DAWE, 2020).	'Alluvial terrace deposits', 'Alluvium', 'Hawkesbury Sandstone', 'Minchinbury Sandstone') **Justification:** Sandstone and sandy alluvium (DAWE, 2020).			
Macquaria australasica	-	N/A	-	The waterways identified in the recovery plan (DoEE & DPI, 2018) that occur within and close to the Strategic Assessment Area that support self-sustaining native populations, or translocated and stocked populations Any additional waterways within the Strategic Assessment Area that support records of the species since 2000	-	-	-	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
Melaleuca deanei	Intact, thinned	BioNet PCT associations	-	-	-	Below 400 metres (DAWE, 2020)	-	1000-1400 mm (DAWE, 2020)
Persicaria elatior	All	BioNet PCT associations	-	Habitat mapped within vegetation polygons occurring within 50m of the following HydroAreas: Anabranch, Backwater, Billabong, Branch, Cowal, Creek, Pond, River, Stream, Swamp, Watercourse, Waterway **Justification:** Species grows in damp places, especially beside streams and lakes, occasionally in swamp forest (OEH, 2020d)	-	-	-	-
Persoonia glaucescens	Intact, thinned	BioNet PCT associations	-	-	-	250-650m (DAWE, 2020)	Restricted to within 7.5 kms of existing records	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
Petauroides volans	Intact	BioNet PCT associations	>25 ha **Justification:** Restrict habitat to larger areas of vegetation. BioNet notes species can occur in medium patches of 5-24ha, however this was returning many unsuitable areas as habitat	-	-	-	-	-
Pimelea curviflora var. *curviflora*	Intact, thinned	BioNet PCT associations	-	-	ROCK UNIT: ('Hawkesbury Sandstone', 'Minchinbury Sandstone', 'Mount Hercules Sandstone Member', 'Razorback Sandstone Member') AND All Blacktown soil landscape within a 500 m buffer on Wianamatta (South Creek) plus all	Below 300 metres (DAWE, 2020)	-	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
					Berkshire Park soil landscape **Justification:** Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils (OEH, 2019d)			
Pterostylis saxicola	Intact	BioNet PCT associations	-	-	Include 'Lucas Heights', 'Woodlands' with ROCK UNIT: ('Hawkesbury Sandstone', 'Ashfield Shale', 'Mittagong Formation' **Justification:** Ashfield Shale, Mittagong Formation shales and sandstones, and Hawkesbury Sandstone and Devonian metasediments (DAWE, 2020)	-	-	<300 mm (DAWE, 2020)

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
Rostratula australis	Intact	Vegetation classes derived from DAWE (DoE, 2015b)	-	All waterways (hydrolines) that have hydronames or group/sub-group types as below with 40m buffer from that watercourse This includes 'Coastal lagoons and lakes', 'Estuarine Wetland', 'Floodplain Wetland', 'Freshwater Lake', 'Reservoir', 'Saline Wetland') And SUBGROUP Coastal vegetation', 'Named coastal lagoons and lakes', 'Unnamed coastal lagoons and lakes', 'Estuarine water body', 'Floodplain water body', 'Named freshwater lake',	-	-	-	-

Scientific name	Vegetation condition	Vegetation associations	Patch size	Waterways	Soil/geology restrictions	Elevation	Geographic	Rainfall associations
				'Unnamed freshwater lake', 'Canal', 'Dam', 'Golf Course', 'Quarry', 'Reservoir', 'Sewage Treatment Pond', 'Saline Lake' **Justification:** Wetland habitats as detailed in SPRAT profile (DAWE, 2020)				

B.3 INFORMATON ON LIDAR PROCESSING

A number of data layers (derived sub-models) were produced using LiDAR for use in preparation of the species polygons. This section:

- Sets out the LiDAR metadata
- Describes the processing steps to create the following LiDAR derived sub-models:
  - Ridge and crest layer
  - Gullies layer
  - Cliff lines layer

B.3.1 LIDAR METADATA

Source: A Division of Department of Finance, Services and Innovation - PENRITH, 2kmx2km Point Cloud Metadata (https://s3-ap-southeast-2.amazonaws.com/nsw.elvis/z56/Metadata/Penrith201102-LID1-C3-AHD_2826250_56_0002_0002_Metadata.html#)

Abstract: The coverage of this dataset is over the PENRITH region. Data of this specification (Spatial Services Category 1 LiDAR) contains point data in LAS format sourced from a LiDAR (Light Detection and Ranging) ALS50 (SN101) sensor. The processed data has been manually edited to achieve ICSM Classification Level 3 whereby the ground class contains minimal non-ground points such as vegetation, water, bridges, temporary features, jetties etc. This data has an accuracy of 0.3m (95% Confidence Interval) vertical and 0.8m (95% Confidence Interval) horizontal with a minimum point density of 1.05 points per square metre. For more information on the data accuracy, refer to the lineage provided in the data history.

Purpose: To provide fit-for-purpose elevation data for use in applications related to coastal vulnerability assessment, natural resource management (especially water and forests), transportation and urban planning.

Topic Category: location, elevation, geoscientific information.

Acquisition Start Date: 2011-02-24

Acquisition End Date: 2011-02-24

Spatial Accuracy Horizontal: +/-0.80@95% Confidence Interval

Spatial Accuracy Vertical: +/-0.30 @95% Confidence Interval

B.3.2 LIDAR DERIVED SUB-MODELS

RIDGE AND CREST LAYER

Purpose

To create polygons representing the Ridged and Crest features in the nominated areas using LiDAR data for use in KBM models. A number of specific values and parameters were developed through numerous iterations of the output layers.

Dependencies

Create DEM and CHM

Method

Step	Tool	Parameters	Justification
Create focal mean raster	Focal Statistics	Stat: Mean Neighbourhood 30x30	Focal mean shows the average change in elevation within the neighbourhood with higher values representing areas that above the neighbourhood average and will typically represent local high spots.

			Testing on several different neighbourhood sizes indicated the 30x30 cells (30mx30m) produced the best results.
Create Topographic Position Index (TPI)	Raster Calculator	Focal Mean minus DEM	Subtracting the DEM value from the focal mean values returns a surface that shows how far above or below the local average each location is.
Convert to binary	Reclassify	Classes: -100-1, No data, 1-100, 1	Comparing different breakpoints to the aerial imagery, 1m change over a 30x30 area was selected as the best fit.
Buffer by 5	Expand	Expand Value 5:	Buffers the features to close small gaps and narrow features to create more linear features.
Convert to polygons	Raster to polygon	Simplify: No	

GULLIES LAYER

Purpose

To create polygons representing the upper slopes and crests of gullies in the in the nominated areas using LiDAR data for use in KBM models. A number of specific values and parameters were developed through numerous iterations of the output layers.

Dependencies

Create DEM and CHM

Method

Step	Tool	Parameters	Justification
Create focal range raster	Focal Statistics	Stat: Range Neighbourhood 5x5	Focal range shows the maximum change in elevation within the neighbourhood with higher values representing cliffed areas. Testing on several different neighbourhood sizes indicated the 5x5 cells (5mx5m) produced the best results.
Convert to binary	Reclassify	Classes: -100-2, No data, 2-100, 1	Comparing different breakpoints to the aerial imagery, 2m change over a 5x5 area was selected as the best fit.
Convert to polygons	Raster to polygon	Simplify: No	
Select crests relating to gullies	Select layer by location	Within 5m of LPI Hydroline	Any cell with a change of greater than 2m with a 5x5m neighbourhood.
Merge adjacent polygons to create linear shapes	Buffer	Buffer by 5m and dissolve Buffer by -5m to retain joins by remove areas on outsides	
Intersect with vegetation zones	Intersect	Input layers: consolidated vegetation	To remove any polygons that do not fall within potential habitat.

		Gully candidates	

CLIFF LINES LAYER

Purpose

To create polygons representing likely cliff lines in the in the nominated areas using LiDAR data for use in KBM models. A number of specific values and parameters were developed through numerous iterations of the output layers.

Dependencies

Create DEM and CHM

Method

Step	Tool	Parameters	Justification
Create focal range raster	Focal Statistics	Stat: Range Neighbourhood 5x5	Focal range shows the maximum change in elevation within the neighbourhood with higher values representing cliffed areas Testing on several different neighbourhood sizes indicated the 5x5 cells (5mx5m) produced the best results.
Convert to binary	Reclassify	Classes: 0-8, No data, 8-100, 1	Comparing different breakpoints to the LPI topo DLS layer indicated that an 8m change over a 5x5 area was the best fit.
Convert to polygons	Raster to polygon	Simplify: No	

C. Biological and important populations definitions

Assumptions made in defining biological populations and identifying important populations for each Commonwealth-listed Category 1 species within the Strategic Assessment are provided in Table C-1. See Section 11.5.3 in Part 3 for context.

Table C-1: Biological populations and important populations definitions

Scientific Name	Cth status	Logic for Including/Excluding Records	How to Define Biological Population	Importance criteria used to identify important populations of this species
Acacia bynoeana	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Limited information is available on the dispersal distance of *A. bynoeana* The recovery plan for *A. pubescens* notes that dispersal over a distance of 300 m is considered likely for *Acacia* spp. (NSW NPWS, 2003a) Therefore, plants within 300 m of each other have been defined as one population	Populations of *A. bynoeana* were considered important because they met one or more of the following criteria: • A large population • A population within a conservation area • A population that is site-managed species or iconic species targeted for conservation under the NSW Saving our Species program
Acacia pubescens	Vulnerable	All available BioNet records were used to identify populations, with no date restrictions	Plants within 300 m of each other have been defined as one population, as dispersal is considered likely to occur over this distance in *Acacia* spp. (NSW NPWS, 2003a)	Populations of *A. pubescens* were considered important because they met one or more of the following criteria: • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program • A large population • Is associated with a commitment made under the Sydney Growth Centres conservation program • A population within a conservation area
Allocasuarina glareicola	Endangered	All available BioNet records were used to identify populations, with no date restrictions	Biological populations were defined based on clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollination	All populations of *A. glareicola* were considered important as the species is endangered
Anthochaera phrygia	Critically Endangered	All available BioNet records were considered in the assessment	The Regent Honeyeater comprises a single population (DoE, 2016b)	The population was considered to be important as the species is critically endangered

Scientific Name	Cth status	Logic for Including/Excluding Records	How to Define Biological Population	Importance criteria used to identify important populations of this species
Botaurus poiciloptilus	Endangered	Records restricted to post 2007 to account for estimated 11-year lifespan of the species	The south-eastern Australian subpopulation of the species is considered as one population for this assessment. All records within the Strategic Assessment Area are therefore considered part of the same population	All populations were considered to be important as the species is endangered
Chalinolobus dwyeri	Vulnerable	All BioNet records for the Strategic Assessment Area were included in the assessment	The species is known to breed in very few locations across NSW and the distance bats move from the maternity roost to over wintering roosts has not been established, but is likely to be less than 100 km (DoEE, 2018). As such all records within the Cumberland subregion are considered likely to be from the same breeding population	The population of Large-eared Pied Bats was considered important within the Strategic Assessment Area because it met the following criteria: A population identified or inferred in a Commonwealth conservation advice, recovery plan, final determination, or other relevant policy document as being important
Commersonia prostrata	Endangered	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Populations were considered to constitute clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	All populations were considered to be important as the species is endangered
Cynanchum elegans	Endangered	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Little is known of the reproduction and dispersal ecology of C. elegans (DoEE, 2018). As part of this assessment, a population was considered to be clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	All populations were considered to be important as the species is endangered
Dasyurus maculatus maculatus	Endangered	BioNet records from 1999 onwards were considered current for the assessment	All records within an area covered by the average male home range (up to 5,512 ha) were considered a single population	All populations were considered to be important as the species is endangered
Deyeuxia appressa	Endangered	All available BioNet records were used to identify populations, with no date restrictions	There are not thought to be any extant populations of this species, as there are no recent records of species, and it is considered possible that the species is now extinct	All populations were considered to be important as the species is endangered

Scientific Name	Cth status	Logic for Including/Excluding Records	How to Define Biological Population	Importance criteria used to identify important populations of this species
Eucalyptus benthamii	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	There is limited information available regarding pollination and dispersal thresholds for *E. benthamii.* Therefore, a population was considered to constitute clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	Populations of *E. benthamii* were considered important because they met one or more of the following criteria: • A population identified or inferred in a Commonwealth conservation advice, plan, final determination, or other relevant policy document as being important • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program • A large population • A population within a conservation reserve • A population that is important for maintaining the Extent of Occurrence of a species
Genoplesium baueri	Endangered	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Records within 500 m of each other have been considered to be a single population	All populations of *G. baueri* have been considered as important as the species is endangered
Grevillea parviflora subsp. *parviflora*	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Little is known about the life cycle of *G. parviflora* subsp. *parviflora.* Flowers are insect pollinated, and it is likely that seeds have limited dispersal distances (probably <2 m) (DoEE, 2018) Populations were identified as clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	Populations of *G. parviflora* subsp. *parviflora* were considered important because they met one or more of the following criteria: • A population that is important for maintaining the Extent of Occurrence of a species • A population within a conservation reserve • A large population
Heleioporus australiacus	Vulnerable	BioNet records were used from 2008 onwards based on the approximate 10 year life-span of the species (noting that this only excluded two records from the assessment – both with limited accuracy from 1974 and 1913)	Records within 300 m were considered to be a population	The populations of Giant Burrowing Frog were considered important within the Strategic Assessment Area because they met the following criteria: A population within a conservation reserve

Scientific Name	Cth status	Logic for Including/Excluding Records	How to Define Biological Population	Importance criteria used to identify important populations of this species
Hibbertia puberula subsp. *glabrescens*	Critically Endangered	All available BioNet records were used to identify populations, with no date restrictions	This species is known to occur in one location, as a single population. The translocation site has been planted with a number of individuals propagated from the Bankstown location	All populations of *H. puberula* subsp. *glabrescens* have been considered as important as the species is critically endangered
Hoplocephalus bungaroides	Vulnerable	Records of this species within the Strategic Assessment Area and Cumberland subregion were assessed to determine the age and accuracy of the record, the characteristics of the landscape in which the record is located, and the likelihood of persistence of the species in that locality due to subsequent removal of, or disturbance to, habitat	There is only one record of this species within the Strategic Assessment Area, which has been identified as a single population	No important populations have been identified for this species (all non-important)
Lathamus discolor	Critically Endangered	All available BioNet records were considered in the assessment	The species is considered to be a single migratory population. All records within the Strategic Assessment Area are therefore considered part of the same population	All populations were considered to be important as the species is critically endangered
Leucopogon exolasius	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	No important populations were identified for *L. exolasius*. All populations are non-important
Litoria aurea	Vulnerable	All available BioNet records from 1995 onwards were included in the assessment, based on the guidance in the EPBC Act Policy Statement 3.19 (DEWHA, 2009)	Populations were considered separate if records were more than 10km apart OR where landscape features interrupted connectivity, based on the guidance in the EPBC Act Policy Statement 3.19 (DEWHA, 2009)	The populations of Green and Golden Bell Frog were considered important within the Strategic Assessment Area because they met the following criteria: A population identified or inferred in a Commonwealth conservation advice, plan, final determination, or other relevant policy document as being important
Macquaria australasica	Endangered	All BioNet records have been included in the assessment	Populations in distinct rivers and streams are considered separate populations	All populations were considered to be important as the species is endangered
Melaleuca deanei	Vulnerable	Records in each population were interrogated to ascertain the likelihood	A population is considered to be individuals within 500 m of each other, as species dispersal is	Populations of *M. deanei* were considered important because they met one or more of the following criteria:

Scientific Name	Cth status	Logic for Including/Excluding Records	How to Define Biological Population	Importance criteria used to identify important populations of this species
		of persistence based on the removal of, or disturbance to, habitat	unlikely to occur beyond this distance (NSW DECCW, 2010)	• A large population • A population within a conservation reserve • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program
Micromyrtus minutiflora	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Populations were defined by clustered records connected by relatively intact and continuous vegetation and not separated by a distance of >1 km (approx.). This is based on the distance travelled by insect pollinators and potential unrecorded individuals	All populations of *M. minutiflora* were considered important within the Strategic Assessment Area because the species is identified as an SAII entity through the BC Act process
Persicaria elatior	Vulnerable	All available BioNet records were used to identify populations	Biological populations were defined based on clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollination	Populations of *P. elatior* were considered important because they met one or more of the following criteria: A large population (number of individuals)
Persoonia bargoensis	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	All recorded plants were mapped as a single population as occurrence of the species within the Plan Area spans 20 km, and genetic flow (fruit dispersal by birds and pollination) could potentially move across the population within the life span of each plant (expected to be 20 years (OEH, 2019b))	Populations of *P. bargoensis* were considered important within the Strategic Assessment Area because they met one or more of the following criteria: • A large population (number of individuals) • Only known population of this species
Persoonia glaucescens	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Individuals within 500 m of each other are likely to be interbreeding and are therefore considered to be the same population	Populations of *P. glaucescens* were considered important because they met one or more of the following criteria: • A population that is important for maintaining the Extent off Occurrence of a species • A population within a conservation reserve • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program

Scientific Name	Cth status	Logic for Including/Excluding Records	How to Define Biological Population	Importance criteria used to identify important populations of this species
Persoonia hirsuta	Endangered	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	All populations of *P. hirsuta* are considered to be important as the species is endangered
Persoonia nutans	Endangered	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Populations were defined by clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	All populations of *P. nutans* are considered to be important as the population is endangered
Petauroides volans	Vulnerable	BioNet records were restricted to post 2003 to account for the average 15 year lifespan of the species	The species occupies a relatively small home range with an average size of 1 to 3 ha and they have a low dispersal ability. Records separated by several kilometres and/or cleared developed areas were identified as separate populations	The populations of Greater Glider were considered important within the Strategic Assessment Area because they met the following criteria: A population within a conservation reserve
Pimelea curviflora var. *curviflora*	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Populations were defined by clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	Populations of *P. curviflora* var. *curviflora* were considered important because they met the following criteria: A large population
Pimelea spicata	Endangered	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators	All populations of *P. spicata* are considered to be important as the species is endangered
Pomaderris brunnea	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Records within 1 km of one another are considered a single population	Populations of *P. brunnea* were considered important because they met one or more of the following criteria: • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program • A population within a conservation reserve • A large population

Scientific Name	Cth status	Logic for Including/Excluding Records	How to Define Biological Population	Importance criteria used to identify important populations of this species
Pommerhelix duralensis	Endangered	All available BioNet records were used to identify populations, with no lifespan restrictions	Records have been grouped into populations based on geographic restrictions and connectivity between patches of suitable vegetation	All populations were considered to be important as the species is endangered
Pteropus poliocephalus	Vulnerable	Based on other bat species, the life expectancy is likely to be between two and ten years. BioNet records have been taken from 2008 onwards	The Grey-headed Flying-fox is considered to be a single population across its range (DoEE, 2017)	The population of Grey-headed Flying-foxes was considered important within the Strategic Assessment Area because it met the following criteria: • A population identified or inferred in a Commonwealth conservation advice, recovery plan, final determination, or other relevant policy document as being important
Pterostylis saxicola	Endangered	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Records within 500 m of one another considered a single population	All populations of this species were considered to be important as the species is endangered
Pultenaea parviflora	Vulnerable	Records in each population were interrogated to ascertain the likelihood of persistence based on the removal of, or disturbance to, habitat	Records within 500 m of each other were considered to be a single population	Populations of *P. parviflora* were considered important because they met one or more of the following criteria: • A population is important for maintaining the Extent of Occurrence of a species • A population within a conservation reserve • A large population • Is associated with a commitment made under the Sydney Growth Centres conservation program • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program
Rostratula australis	Endangered	Records restricted to post 2002 to account for estimated 16-year lifespan of the species	All records within the Cumberland subregion are representative of a portion of the east coast population and therefore records in the Strategic Assessment Area have been grouped as one single population	All populations were considered to be important as the species is endangered

D. Additional detail on BAM plots recorded within the nominated areas

Additional detail on the BAM plots recorded in the nominated areas is provided in Table D-1. See Section 11.3.2 in Part 3 for context.

Table D-1: Additional detail on BAM plots recorded within the nominated areas

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
GPEC	Major Transport Corridor	BAM001_ GPC	724	Intact	293697	6265765	Yes	-
GPEC	Non-certified	BAM002_ GPC	724	Intact	293487	6266593	Yes	-
WSAGA	Non-certified	BAM003_ WSA	724	Intact	295512	6250041	Yes	-
WSAGA	Non-certified	BAM004_ WSA	724	Intact	295479	6250073	Yes	-
GPEC	Non-certified	BAM005_ GPC	724	Thinned	293583	6265809	Yes	-
WSAGA	Urban Capable	BAM006_ WSA	724	Thinned	292659	6249881	Yes	-
WSAGA	Non-certified	BAM007_ WSA	724	Thinned	295507	6250208	Yes	-
GPEC	Non-certified	BAM008_ GPC	724	Scattered trees	293812	6265682	Yes	-
GPEC	Non-certified	BAM009_ GPC	725	Intact	293806	6266494	Yes	-
GPEC	Major Transport Corridor	BAM010_ GPC	725	Intact	294002	6266180	Yes	-
GPEC	Major Transport Corridor	BAM011_ GPC	725	Intact	293898	6266708	Yes	-
WSAGA	Urban Capable	BAM012_ WSA	725	Thinned	295202	6249135	Yes	-
GPEC	Major Transport Corridor	BAM013_ GPC	725	Thinned	293942	6266474	Yes	-
GPEC	Non-certified	BAM014_ GPC	725	Thinned	295861	6265780	Yes	-
GPEC	Non-certified	BAM015_ GPC	725	Thinned	295683	6266302	Yes	-
WSAGA	Urban Capable	BAM016_ WSA	725	Thinned	292680	6250054	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
WSAGA	Urban Capable	BAM017_ WSA	725	Thinned	295665	6249079	Yes	-
WSAGA	Urban Capable	BAM019_ WSA	725	Thinned	295262	6249137	Yes	-
GPEC	Non-certified	BAM020_ GPC	725	Scattered trees	295769	6265640	Yes	-
GPEC	Non-certified	BAM021_ GPC	725	Scattered trees	295166	6264658	Yes	-
GPEC	Non-certified	BAM022_ GPC	781	Thinned	292835	6256427	Yes	-
Macarthur	Non-certified	BAM023_ MAC	830	Thinned	294753	6224078	Yes	-
Macarthur	Non-certified	BAM024_ MAC	830	Thinned	294800	6223672	Yes	-
GPEC	Non-certified	BAM025_ GPC	835	Intact	293151	6266410	Yes	-
GPEC	Non-certified	BAM026_ GPC	835	Intact	293412	6266024	Yes	-
WSAGA	Non-certified	BAM027_ WSA	835	Intact	292160	6250304	Yes	-
GPEC	Major Transport Corridor	BAM028_ GPC	835	Thinned	292717	6259347	Yes	-
GPEC	Non-certified	BAM029_ GPC	n/a	Urban native and exotic	285600	6263848	No	-
GPEC	Non-certified	BAM030_ GPC	835	Thinned	292949	6266564	Yes	-
GPEC	Non-certified	BAM031_ GPC	835	Thinned	292881	6266165	Yes	-
Macarthur	Urban Capable	BAM032_ MAC	835	Thinned	294252	6222918	Yes	-
WSAGA	Non-certified	BAM033_ WSA	835	Scattered trees	293982	6254444	Yes	-
WSAGA	Non-certified	BAM034_ WSA	835	Thinned	291010	6252119	Yes	-
WSAGA	Non-certified	BAM035_ WSA	835	Thinned	295626	6250197	Yes	-
GPEC	Non-certified	BAM036_ GPC	835	Scattered trees	292848	6266479	Yes	-
WSAGA	Urban Capable	BAM037_ WSA	835	Scattered trees	296520	6249319	Yes	-
WSAGA	Non-certified	BAM038_ WSA	835	Scattered trees	293666	6254488	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
WSAGA	Urban Capable	BAM039_ WSA	835	Scattered trees	292492	6249627	Yes	-
WSAGA	Urban Capable	BAM040_ WSA	835	Scattered trees	290771	6251694	Yes	-
GPEC	Non-certified	BAM041_ GPC	835	NO grassland	292946	6256334	Yes	-
GPEC	Non-certified	BAM042_ GPC	835	NO grassland	293419	6256540	Yes	-
Macarthur	Non-certified	BAM043_ MAC	849	NO grassland	297183	6228672	Yes	-
Macarthur	Non-certified	BAM044_ MAC	849	NO grassland	297056	6228622	Yes	-
WSAGA	Urban Capable	BAM045_ WSA	835	NO grassland	296938	6253430	Yes	-
WSAGA	Urban Capable	BAM046_ WSA	849	NO grassland	293903	6253647	Yes	-
Macarthur	Non-certified	BAM047_ MAC	849	Intact	292762	6215736	Yes	-
Macarthur	Urban Capable	BAM048_ MAC	849	Intact	295486	6212635	Yes	-
Macarthur	Non-certified	BAM049_ MAC	849	Intact	295910	6217532	Yes	-
Macarthur	Urban Capable	BAM051_ MAC	849	Intact	294575	6216339	Yes	-
Macarthur	Non-certified	BAM052_ MAC	849	Intact	294896	6217535	Yes	-
Wilton	Urban Capable	BAM053_ WLT	849	Intact	286721	6213544	Yes	Yes
WSAGA	Non-certified	BAM054_ WSA	849	Intact	295225	6254717	Yes	-
WSAGA	Major Transport Corridor	BAM055_ WSA	849	Intact	295354	6254883	Yes	-
WSAGA	Urban Capable	BAM056_ WSA	849	Intact	295103	6254658	Yes	-
Macarthur	Urban Capable	BAM057_ MAC	849	Thinned	291729	6214761	Yes	-
Macarthur	Non-certified	BAM058_ MAC	849	Thinned	293087	6211823	Yes	-
Macarthur	Urban Capable	BAM059_ MAC	849	Scattered trees	292951	6212455	Yes	-
Macarthur	Non-certified	BAM061_ MAC	849	Thinned	295973	6219368	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Macarthur	Non-certified	BAM062_MAC	849	Thinned	297092	6228606	Yes	-
Macarthur	Non-certified	BAM063_MAC	849	Thinned	306704	6238330	Yes	-
Macarthur	Non-certified	BAM064_MAC	849	Thinned	306669	6238159	Yes	-
Macarthur	Non-certified	BAM065_MAC	849	Thinned	306842	6238971	Yes	-
Macarthur	Non-certified	BAM066_MAC	849	Thinned	306817	6238650	Yes	-
Macarthur	Non-certified	BAM067_MAC	850	Thinned	294018	6224019	Yes	-
Wilton	Urban Capable	BAM068_WLT	849	Thinned	285051	6212093	Yes	Yes
Wilton	Urban Capable	BAM069_WLT	849	Thinned	285464	6211969	Yes	Yes
Wilton	Non-certified	BAM070_WLT	849	Thinned	286533	6213227	Yes	Yes
Wilton	Non-certified	BAM071_WLT	1395	Thinned	284462	6212463	Yes	-
WSAGA	Non-certified	BAM072_WSA	849	Thinned	294305	6250912	Yes	-
WSAGA	Urban Capable	BAM073_WSA	849	Thinned	295009	6254508	Yes	-
WSAGA	Urban Capable	BAM074_WSA	849	Thinned	288063	6243633	Yes	-
WSAGA	Urban Capable	BAM075_WSA	849	Thinned	287958	6244419	Yes	-
WSAGA	Urban Capable	BAM076_WSA	849	Thinned	287815	6244084	Yes	-
WSAGA	Urban Capable	BAM077_WSA	849	Thinned	296059	6253470	Yes	-
Macarthur	Urban Capable	BAM078_MAC	849	Scattered trees	292216	6213059	Yes	-
Macarthur	Urban Capable	BAM079_MAC	849	Scattered trees	296142	6216634	Yes	-
Macarthur	Urban Capable	BAM080_MAC	849	Scattered trees	291703	6211934	Yes	-
Macarthur	Urban Capable	BAM081_MAC	849	Scattered trees	294862	6215956	Yes	-
Macarthur	Non-certified	BAM082_MAC	849	Scattered trees	298143	6228699	Yes	-
Wilton	Urban Capable	BAM083_WLT	849	Scattered trees	286681	6211757	Yes	Yes

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Wilton	Urban Capable	BAM084_ WLT	849	Scattered trees	286206	6212399	Yes	Yes
Wilton	Non-certified	BAM085_ WLT	849	Thinned	285215	6212250	Yes	-
WSAGA	Non-certified	BAM086_ WSA	849	Scattered trees	295997	6249394	Yes	-
WSAGA	Major Transport Corridor	BAM087_ WSA	849	Scattered trees	294166	6254638	Yes	-
WSAGA	Urban Capable	BAM088_ WSA	849	Scattered trees	288404	6252324	Yes	-
WSAGA	Urban Capable	BAM089_ WSA	849	Scattered trees	289002	6252131	Yes	-
Macarthur	Non-certified	BAM090_ MAC	849	DNG	292640	6216589	Yes	-
Macarthur	Non-certified	BAM091_ MAC	849	DNG	293089	6216124	Yes	-
Macarthur	Urban Capable	BAM092_ MAC	849	DNG	293309	6215176	Yes	-
Macarthur	Urban Capable	BAM093_ MAC	849	DNG	295102	6216310	Yes	-
Macarthur	Urban Capable	BAM094_ MAC	849	DNG	293939	6215026	Yes	-
Wilton	Urban Capable	BAM095_ WLT	849	DNG	285798	6211633	Yes	Yes
Wilton	Urban Capable	BAM096_ WLT	849	DNG	286797	6213980	Yes	Yes
Wilton	Urban Capable	BAM097_ WLT	849	DNG	286951	6213717	Yes	Yes
Wilton	Urban Capable	BAM098_ WLT	849	DNG	286354	6212677	Yes	Yes
Wilton	Urban Capable	BAM099_ WLT	849	DNG	286618	6212412	Yes	Yes
Wilton	Non-certified	BAM100_ WLT	849	DNG	285865	6208971	Yes	Yes
Wilton	Non-certified	BAM101_ WLT	849	DNG	286112	6208940	Yes	Yes
WSAGA	Urban Capable	BAM102_ WSA	849	DNG	294105	6250661	Yes	-
WSAGA	Urban Capable	BAM103_ WSA	849	DNG	294826	6253522	Yes	-
GPEC	Urban Capable	BAM104_ GPC	849	NO grassland	286109	6249333	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Macarthur	Non-certified	BAM105_MAC	849	NO grassland	292715	6216648	Yes	-
Macarthur	Non-certified	BAM106_MAC	849	NO grassland	292777	6215851	Yes	-
Macarthur	Urban Capable	BAM107_MAC	849	NO grassland	291050	6214538	Yes	-
Wilton	Non-certified	BAM108_WLT	849	NO grassland	285563	6214087	Yes	Yes
Wilton	Non-certified	BAM109_WLT	849	NO grassland	286542	6209083	Yes	Yes
Wilton	Non-certified	BAM110_WLT	849	NO grassland	286342	6209041	Yes	Yes
Wilton	Non-certified	BAM111_WLT	849	NO grassland	286504	6208814	Yes	Yes
Wilton	Urban Capable	BAM112_WLT	849	NO grassland	286784	6208598	Yes	Yes
Wilton	Urban Capable	BAM113_WLT	849	NO grassland	288013	6208102	Yes	Yes
WSAGA	Urban Capable	BAM114_WSA	849	NO grassland	296609	6252306	Yes	-
WSAGA	Non-certified	BAM115_WSA	849	NO grassland	295354	6253100	Yes	-
WSAGA	Non-certified	BAM116_WSA	849	NO grassland	295559	6252943	Yes	-
WSAGA	Urban Capable	BAM117_WSA	849	NO grassland	295709	6249070	Yes	-
WSAGA	Urban Capable	BAM118_WSA	849	NO grassland	290790	6252261	Yes	-
Macarthur	Non-certified	BAM120_MAC	850	Intact	294067	6212359	Yes	-
Macarthur	Non-certified	BAM121_MAC	850	Intact	294252	6212013	Yes	-
Macarthur	Urban Capable	BAM122_MAC	850	Intact	293754	6212292	Yes	-
Macarthur	Non-certified	BAM123_MAC	850	Intact	294263	6212319	Yes	-
Macarthur	Non-certified	BAM124_MAC	850	Intact	294002	6212649	Yes	-
Macarthur	Non-certified	BAM125_MAC	850	Intact	294312	6212086	Yes	-
Macarthur	Urban Capable	BAM126_MAC	850	Intact	293766	6212556	Yes	-
Macarthur	Non-certified	BAM127_MAC	850	Intact	294668	6223847	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Macarthur	Non-certified	BAM128_MAC	850	Intact	294322	6223933	Yes	-
Macarthur	Urban Capable	BAM129_MAC	850	Thinned	295017	6223078	Yes	-
Macarthur	Urban Capable	BAM130_MAC	850	Thinned	295349	6216343	Yes	-
Macarthur	Urban Capable	BAM131_MAC	850	Thinned	293791	6223570	Yes	-
Macarthur	Urban Capable	BAM132_MAC	850	Scattered trees	295319	6215913	Yes	-
Macarthur	Non-certified	BAM133_MAC	850	Scattered trees	294897	6224989	Yes	-
Macarthur	Urban Capable	BAM134_MAC	850	Scattered trees	295091	6224369	Yes	-
Macarthur	Urban Capable	BAM135_MAC	850	Scattered trees	294950	6223885	Yes	-
Macarthur	Non-certified	BAM136_MAC	1395	Thinned	296116	6217734	Yes	-
Macarthur	Urban Capable	BAM137_MAC	850	DNG	294335	6222878	Yes	-
Macarthur	Urban Capable	BAM138_MAC	850	DNG	294392	6223025	Yes	-
Wilton	Urban Capable	BAM139_WLT	850	DNG	282772	6211079	Yes	-
Wilton	Urban Capable	BAM140_WLT	850	DNG	282793	6211004	Yes	-
Wilton	Urban Capable	BAM141_WLT	850	DNG	283055	6211003	Yes	-
Macarthur	Urban Capable	BAM142_MAC	850	NO grassland	295129	6215948	Yes	-
Macarthur	Non-certified	BAM143_MAC	850	NO grassland	298632	6227486	Yes	-
Macarthur	Non-certified	BAM144_MAC	850	NO grassland	299175	6227948	Yes	-
Macarthur	Non-certified	BAM145_MAC	850	NO grassland	299241	6228015	Yes	-
Macarthur	Non-certified	BAM146_MAC	850	NO grassland	298183	6229605	Yes	-
Macarthur	Non-certified	BAM147_MAC	850	NO grassland	294232	6223858	Yes	-
GPEC	Non-certified	BAM148_GPC	883	Intact	295402	6265364	No	-
Wilton	Non-certified	BAM149_WLT	1081	Intact	283558	6212410	No	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Macarthur	Non-certified	BAM150_MAC	1105	Thinned	291350	6223628	No	-
Macarthur	Non-certified	BAM151_MAC	1181	Intact	296839	6220438	No	-
Wilton	Non-certified	BAM152_WLT	1181	Intact	288775	6206133	No	-
Wilton	Non-certified	BAM153_WLT	1292	Intact	282579	6210099	No	-
Macarthur	Urban Capable	BAM154_MAC	1395	DNG	291132	6212331	Yes	-
Macarthur	Non-certified	BAM155_MAC	1395	Intact	291436	6212336	Yes	-
Macarthur	Urban Capable	BAM156_MAC	1395	Intact	294293	6216200	Yes	-
Macarthur	Non-certified	BAM157_MAC	1395	Intact	294566	6215949	Yes	-
Macarthur	Non-certified	BAM158_MAC	1395	Intact	293023	6211781	Yes	-
Wilton	Non-certified	BAM159_WLT	1395	Intact	285620	6213697	Yes	Yes
Wilton	Non-certified	BAM160_WLT	1395	Intact	284211	6212541	Yes	Yes
Wilton	Non-certified	BAM161_WLT	1395	Intact	285711	6213173	Yes	Yes
Wilton	Non-certified	BAM162_WLT	1395	Intact	285838	6214553	Yes	Yes
Wilton	Non-certified	BAM163_WLT	1395	Intact	286101	6214915	Yes	Yes
Wilton	Non-certified	BAM164_WLT	1395	Intact	286410	6214708	Yes	Yes
Wilton	Urban Capable	BAM165_WLT	1395	Intact	288112	6206768	Yes	-
Wilton	Non-certified	BAM166_WLT	1395	Intact	283062	6210320	Yes	-
Wilton	Non-certified	BAM167_WLT	1395	Intact	281319	6209719	Yes	-
Wilton	Non-certified	BAM168_WLT	1395	Intact	281863	6211574	Yes	-
Wilton	Urban Capable	BAM169_WLT	1395	Intact	285259	620884	Yes	-
Wilton	Non-certified	BAM170_WLT	1395	Intact	288324	6206567	Yes	Yes
Macarthur	Non-certified	BAM171_MAC	1395	Thinned	292892	6216897	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Macarthur	Urban Capable	BAM172_ MAC	1395	Thinned	293726	6215531	Yes	-
Macarthur	Urban Capable	BAM173_ MAC	1395	Thinned	294894	6212210	Yes	-
Macarthur	Urban Capable	BAM174_ MAC	1395	Thinned	293344	6217133	Yes	-
Macarthur	Non-certified	BAM175_ MAC	1395	Thinned	292785	6212073	Yes	-
Macarthur	Non-certified	BAM176_ MAC	1395	Thinned	296069	6217716	Yes	-
Wilton	Non-certified	BAM177_ WLT	1395	Thinned	284496	6212516	Yes	Yes
Wilton	Urban Capable	BAM178_ WLT	1395	Thinned	286541	6212045	Yes	Yes
Wilton	Urban Capable	BAM179_ WLT	1395	Thinned	285678	6212971	Yes	Yes
Wilton	Urban Capable	BAM180_ WLT	1395	Thinned	287102	6213569	Yes	Yes
Wilton	Non-certified	BAM181_ WLT	1395	Thinned	286123	6214764	Yes	Yes
Wilton	Non-certified	BAM182_ WLT	1395	Thinned	285886	6214703	Yes	Yes
Wilton	Non-certified	BAM183_ WLT	1395	Thinned	285403	6214334	Yes	Yes
Wilton	Non-certified	BAM184_ WLT	1395	Thinned	285510	6213852	Yes	Yes
Wilton	Non-certified	BAM185_ WLT	1395	Thinned	288425	6208591	Yes	-
Wilton	Non-certified	BAM186_ WLT	1395	Thinned	285340	6211548	Yes	-
Wilton	Non-certified	BAM187_ WLT	1395	Thinned	288045	6209436	Yes	-
Wilton	Non-certified	BAM188_ WLT	1395	Thinned	288432	6208635	Yes	-
Wilton	Non-certified	BAM189_ WLT	1395	Thinned	281397	6209958	Yes	-
Wilton	Non-certified	BAM190_ WLT	1395	Thinned	282121	6211400	Yes	-
Wilton	Non-certified	BAM191_ WLT	1395	Thinned	287882	6207138	Yes	Yes
Wilton	Non-certified	BAM192_ WLT	1395	Thinned	288385	6206865	Yes	Yes
Wilton	Urban Capable	BAM193_ WLT	1395	Thinned	287864	6206971	Yes	Yes

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Wilton	Non-certified	BAM194_WLT	1395	Thinned	288106	6206436	Yes	Yes
Wilton	Non-certified	BAM195_WLT	1395	Thinned	287983	6207880	Yes	Yes
Wilton	Urban Capable	BAM196_WLT	1395	Thinned	286480	6214390	Yes	-
Wilton	Urban Capable	BAM197_WLT	1395	Thinned	286989	6214143	Yes	-
Wilton	Urban Capable	BAM198_WLT	1395	Thinned	286705	6213439	Yes	-
Wilton	Urban Capable	BAM199_WLT	1395	Scattered trees	286099	6213781	Yes	Yes
Wilton	Urban Capable	BAM200_WLT	1395	Scattered trees	281538	6210914	Yes	-
Wilton	Urban Capable	BAM201_WLT	1395	Scattered trees	282051	6209815	Yes	-
Wilton	Non-certified	BAM202_WLT	1395	Scattered trees	285402	6214618	Yes	Yes
Wilton	Non-certified	BAM203_WLT	1395	Scattered trees	286360	6214766	Yes	Yes
Macarthur	Urban Capable	BAM204_MAC	1395	DNG	291549	6214782	Yes	-
Wilton	Urban Capable	BAM205_WLT	1395	DNG	284926	6212336	Yes	Yes
Wilton	Urban Capable	BAM206_WLT	1395	DNG	284587	6212188	Yes	Yes
Wilton	Non-certified	BAM207_WLT	1395	DNG	285171	6208897	Yes	-
Wilton	Urban Capable	BAM208_WLT	849	DNG	283995	6210409	Yes	-
Wilton	Urban Capable	BAM209_WLT	1395	DNG	285492	6209833	Yes	-
Wilton	Non-certified	BAM210_WLT	1395	DNG	285163	6208904	Yes	-
Wilton	Non-certified	BAM211_WLT	1395	DNG	285091	6208847	Yes	-
Wilton	Urban Capable	BAM212_WLT	1395	DNG	285492	6209833	Yes	-
Wilton	Non-certified	BAM213_WLT	1395	DNG	285352	6209919	Yes	-
Wilton	Non-certified	BAM214_WLT	1395	DNG	286510	6214459	Yes	Yes
Wilton	Urban Capable	BAM215_WLT	1395	DNG	287191	6213901	Yes	Yes

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Wilton	Non-certified	BAM216_WLT	1395	DNG	284295	6212520	Yes	Yes
Wilton	Urban Capable	BAM217_WLT	849	DNG	286710	6212709	Yes	Yes
Wilton	Urban Capable	BAM218_WLT	1395	DNG	285549	6212631	Yes	Yes
Wilton	Non-certified	BAM219_WLT	1395	DNG	285498	6213417	Yes	Yes
Macarthur	Urban Capable	BAM220_MAC	1395	NO grassland	293761	6214851	Yes	-
Macarthur	Urban Capable	BAM221_MAC	1395	NO grassland	293981	6214742	Yes	-
Macarthur	Urban Capable	BAM222_MAC	1395	NO grassland	290771	6213518	Yes	-
Macarthur	Urban Capable	BAM223_MAC	1395	NO grassland	293480	6217165	Yes	-
Wilton	Urban Capable	BAM224_WLT	1395	NO grassland	286132	6214529	Yes	Yes
Wilton	Urban Capable	BAM225_WLT	1395	NO grassland	286116	6214350	Yes	Yes
Wilton	Urban Capable	BAM226_WLT	1395	NO grassland	285864	6214362	Yes	Yes
Wilton	Urban Capable	BAM227_WLT	1395	NO grassland	287731	6207158	Yes	-
Wilton	Urban Capable	BAM228_WLT	1395	NO grassland	288002	6208022	Yes	-
WSAGA	Non-certified	BAM229_WSA	1800	Intact	296965	6253519	Yes	-
WSAGA	Non-certified	BAM230_WSA	1800	Intact	292187	6250238	Yes	-
WSAGA	Non-certified	BAM231_WSA	1800	Intact	296868	6253713	Yes	-
WSAGA	Non-certified	BAM232_WSA	1800	Intact	288009	6252563	Yes	-
Macarthur	Non-certified	BAM233_MAC	1800	Thinned	301010	6235758	Yes	-
WSAGA	Urban Capable	BAM234_WSA	1800	Thinned	293578	6253457	Yes	-
WSAGA	Non-certified	BAM235_WSA	1800	Thinned	290405	6251652	Yes	-
WSAGA	Urban Capable	BAM236_WSA	1800	Thinned	296378	6253673	Yes	-
WSAGA	Non-certified	BAM237_WSA	1800	Thinned	296288	6249718	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
WSAGA	Non-certified	BAM238_WSA	1800	Thinned	293267	6254144	Yes	-
WSAGA	Urban Capable	BAM239_WSA	1800	Thinned	287770	6252382	Yes	-
WSAGA	Major Transport Corridor	BAM240_WSA	1800	Thinned	292498	6251336	Yes	-
WSAGA	Urban Capable	BAM241_WSA	1800	Scattered trees	294785	6251587	Yes	-
WSAGA	Major Transport Corridor	BAM242_WSA	1800	Scattered trees	292576	6251320	Yes	-
GPEC	Non-certified	BAM243_GPC	n/a	Urban native and Exotic	284493	6262488	No	-
GPEC	Non-certified	BAM244_GPC	n/a	Urban native and Exotic	293246	6260540	No	-
Macarthur	Urban Capable	BAM245_MAC	n/a	Urban native and Exotic	292852	6213218	No	-
Macarthur	Non-certified	BAM246_MAC	n/a	Urban native and Exotic	297924	6227593	No	-
Macarthur	Non-certified	BAM247_MAC	n/a	Urban native and Exotic	306818	6238842	No	-
WSAGA	Urban Capable	BAM248_WSA	n/a	Urban native and Exotic	286042	6249236	No	-
WSAGA	Non-certified	BAM249_WSA	781	Thinned	286690.2	6266794	Yes	-
WSAGA	Non-certified	BAM250_WSA	781	Thinned	286686.1	6266778	Yes	-
WSAGA	Non-certified	BAM251_WSA	781	Thinned	287426.5	6264549	Yes	-
WSAGA	Urban Capable	BAM252_WSA	850	Thinned	287737.6	6242222	Yes	-
WSAGA	Urban Capable	BAM253_WSA	850	Thinned	287712.1	6242317	Yes	-
Macarthur	Non-certified	BAM254_MAC	850	DNG	283218.3	6214096	Yes	-
WSAGA	Non-certified	BAM255_WSA	724	Thinned	295540.1	6250206	Yes	-

Nom. area	Mgmt. zone	Plot name	PCT	Condition	Easting	Northing	Used in BAM-C	BBAM to BAM plot
Macarthur	Non-certified	BAM256_MAC	850	NO grassland	297196.6	6227937	Yes	-
Macarthur	Non-certified	BAM257_MAC	850	NO grassland	297981.8	6227543	Yes	-
Macarthur	Non-certified	BAM258_MAC	850	NO grassland	297708.8	6227850	Yes	-
WSAGA	Urban Capable	BAM259_WSA	835	NO grassland	294448.1	6253492	Yes	-
WSAGA	Urban Capable	BAM260_WSA	835	NO grassland	294347.5	6253478	Yes	-
Macarthur	Non-certified	BAM261_MAC	835	NO grassland	300947.1	6233563	Yes	-
Macarthur	Non-certified	BAM262_MAC	835	NO grassland	301299.8	6233784	Yes	-
GPEC	Urban Capable	BAM263_GPC	724	Scattered trees	292627.2	6254671	Yes	-
GPEC	Urban Capable	BAM264_GPC	724	Scattered trees	292685.5	6254794	Yes	-
GPEC	Non-certified	BAM265_GPC	724	Scattered trees	294000.0	6264007	Yes	-
GPEC	Non-certified	BAM266_GPC	830	Intact	283247.6	6258549	Yes	-
GPEC	Non-certified	BAM267_GPC	724	Thinned	296622.0	6265490	Yes	-
GPEC	Non-certified	BAM268_GPC	385	NO grassland	295432.0	6262479	Yes	-

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CUMBERLAND PLAIN ASSESSMENT REPORT

PART 4: MINIMISING IMPACTS

CHAPTER 14 - AVOIDING AND MINIMISING IMPACTS

CHAPTER 15 - MANAGING INDIRECT IMPACTS

CHAPTER 16 - ADAPTIVE MANAGEMENT FOR ADDRESSING UNCERTAINTY

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	James Shepherd, Callan Wharfe, Rebecca Dwyer, Matthew Hyde (Biosis) Darren James (DAJ Environmental)
CONTENT:	Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines) Darren James (DAJ Environmental)
REVIEWED BY:	
OPEN LINES:	Peter Hemphill, Tom Holden (Open Lines)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor – BAAS18134
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DATE:	2021

Part 4 Contents

Part 4 List of Figures

Part 4 List of Tables

This Part describes:

- Avoiding and minimising impacts under the Plan (Chapter 14)
- Managing indirect impacts of the urban and industrial, infrastructure, intensive plant agriculture, and transport development under the Plan (Chapter 15)
- Adaptive management for addressing uncertainty (Chapter 16)

14 Avoiding and minimising impacts

14.1 INTRODUCTION

The Department of Planning, Industry and Environment (the Department) and Transport for NSW have undertaken planning processes to locate and design the urban capable land in the nominated areas and the major transport corridors to avoid and minimise impacts on biodiversity values. This has been undertaken in accordance with:

- Guidance provided under section 8 of the Biodiversity Assessment Method (BAM)
- *Conservation measures in strategic applications for biodiversity certification: Guidance for planning authorities* (DPIE, 2020a)
- Commonwealth Terms of Reference (ToR)

This Chapter:

- Defines avoidance in the context of the Plan and explains how avoidance calculations were determined
- Sets out the regulatory requirements for avoiding and minimising impacts under the BAM and ToR
- Describes the steps taken and processes to avoid and minimise impacts for:
    - Urban and industrial development, intensive plant agriculture and infrastructure within urban capable land
    - Major transport corridors
    - Essential infrastructure
- Describes the avoidance and minimisation outcomes for:
    - Urban and industrial development, intensive plant agriculture and infrastructure within urban capable land
    - Major transport corridors
    - Essential infrastructure

This Chapter summarises avoidance and minimisation outcomes for biodiversity values generally. Further details on avoidance outcomes for specific matters, including serious and irreversible impacts, prescribed impacts, and each Commonwealth-listed species and threatened ecological community, are provided in:

- Chapter 24 (prescribed impacts)
- Chapter 25 (SAII)
- Chapters 29 to 31 (each Commonwealth-listed species and TEC)

The different types of development under the Plan were subject to different avoidance processes. It is important to note that for the major transport corridors and essential infrastructure, the avoidance process is not yet complete as detailed design will be undertaken in the future at the time the projects are proposed (see Part 2). The Plan includes commitments to ensure these future processes lead to acceptable avoidance outcomes for these developments.

Avoiding and minimising impacts to biodiversity values is an important part of the assessment process. It is a critical step in minimising the impacts of the development and reducing the need for commitments and actions to offset those impacts. It also provides opportunities to protect important areas of remaining biodiversity, through the application of commitments and actions (such as biodiversity stewardship agreements) to avoided lands.

Avoiding and minimising impacts on biodiversity values is fundamental to demonstrating that the commitments and actions proposed for a strategic biodiversity certification adequately address the impacts of the development under section 8.7 of the *Biodiversity Conservation Act 2016* (see Part 7).

Documenting the process is also a requirement of the Commonwealth ToR (section 4.5(2)).

14.2 DEFINITION OF AVOIDANCE

This section describes the definition of avoidance and the method used to calculate avoidance for urban and industrial development, intensive plant agriculture and infrastructure within urban capable land.

There may be several reasons why land is avoided and not impacted under the Plan, including because:

- Land has high biodiversity value and is avoided for biodiversity purposes
- Land is not suitable for development or biodiversity certification
- Land is excluded from the area proposed for development or biodiversity certification

Under the BAM, avoidance refers to land that is suitable for development and included in the area proposed for development or biodiversity certification but has been avoided and not certified because of its biodiversity value. Land not impacted because it is unsuitable for development, or land that has been excluded from the area proposed for development is not considered to have been avoided under the BAM.

In accordance with the BAM, the Assessment Report determines avoidance outcomes for biodiversity values on the basis of the amount of land avoided because of its biodiversity value. The amount of land 'avoided' for other purposes (i.e. the land is not suitable for development) is also presented in this report for additional context.

14.2.1 DEFINITION OF LAND AVOIDED FOR OTHER PURPOSES

For the Assessment Report, the following land is considered to be avoided for other purposes:

- Land that is mapped as a riparian corridor associated with a Strahler order 3 stream or above (or Strahler order 2 streams with mapped vegetation, adjacent to avoided lands or that contribute to landscape connectivity). Riparian buffers applied are consistent with the *Water Management Act 2000*:
    - Strahler stream order 2 - buffer 20 m either side
    - Strahler stream order 3 - buffer 30 m either side
    - Strahler stream order 4 and above - buffer 40 m either side
- State protected land within avoided lands (>18 degrees slope, considered too steep for urban development)

Flood-prone land is not included in the list of land avoided for other purposes because significant development does occur within flood-prone land in the Plan Area. The use of fill and other flood-mitigation works means that flood-prone land does not necessarily constrain urban development.

14.2.2 DEFINITION OF EXCLUDED LAND

Some land within the nominated areas was not considered for inclusion in the area proposed for development and has therefore been identified as 'excluded' land. These lands include:

- Existing protected land, including reserves and established offset sites
- Council owned land which is zoned for environmental conservation, environmental management, or recreation
- Commonwealth land, such as Defence Establishment Orchard Hills
- Lands within the nominated areas already assessed as part of another development approval (Bingara Gorge), or lands progressing through an alternate assessment (Mount Gilead, Menangle Park, Sydney Metro Stage 1)
- Lands already developed (existing urban areas, urban land zones and roads)

14.2.3 ALLOCATION OF LAND TO AVOIDANCE CATEGORIES

As land can be allocated to several categories (e.g. land can be allocated to both 'riparian corridor' and 'excluded land') a prioritisation process was used to allocate land to one of the four categories used.

The priority applied to the classification of land for avoidance calculations is provided in Table 14-1.

Table 14-1: Priority applied to classification of lands for avoidance calculations

Priority	Avoidance category	Input data
1	Biodiversity certified	Urban capable land (including urban and industrial development, infrastructure, and intensive plant agriculture) and major transport corridors
2	Excluded/Non-certified – Western Sydney Aerotropolis	Land in the nominated areas already assessed as part of another development approval or lands progressing through an alternate development assessment (Bingara Gorge, Mount Gilead, Menangle Park, Sydney Metro Stage 1) Land already developed (existing urban areas, urban land zones and roads) Land not available to development (existing protected land, council owned land which is zoned for environmental conservation, environmental management or recreation, Commonwealth land and easements) Land identified as 'Environment and Recreation' lands within the updated Western Sydney Aerotropolis Stage 1 Structure Plan
3	Avoided for other purposes	Land that cannot be feasibly developed due to topography (area of steep slope within avoided lands) or is land that is mapped as a riparian corridor associated with a Strahler order 3 stream or above (or Strahler order 2 streams with mapped vegetation, adjacent to avoided lands or that contribute to landscape connectivity)
4	Avoided for biodiversity purposes	All other land (apart from land to be developed under the Plan)

14.2.4 METHOD TO CALCULATE AVOIDANCE OUTCOMES

The method to calculate avoidance outcomes within the nominated areas is as follows:

Step 1: Determine the existing area (in hectares) of each biodiversity value within the nominated areas

Step 2: Determine the area impacted by urban capable land and major transport corridors for each biodiversity value

Step 3: Determine the area of each biodiversity value within excluded land

Step 4: Determine the area of each biodiversity value avoided for other purposes

Step 5: Determine the area of each biodiversity value avoided for biodiversity purposes (this is done by subtracting the summed amount (hectares) in steps 2, 3, and 4 from step 1)

14.3 REGULATORY REQUIREMENTS

The BAM and ToR both require the Assessment Report to demonstrate how impacts to biodiversity values have been avoided and minimised. The BAM provides more detailed guidance than the ToR on how avoidance should be achieved.

14.3.1 BC ACT REQUIREMENTS

BAM

Section 8 of the BAM requires the BCAR to describe the actions taken to avoid and minimise impacts on biodiversity values through the location and design of the urban capable land and transport corridors on:

- Native vegetation and habitat
- Prescribed impacts

The BCAR must describe how actions taken to avoid and minimise impacts on biodiversity values have influenced both the project location and the design of the project. The BCAR should explain how impacts have influenced the location and design of the urban capable land and transport corridors, including the extent to which areas of higher biodiversity value have been identified and then excluded from the urban capable land and transport corridors.

The BAM provides that direct impacts on native vegetation and habitat can be avoided and minimised by:

- **Development location considerations:**
  - Locating development in areas where there are no or minimal biodiversity values
  - Locating development in areas where native vegetation or habitat is in the poorest condition (as measured by the Vegetation Integrity score for each vegetation zone)
  - Avoiding habitat for species with higher biodiversity risk weightings
  - Avoiding critically endangered or endangered TECs
  - Avoiding areas that maintain habitat connectivity between areas of nearby habitat
- **Development design considerations:**
  - Reducing the urban capable land and transport corridors of the project
  - Providing structures to enable species to move across barriers or habitat gaps
  - Making provision for the ecological restoration and ongoing maintenance of retained native vegetation

The BAM provides that prescribed impacts can be avoided and minimised by:

- **Development location considerations:**
  - Locating urban capable land or sub-surface works to avoid habitat features associated with prescribed impacts (such as caves, cliffs, water bodies, important non-native vegetation, or areas of habitat connectivity)
  - Avoiding areas that maintain habitat connectivity between areas of nearby habitat
- **Development design considerations:**
  - Designing project elements to minimise interactions with biodiversity values, such as designing fencing to prevent animal entry to roads or transport corridors or roads
  - Designing the project to maintain hydrological processes
  - Design the project to avoid and minimise downstream impacts on water bodies by controlling water quality

Section 8.1.1.4 and section 8.2.2.2 of the BAM requires the BCAR to:

- Analyse alternative locations for urban capable land that would further avoid or minimise impacts
- Justify the location of the final urban capable land

In justifying the selection of final urban capable land, a rationale should be provided for the location of the boundaries where they do not avoid areas of biodiversity value, such as strategic planning reasons.

GUIDELINES UNDER THE BAM

In addition to the BAM, the *Conservation measures in strategic applications for biodiversity certification: Guidance for planning authorities* (DPIE, 2020a) provides a set of guiding principles for demonstrating that commitments and actions proposed for a strategic biodiversity certification adequately address impacts on biodiversity values.

The first principle relates to avoidance and requires that:

> *"Principle 1 – Potential serious and irreversible impacts are avoided and minimised"*

14.3.2 EPBC ACT REQUIREMENTS

Section 4.5(2) of the ToR requires the SAR to include an analysis of the likely adverse impacts of actions of the Plan on protected matters, including consideration of:

> *"How impacts on protected matters will be avoided through land use planning and other measures…"*

14.4 STEPS TAKEN AND PROCESSES TO AVOID AND MINIMISE IMPACTS

The steps taken and future processes to avoid and minimise impacts for the different types of development under the Plan are summarised in Table 14-2 and described in more detail in section 14.4.1 to section 14.4.3.

The avoidance process involved:

- Strategic planning to determine the broad locations of the nominated areas and major transport corridors
- Detailed design to determine the urban capable land footprint and transport infrastructure footprint within the nominated areas and major transport corridors

For the major transport corridors and essential infrastructure, the avoidance process is not yet complete as detailed design will be undertaken in the future at the time the project is proposed (see Part 2). The Plan includes commitments to ensure this future process leads to acceptable avoidance outcomes for these developments.

Table 14-2: Steps taken and future processes to avoid and minimise impacts for the different types of development

Development under the Plan	Avoidance process	Implementation of avoidance process
Urban and industrial development, intensive plant agriculture and infrastructure within urban capable land	Step 1: Strategic planning to determine the locations of the nominated areas	Completed prior to development of Plan
	Step 2: Detailed design of urban capable land footprint within the nominated areas	Completed as part of development of Plan Statistics on biodiversity values avoided within nominated areas are provided in Section 14.5.1
Major transport corridors	Step 1: Strategic planning to determine the locations of the major transport corridors	Completed prior to development of Plan
	Step 2: Future detailed design to determine the location of the infrastructure within the transport corridor footprints	To be completed in the future at the time the project is proposed in accordance with commitments under the Plan
'Essential infrastructure' within avoided land	Future strategic planning and detailed design to determine the location of infrastructure within avoided land	To be completed in the future at the time the project is proposed in accordance with commitments under the Plan

14.4.1 URBAN AND INDUSTRIAL DEVELOPMENT, INTENSIVE PLANT AGRICULTURE AND INFRASTRUCTURE

Consistent with Section 8.1.1.2 of the BAM, the process to identify the location of urban and industrial development, intensive plant agriculture and infrastructure within urban capable land in the nominated areas was an iterative one that began early in the assessment process before the final data on biodiversity values was completed.

The urban capable land was identified in three phases:

- Strategic planning to locate the nominated areas
- Initial development of footprints through Land Use and Infrastructure Implementation Plans (LUIIP)
- Iterative refinement of the footprints through development of the Plan and assessment of impacts

STRATEGIC PLANNING TO DETERMINE THE LOCATION OF THE NOMINATED AREAS

The location of the nominated areas was determined through various strategic planning strategies and investigations over many years. Two key planning strategies that informed the location of the nominated areas were:

- *A Plan for Growing Sydney* (DPE, 2014) – this identified the general location of Wilton Growth Area (Wilton) and Greater Macarthur Growth Area (GMAC) and the Badgerys Creek Airport precinct, which was subsequently refined further by the Department to become WSA
- *A Metropolis of Three Cities* (GFC, 2017) – this identified the general location of Greater Penrith to Eastern Creek Investigation Area (GPEC) and establishes a 40-year vision for Sydney as a global metropolis of three cities, including the Western Parkland City covering the nominated areas

The nominated areas were located based on a broad range of strategic planning considerations, including:

- Proximity to current and planned locations of employment

- The cost of infrastructure provision including roads, water, sewerage, public transport, schools, and health facilities
- The economic and social cost to communities of having poor access to employment and services, including transport
- Environmental constraints, including biodiversity values

Action 2.4.2 of *A Plan for Growing Sydney* (DPE, 2014) aimed to develop a long-term framework for the identification of new nominated areas to improve the management of future land release in Sydney. In preparing a framework for the identification of nominated areas, Action 2.4.2 indicates that a range of issues should be considered, including:

- The value of land for drinking water supply, agriculture, environmental management and other purposes
- Constraints to development, including environmental constraints and natural hazards

The Department undertook investigations into the location of the nominated areas in accordance with Action 2.4.2.

LAND USE AND INFRASTRUCTURE IMPLEMENTATION PLANS

Land Use and Infrastructure Implementation Plans (LUIIP) are currently being prepared for the nominated areas. LUIIPs are high level plans for the growth and development of each nominated area. They identify the location of urban capable land, broad land uses and the location of infrastructure, as well as housing and employment targets.

Indicative urban capable land had been developed as part of the early preparation of the LUIIPs, including for Wilton, GMAC, and part of WSA. Urban capable land was identified largely on the basis of avoiding large patches of intact native vegetation (Eco Logical Australia, 2017), including:

- BIO Map core areas and corridors (OEH, 2015)
- Priority Conservation Lands identified as part of the Cumberland Plain Recovery Plan methodology report (DECCW, 2010)

The early LUIIP footprints provided the starting point for the iterative refinement of the footprints through development of the Plan. Any changes made through this process are, or will ultimately be, reflected in the LUIIPs.

ITERATIVE REFINEMENT OF URBAN CAPABLE LAND THROUGH DEVELOPMENT OF THE PLAN

Development of the Plan provided an important opportunity to iteratively refine the initial urban capable land with the aim of avoiding and minimising impacts to biodiversity values. The process involved:

- Compilation of data on biodiversity values of each nominated area
- Development of criteria to identify priorities for avoidance of biodiversity values
- Workshops to apply the avoidance criteria to each nominated area and refine urban capable land
- Consultation with key stakeholders and resolution of issues
- Finalisation of initial urban capable land

Compilation of data on biodiversity values

The best available data on the biodiversity values of each of nominated area was compiled and used to identify areas of high biodiversity value and inform the location and design of the urban capable land.

The data on biodiversity values was compiled into a series of GIS datasets and used in two phases:

- Initial urban capable land was identified based on preliminary data on biodiversity values
- Finalisation of initial urban capable land was undertaken based on final data on biodiversity values

The preliminary data used to inform the initial urban capable land comprised:

- Draft native vegetation maps of each nominated area showing:
  - Extent and condition of Plant Community Types (PCTs)
  - Extent and condition of NSW-listed TECs
- Threatened species records derived from BioNet for all species needing to be assessed in the Assessment Report (all Commonwealth-listed Category 1 matters and all NSW-listed candidate species – see Part 3)

- Draft habitat maps for threatened species where available, particularly including Koala habitat mapping

The data used to finalise the initial urban capable land comprised:

- Final native vegetation maps of each nominated area showing:
  - Extent and condition of PCTs
  - Extent and condition of Commonwealth-listed and NSW-listed TECs
- Threatened species records derived from BioNet for all species needing to be assessed in the Assessment Report (all Commonwealth-listed Category 1 matters and all NSW-listed candidate species)
- Final habitat maps for threatened species where available

A more detailed description of each dataset used to inform the urban capable land is provided in Part 3.

Development of avoidance criteria

Criteria were developed to identify priorities for the avoidance of biodiversity values. The purpose of the criteria was to provide detailed guidance, consistent with the guidance provided in the BAM, to inform decisions about the location and design of the urban capable land through the series of workshops with precinct planners and ecologists.

The avoidance criteria identified priorities for avoidance within three main categories:

- TECs and PCTs, including condition
- Threatened species
- Ecological processes

In applying the criteria, the highest priority within each category was given equal weight (the TEC/PCT priority 1 was given equal weight to the threatened species priority 1).

The avoidance criteria are provided in Box 1.

BOX 1: AVOIDANCE CRITERIA AND CATEGORIES

(a) TECs and PCTs

1. Critically endangered ecological communities (CEECs) or PCTs ≥90% cleared in large patches and in good condition; or serious and irreversible impact (SAII) entities (TECs)
2. Endangered ecological communities (EECs) or PCTs ≥70% to <90% cleared in large patches and in good condition
3. PCTs ≥50% to <70% cleared in large patches and in good condition
4. PCTs <50% cleared in large patches and in good condition

(b) Threatened species

1. Known habitat^ for critically endangered species, SAII entities (species), Saving Our Species (SOS) species polygons (where species-specific habitat is present), or large populations of threatened species (relative to typical size for that species); or known primary koala habitat
2. Known habitat^ for endangered species or known secondary koala habitat
3. Known habitat^ for vulnerable species

(c) Ecological processes

1. Land identified as priority conservation lands, BIO Map core areas, or important local habitat corridors for key species including Koalas
2. Land identified as BIO Map regional corridors or as areas that provide significant opportunities to support important local habitat corridors for key species, including Koalas
3. Areas identified on the Biodiversity Values Map

Boundary rationalisation

Consider removing:

- Small nodes or isolated patches of features identified in (a), (b) or (c) if future land use change will lead to significant edge effects and low viability over the timeframe identified, and there is no feasible opportunity to enhance connectivity and extent
- Corridors that do not link important areas of habitat, including 'blind corridors'

^ As indicated by BioNet records or recent survey data

Application of avoidance criteria

The avoidance criteria were applied through a series of workshops to each nominated area to identify areas of high biodiversity value and priorities for avoidance. The workshops included the following participants:

- The Department's team that is preparing the Plan
- Accredited assessors and other expert ecologists who advised on biodiversity values and priorities
- The Department's precinct planning team who advised on urban development priorities and targets

Urban capable land identified in the LUIIP processes for Wilton, GMAC and part of WSA was used as a starting point. The workshops involved:

- Reviewing the data on biodiversity values compiled into a series of GIS datasets. Accredited assessors and other expert ecologists reviewed the accuracy of the data and made adjustments where necessary. As part of this process, consultation was undertaken with field ecologists to verify the accuracy of data
- Identifying areas of high biodiversity value and priorities for avoidance based on the identified criteria. This work focused on identifying priority 1 and priority 2 avoidance areas within each nominated area
- Rationalising the urban capable land to remove areas of biodiversity value that comprised:
    - Small nodes or isolated patches where future land use change will lead to significant edge effects and low viability and in which the opportunity to enhance connectivity and extent are not feasible
    - Habitat corridors that do not link important areas of habitat, including 'blind corridors'
- Identifying where priorities for avoidance of biodiversity were inconsistent with:
    - Indicative urban capable land identified in current LUIIPs, and/or
    - The achievement of urban development priorities reflected in relevant planning strategies and plans, including LUIIPs. These priorities included matters such as:
        - Urban planning/urban structure and design principles
        - Housing provision and dwelling targets
        - Transport and infrastructure provision and accessibility targets
        - Employment areas and targets
        - Open space provision and targets

Where priorities for avoidance of biodiversity values were inconsistent with urban development priorities, further consideration of the specific urban development imperative and needs, and further desktop investigation and validation of the biodiversity values of the site, was undertaken. Potential alternatives were explored, and negotiations undertaken between the Department's strategic assessment team and the Department's planning team to:

- Explain and justify urban development and biodiversity avoidance priorities
- Explore alternative development locations to achieve the urban development priorities
- Seek a balance between urban development and biodiversity priorities

Box 2 provides a case study of the application of the avoidance criteria.

BOX 2: CASE STUDY - MINIMISING IMPACTS TO BIODIVERSITY VALUES IN AN AREA TARGETED FOR URBAN GROWTH IN WILTON

Step 1: Map the biodiversity values in Wilton and integrate this information with development plans for the area

The development of lands in north Wilton precinct identified an opportunity for a recreation reserve in the northern end of the precinct to support open space targets. The land is largely pasture within a matrix of Shale Sandstone Transition Forest, which cover the full range of condition classes (intact, thinned, scattered trees and derived native grassland). The forested portions of this community comprise the CEEC under both the BC Act and EPBC Act. Furthermore, as part of the work to develop the Plan, the area for the proposed recreation reserve was identified as a priority for ecological restoration, including because the land contained a Koala corridor and the TEC

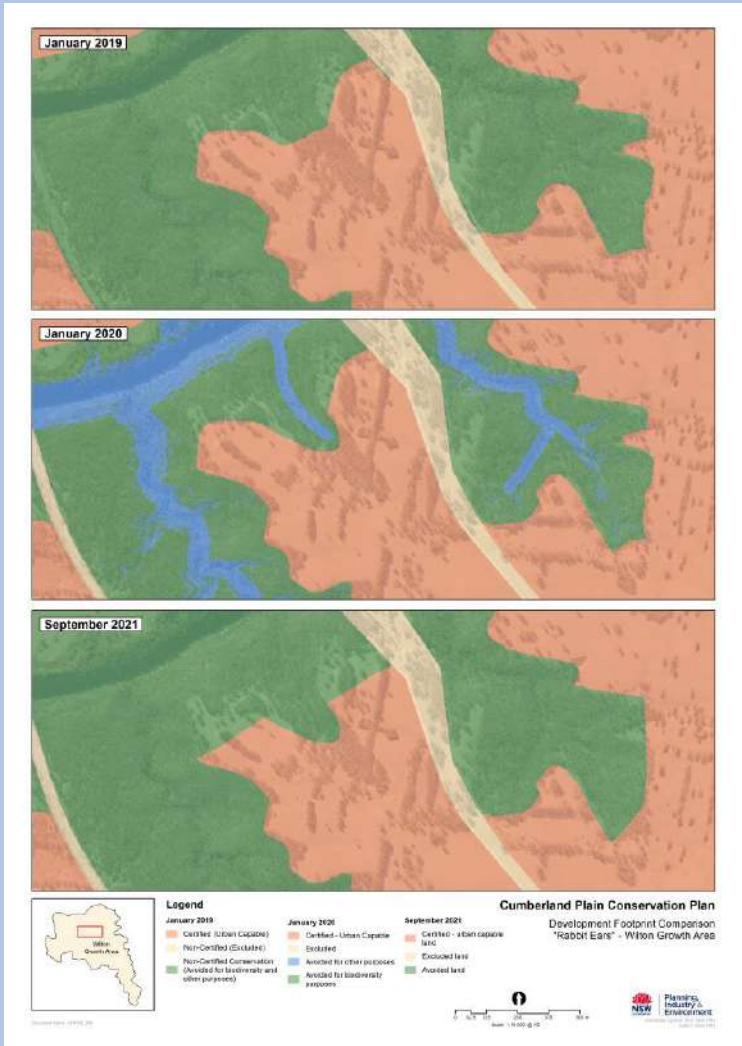
Step 2: Initial amendment of footprint to minimise impacts to biodiversity values

Discussions were undertaken between the Department and the landholder to explore opportunities to reduce impacts on biodiversity values while providing for the recreational reserve to support open space targets. This led to reducing the footprint of the reserve in key areas of biodiversity value, while still allowing for an access road for public access

Step 3: Further amend footprint and recreational design and use to further reduce impacts

The Department and the landholder met further to discuss opportunities to further amend the footprint and the recreational design and use of land to balance open space targets and impacts to biodiversity values. The agreed final design of the recreational reserve will focus on passive, constructed play, and will retain of some of the original recreational land uses as well as potentially including car parking facilities. This allowed for a more effective wildlife corridor around the top of the Nepean River gorge to provide connectivity for animals such as Koala

These steps are reflected in the diagram below:



Public and key stakeholder consultation

Consultation was undertaken with key stakeholders on the indicative urban capable land boundary prior to public exhibition of the Plan and Assessment Report. This occurred through:

- Public exhibition of draft LUIIPs that identified indicative urban capable land
- Targeted consultation with planning authorities, including Councils, to clarify urban development priorities particularly where these were inconsistent with avoidance priorities
- Consultation with accredited assessors and other expert ecologists to verify the accuracy of the data, particularly where urban development priorities were inconsistent with avoidance priorities
- Consultation with developers and landholders within the nominated areas to gain access to additional data

Public exhibition of the Plan and Assessment Report provided further opportunity for stakeholders to comment on the avoidance outcomes and urban capable land boundary. This led to the adjustment of the urban capable land boundary in some cases. Key adjustments were made in relation to:

- Advice from the Office of the NSW Chief Scientist & Engineer – the office provided two sets of advice to the Department on the adequacy of the protection of Koala relating to the Plan. The advice included a range of principles and recommendations, including that Koala movement corridors should meet a minimum average width of 390 metres. This led to changes to the urban capable land boundary in Wilton and GMAC
- Existing easements – all existing easements are to be certified except where:
    - Easements intersect or are adjacent to avoided land – these remain excluded
    - Easements intersect or are adjacent to excluded land – these remain excluded
    - Roads remain excluded (except major Transport for NSW roads identified in the Plan)
    - Sydney Water Canal – this remains excluded
- 'Environment and Recreation' land in Western Sydney Aerotropolis (WSA) – this land was identified in the public exhibition version of the Plan as 'Non-certified – Western Sydney Aerotropolis' and is to be certified under the Plan and included in the urban capable land. Note that this land was previously not considered avoided land and was included in the broad definition of excluded land in the public exhibition version of the Plan and for the purposes of the avoidance statistics in the public exhibition version of the Assessment Report
- Riparian buffers – Strahler order 1 and 2 waterways are to be certified (and Strahler order 3, 4 and above waterways are to remain 'avoided for other purposes'). Exceptions include where the section of Strahler order 2 waterways contain mapped vegetation, are adjacent to avoided land or contribute to landscape connectivity (these will be considered 'avoided for other purposes' – see section 14.2) and where the section of Strahler order 3 waterways are isolated in the landscape and do not support a landscape scale corridor (these will be certified and not avoided)
- Submissions from landholders – where landholders made submissions that included on-site data collected by qualified ecological consultants that indicated native vegetation mapping was inaccurate on their property. Where it was determined the mapping needed updating, this led to re-consideration of previous avoidance decisions and in some cases, changes to the urban capable land boundary consistent with the avoidance criteria (see Box 1)
- Development applications – where development applications were approved within avoided land, updates were made to the urban capable land boundary to reflect these previous decisions

COMMITMENTS FOR AVOIDANCE AND MINIMISATION

The Plan includes a commitment (Commitment 2) to avoid and minimise impacts to 4,505 hectares of high biodiversity value area through strategic planning of the nominated areas. This area comprises the avoided land.

The Plan also includes a commitment (Commitment 5) to mitigate indirect impacts from urban and other development that would lead to avoidance of impacts on key habitat features within urban capable land. These include:

- Retain large trees (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction
- Retain areas of high density Proteaceae shrubs where possible, particularly along riparian corridors

Several actions under Commitment 2 will provide protection to avoided land and ensure the impacts of any future urban development proposed on avoided land is minimised. These include:

- Introduction of an environmental planning instrument to apply development controls to protect important biodiversity on avoided land under the Plan. This comprises the SEPP (Strategic Conservation Planning). The development controls included in the SEPP are described in more detail in Part 2
- Preparation of a Ministerial Direction under section 9.1 of the EP&A Act to restrict rezoning of avoided land from its current zone to a zone that permits a more intensive land use. This is described in more detail in Part 2
- Locate asset protection zones wholly within urban capable land. The SEPP (Strategic Conservation Planning) gives this requirement legal effect. This is described in more detail in Part 2
- Monitor the impacts of any proposed development on avoided land through the Plan's reconciliation accounting process. The reconciliation process is described in more detail in Part 7

14.4.2 MAJOR TRANSPORT CORRIDORS

Avoidance and minimisation of impacts from the major transport corridors is being undertaken in two stages:

- Strategic planning to determine the locations of the major transport corridors. This was completed under Transport for NSW planning processes prior to development of Plan
- Future detailed design to determine the location of the infrastructure within the transport corridor footprint. This is to be completed in the future at the time the project is proposed in accordance with commitments under the Plan

STRATEGIC PLANNING TO DETERMINE THE LOCATIONS OF THE MAJOR TRANSPORT CORRIDORS

The process for identifying, selecting, and designing future corridors and transport projects involves a detailed set of steps and processes to ensure optimum infrastructure, environmental, social and economic outcomes are achieved. The *Planning guideline for Major Infrastructure Corridors* (DPE, 2016) sets out the recommended processes for infrastructure agencies to follow through the different phases of corridor planning.

The guideline provides advice in relation to the three broad phases:

- Strategic planning – identification
- Corridor planning and selection
- Infrastructure delivery

The first two phases lead to the identification and protection of major transport corridors. As part of this process, a Strategic Environmental Assessment (SEA) is prepared which provides an assessment of the environmental, economic, and social impacts of reserving the corridor. SEAs are non-statutory documents that assist in the planning and decision-making process for the community and Government. They are subject to public consultation and include justification for a preferred corridor alignment and provide information on the assessment of alternative corridor alignments.

In making decisions on corridor selection, infrastructure agencies undertake a constraints analysis and multi-criteria comparison of options. These include consideration of a wide range of factors including:

- Aboriginal heritage
- Biodiversity
- Costs
- Engineering and construction limitations
- Land use and property impacts
- Landscape character and visual amenity
- Noise and vibration
- Non-Aboriginal heritage
- Socio-economic considerations
- Soils, geology, and contamination
- Transport planning
- Water quality and hydrology

Example of SEA process – location of the OSO corridor

The Draft SEA for the OSO (AECOM, 2018) sets out the process used to identify the preferred location of the OSO corridor in the Plan (see Part 2). Transport for NSW commissioned the OSO study "to identify the most appropriate location for the corridor and to protect land within that corridor for the future provision of critical road and freight rail infrastructure". To do so, the SEA included evaluating legislative and policy frameworks, identifying regional and local baseline conditions, consulting with the community and stakeholders, a strategic assessment of options for the corridor, and an evaluation of the social, economic, and environmental consequences of the OSO.

The process for corridor identification was conducted in alignment with the *Planning Guidelines for Major Infrastructure Corridors* (DPE, 2016). The method for identifying the recommended corridor involved seven steps (AECOM, 2018):

Identifying a study area

The investigations for the OSO began with a broad OSO study area that was used to identify high level environmental attributes, along with the constraints, capacity, and opportunities within the area. The study area was refined during the OSO study based on stakeholder and community feedback, and to better suit the project objectives.

Understanding constraints and opportunities

A comprehensive review of the environmental, social, and engineering constraints and opportunities within the refined study area was conducted to identify a corridor that balances benefits and impacts. The environmental factors involved in this process include but are not limited to ecology and biodiversity, bushfire hazard, Aboriginal and non-Aboriginal heritage, soils and contaminated land, and water resources.

Developing guiding principles

A list of guiding principles was developed to identify a long list of corridor options. The principles were rated as either required, highly desirable, or desirable. The guiding principles were grouped into three sections: environment and land use, strategic planning, and engineering. The following principles relate to biodiversity:

- *Avoiding reserves including national parks and nature reserves (excluding regional parks)* (required)
- *Avoiding gazetted reserves (regional parks)* (highly desirable)
- *Avoiding lands identified as Priority Conservation Lands* (highly desirable)

Identifying corridor options

A variety of tools such as specialist advice and computer software were used to identify a long list of corridor options in alignment with the guiding principles and fatal flaw analysis (refer to the draft SEA for further information) (AECOM, 2018). The following 'fatal flaw' issue relevant to biodiversity values was considered:

- *Impacts on gazetted reserves including national parks and nature reserves (excluding regional parks)*

Evaluating corridor options

Various assessment and screening methods were applied to the long list of corridor options. A multi-criteria analysis (MCA) was used to evaluate corridor options and refine the long list to a short list.

Selecting a recommended OSO corridor

The MCA was used to select a recommended corridor option from the short list. Once this option was identified, it was further investigated and reviewed. Table 14-3 identifies the constraints and opportunities of recommended corridors.

Consultation on the recommended corridor

The public consultation period is intended to allow stakeholders and the community to provide feedback on the final corridor, after which a final SEA will be prepared.

The recommended corridor

The recommended corridor shown in the Plan (see Part 2) was chosen as it balances social, environmental, engineering, and current land use. The chosen corridor is considered to avoid where possible ecologically sensitive areas, residential

areas, major infrastructure, community facilities, open spaces, and existing schools. The process involved consultation and engagement with key agencies, land holders and community groups, along with the Department of Planning and Environment, and EES (AECOM, 2018).

Once the recommended corridor was identified, a desktop review of biodiversity was conducted to identify areas of vegetation considered significant habitat for threatened flora and fauna and a strategic assessment of the corridor was conducted that considered potential social, environmental, and economic impacts (AECOM, 2018).

Table 14-3: Avoidance or non-avoidance of reserves, national parks, and priority conservation lands within each section of the recommended corridor and relevant justification for non-avoidance (summary from AECOM, 2018)

Section of the OSO corridor	Avoidance or impacts to reserves, national parks, and priority conservation lands	Justification of impacts
1 (Box Hill to Dunheved)	The recommended corridor avoids: • Scheyville National Park, and ensures future expansion to Central Coast also excludes the park • South Creek riparian corridor through the centre of Wianamatta Regional Park The recommended corridor impacts: • Shanes Park • Wianamatta Regional Park	• Shanes Park – the placement is not expected to compromise planned urban development of the North West Growth Area • Wianamatta Regional Park – the alignment of the recommended corridor through Wianamatta Regional Park was considered reasonable to avoid impacts to planned and existing development, and in the context of potential impacts to more ecologically sensitive areas of the park
2 (Dunheved to Orchard Hills)	The recommended corridor impacts: • South Creek riparian corridor	• South Creek riparian corridor – placement along South Creek riparian corridor is preferred to reduce property impacts for hundreds of households near St Marys
3 (Orchard hills to Cobbitty)	No significant impacts to or avoidance of reserves, national parks, or priority conservation lands	• Avoids reserves, national parks, and priority conservation lands
4 (Cobbitty to Camden Park)	The recommended corridor avoids: • Where possible, the floodplain of Nepean River • Mater Dei biodiversity offset site • Allows perpendicular crossing of the Nepean River to minimise riparian impacts The recommended corridor impacts: • Priority conservation land in the locality	• Priority conservation land – the recommended corridor affects the least amount of priority conservation land when compared to other options east or west of the corridor
5 (Camden Park to Menangle	The recommended corridor avoids: • Razorback range There are no significant impacts to reserves, national parks, or priority conservation lands	Avoids reserves, national parks, and priority conservation lands

DETAILED DESIGN OF INFRASTRUCTURE WITHIN TRANSPORT CORRIDOR FOOTPRINTS

Because infrastructure alignments within the transport corridors are not final (see Part 2), the major transport corridors will be subject to a future process of avoidance and minimisation as part of the detailed design phase of each project to determine the location of the infrastructure within the transport corridor footprints. Note that for the purposes of the Assessment Report, the entire footprint of each major transport corridor is assumed to be impacted.

These future detailed design processes are different for the certified-major transport corridors within the nominated areas and the major transport corridors (strategically assessed only) outside the nominated areas, because of the different approvals that are being sought under the Plan for these corridors.

For the certified-major transport corridors, avoidance under the BAM has already been undertaken to locate the corridors, and no further avoidance is required to meet the requirements of the BC Act. However, Transport for NSW will undertake further avoidance and minimisation as part of business as usual through detailed design and in accordance with Commitment 3, including in consideration of the Plan's avoidance criteria (see Box 1).

For the major transport corridors (strategically assessed only), avoidance under the BAM has not been undertaken. Transport for NSW will be required to apply the avoidance requirements of the BAM (or equivalent) to meet each project's State Significant Infrastructure approval (or equivalent), in addition to applying other requirements for Commonwealth-listed matters in accordance with Commitment 4.

Both commitment 3 and 4 will lead to additional avoidance and minimisation outcomes for biodiversity values.

Certified - major transport corridors within the nominated areas

For the certified - major transport corridors within the nominated areas, the Plan commits to avoiding and minimising impacts to TECs, species and habitat through detailed planning and design (Commitment 3).

Actions under this commitment specify how Transport for NSW is to implement the commitment. This includes:

- Applying the Plan's avoidance criteria (see Box 1) during the planning phase of each transport project to guide and prioritise avoidance and minimisation of impacts to TECs, species, and habitat
- Including the biodiversity benefits of avoiding TECs, species, and habitat as well as the costs of offsets into the evaluation of route options (for example multi-criteria analysis)
- Locating asset protection zones, if required, within the major transport corridor footprint
- Minimising as far as possible using design refinements impacts on areas of high environmental value, where actions cannot feasibly or practically avoid impacts
- Providing to the Department a Clearing Reconciliation Report within 30 days of the completion of clearing for each major transport corridor project. The report will provide information on vegetation cleared, direct impacts to habitat and TECs, and a demonstration of how the Plan's Avoidance Criteria were applied. The report will be used to:
    - Inform the Plan's reconciliation accounting process to track impacts
    - Determine Transport for NSWs actual offsets liability. Actual offsets liability will be reconciled against Transport for NSW's scheduled forward payments for amounts outstanding or overpaid

The Department will publish impacts to biodiversity (including to MNES) within the major transport corridors through the Plan's annual updates and five yearly reviews (see Part 2).

There is also an action under the commitment in relation to third party activities within the major transport corridors undertaken by a party other than Transport for NSW. For these activities, Transport for NSW will ensure that third party proponents not included in the major transport corridors class of action are aware that they must consider the need for referral under the EPBC Act for actions likely to have a significant impact on MNES.

Major transport corridors (strategically assessed only) outside the nominated areas

For the major transport corridors (strategically assessed only) outside the nominated areas, the Plan commits to avoiding and minimising impacts to TECs, species and habitat, including the Outer Sydney Orbital (OSO) and Metro Rail Future Extension (MRFE) tunnel sections, in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (or equivalent) approvals process
- Biodiversity Assessment Method under the BC Act (or equivalent) (Commitment 4)

Commitment 4 includes avoiding and minimising impacts to known populations within the OSO and M7/Ropes Crossing Link Road corridors (Commitment 4.1), including:

- *Dillwynia tenuifolia*

- *Grevillea juniperina* subsp. *juniperina*
- *Pultenaea parviflora*
- *Cynanchum elegans*

Commitment 4 also includes avoiding and minimising impacts where possible within and adjacent to the OSO and MRFE tunnel sections, including (Commitment 4.2):

- Known populations and habitat of:
  - *Eucalyptus benthamii*
  - *Pomaderris brunnea*
  - *Pimelea spicata*
  - Cumberland Plain Land Snail
- Known populations and habitat and TECs within:
  - Mater Dei BioBank site within the OSO tunnel footprint near Camden
  - Registered Property Agreement site within the OSO tunnel footprint at Camden Airport
  - Metro Offset site within the OSO and MRFE tunnel footprints near Harrington Park
  - Nepean River and associated riparian corridor within the OSO tunnel footprint
  - Camden Golf Club at Narellan adjacent to the MRFE tunnel footprint
  - Mount Annan Botanic Gardens within the MRFE tunnel footprint

Commitment 4 also includes avoiding and minimising impacts where possible to environmental values within Commonwealth land sites, including known populations and habitat and TECs, as well as existing infrastructure and services, at (Commitment 4.3):

- Camden Airport
- Western Sydney University (Campbelltown Campus)
- 12 Werombi Road, Grassmere

Actions under Commitment 4 specify how Transport for NSW is to implement the commitment. This includes:

- Undertaking surveys to confirm biodiversity values and MNES, during planning phase of each transport project
- Including the biodiversity benefits of avoiding TECs, species and habitat as well as the costs of offsets into the evaluation of route options (for example multi-criteria analysis)
- Avoiding and minimising impacts to biodiversity values, including MNES, in accordance with the Biodiversity Assessment Method (or equivalent) and with specific consideration to the protected matters identified in Commitments 4.1, 4.2 and 4.3 during the environmental impact assessment phase of each transport project
- Offsetting impacts to biodiversity values, including MNES, in accordance with the BAM (or equivalent) and EPBC Act Environmental Offsets Policy, 2012, for any EPBC Act matters not covered by the BAM
- Reporting to the Department and executive implementation committee on vegetation cleared and adjustments to transport corridor boundaries identified through the NSW SSI approval (or equivalent) for each transport project. This will include reporting on:
  - Avoidance achieved within the major transport corridors
  - Any additional impacts outside the corridors for Commonwealth-listed species, populations or TECs
  - Any offsets to be secured under the NSW SSI approval and EPBC Act Environmental Offsets Policy, 2012

  The Department will use this information to track impacts and adjust Transport for NSW's offset liabilities through the Plan's reconciliation accounting process.

As for Commitment 3, the Department will publish impacts to biodiversity (including to MNES) within the major transport corridors through the Plan's annual updates and five yearly reviews (see Part 2).

14.4.3 ESSENTIAL INFRASTRUCTURE

Planning for essential infrastructure to support the nominated areas, such as water and electricity utilities, is in various stages of development, and the location of this infrastructure is not yet known.

The Plan is seeking approval under the EPBC Act for essential infrastructure to occur within the nominated areas outside urban capable land but not excluded land (i.e. within avoided land) (see Part 2).

It is important to note that approval is not being sought under the Plan for essential infrastructure within avoided land under the BC Act. Separate approval under the BC Act will need to be sought for essential infrastructure in the future (if the BC Act is triggered), along with planning and approvals required under the EP&A Act.

Essential infrastructure will be subject to a future process of avoidance and minimisation as part of the strategic planning and detailed design phase of each project. Each project will be managed through the NSW planning and approvals framework under the EP&A Act as current at the time of the project.

Essential infrastructure in avoided land must be carried out in accordance with:

- Guidelines for essential infrastructure development in Appendix A of the Plan
- Relevant commitments in the Plan

A description of the avoidance requirements and process for essential infrastructure is provided in Chapter 37.

14.5 AVOIDANCE AND MINIMISATION OUTCOMES

14.5.1 URBAN AND INDUSTRIAL DEVELOPMENT, INTENSIVE PLANT AGRICULTURE AND INFRASTRUCTURE

This section describes the avoidance and minimisation outcomes resulting from the processes described in Section 14.4.1 to design the urban and industrial development, intensive plant agriculture and infrastructure within urban capable land, and justifies the location of the urban capable land.

Avoidance outcomes are described in relation to:

- Serious and irreversible impact entities
- Prescribed impacts
- Native vegetation, including high condition native vegetation
- TECs
- Species potential habitat
- Important populations
- Areas important for connectivity

Avoidance outcomes are shown in Figure 14-1 to Figure 14-4.

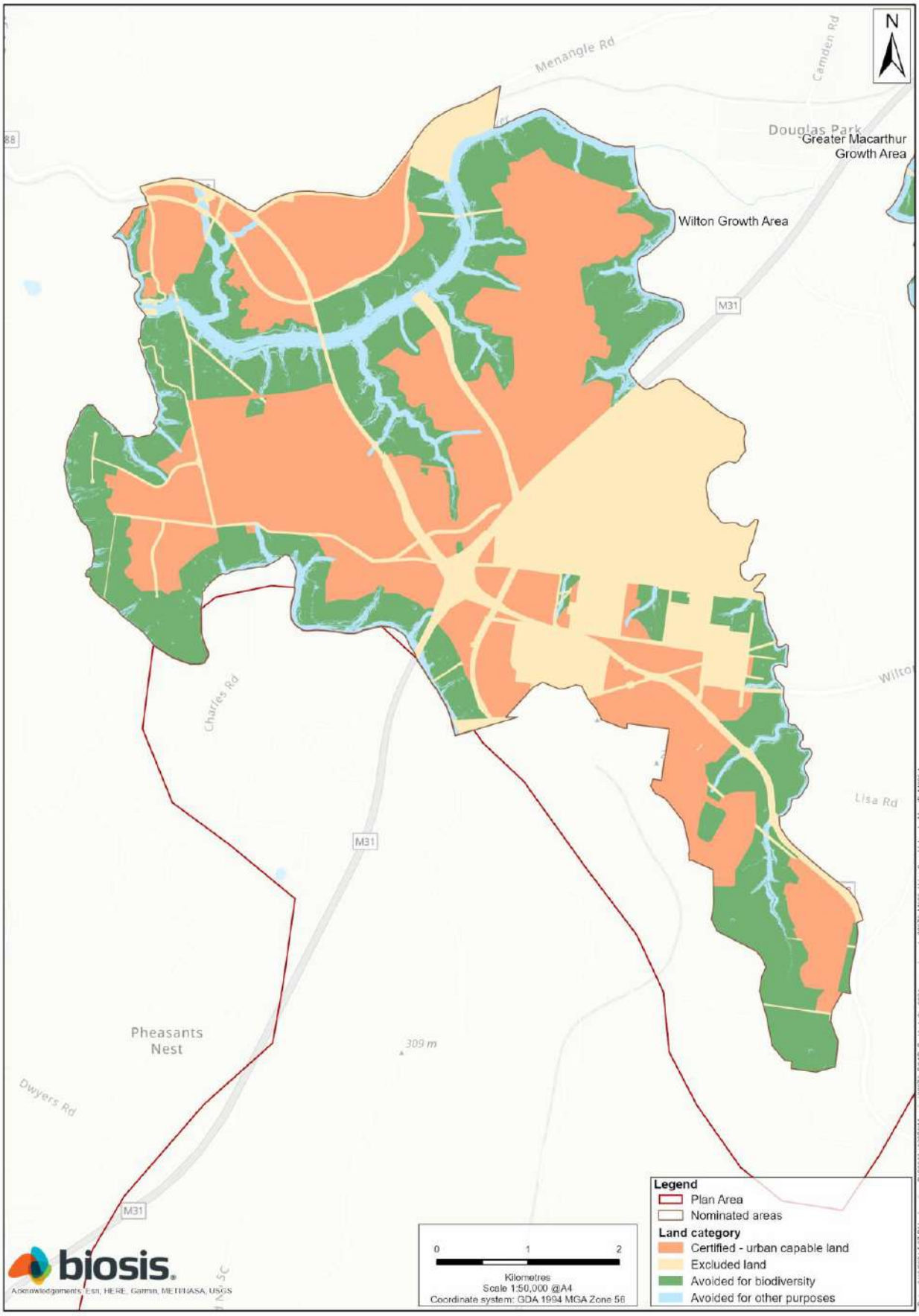


Figure 14-1: Avoidance outcomes – Wilton

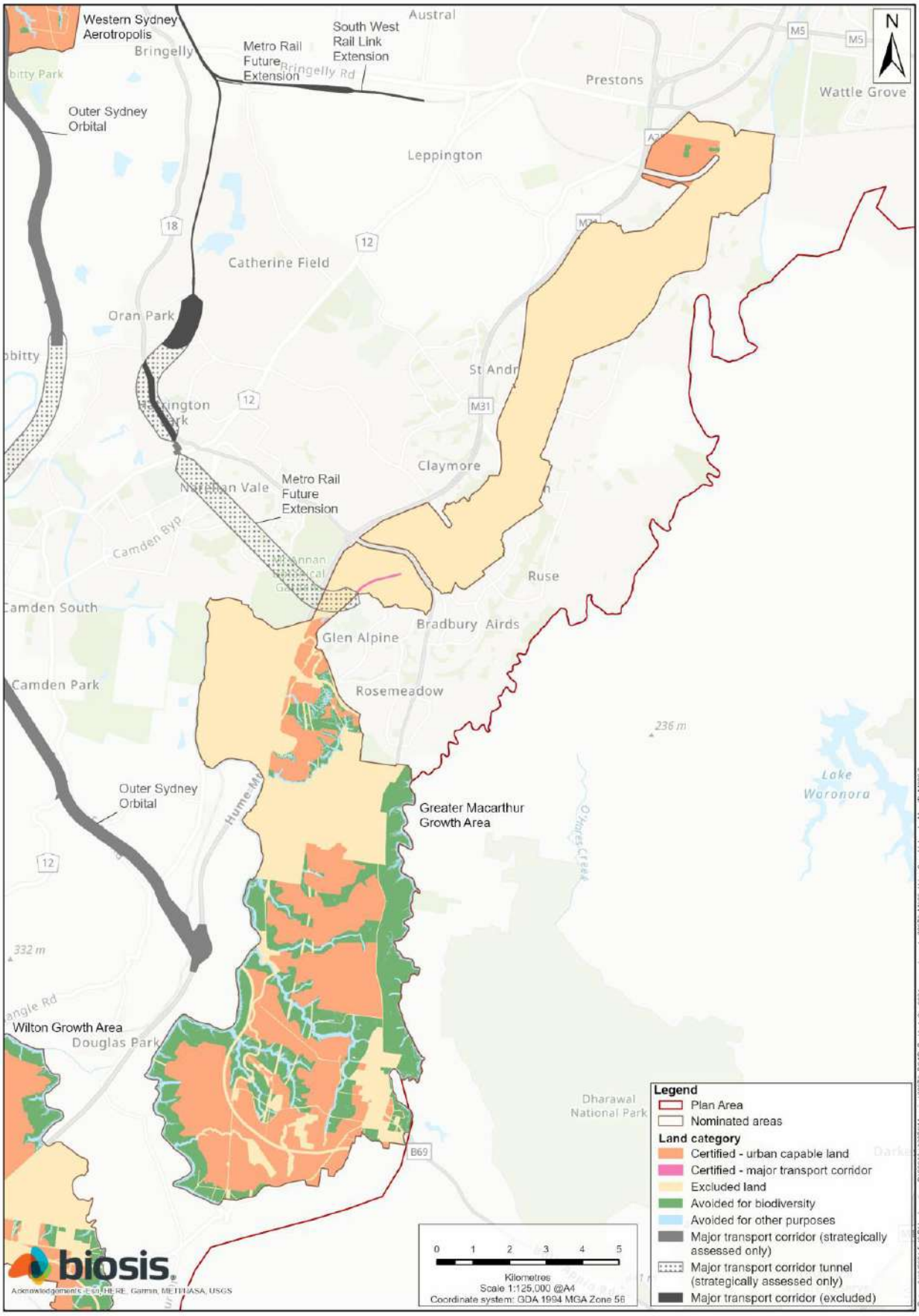


Figure 14-2: Avoidance outcomes – GMAC

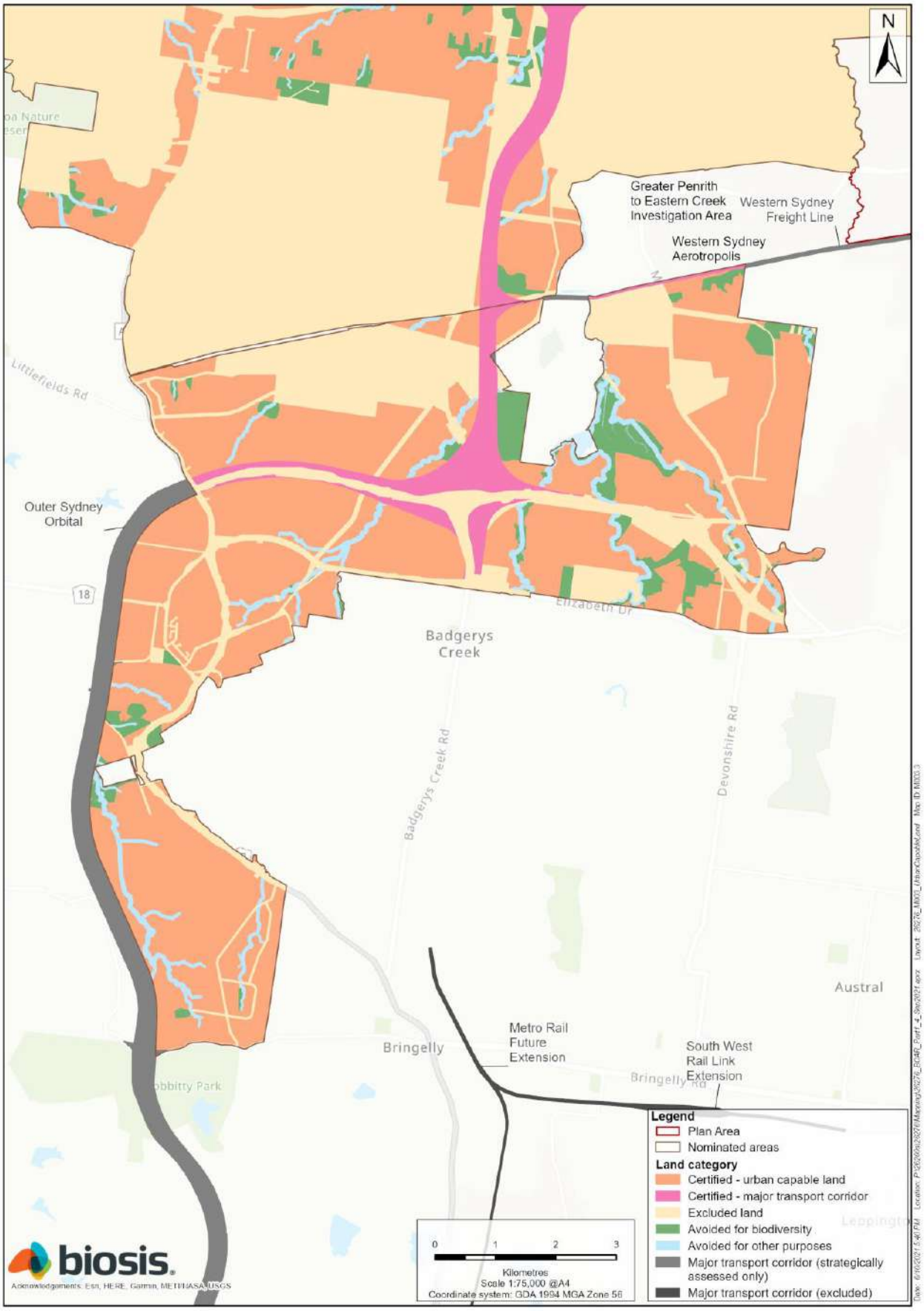


Figure 14-3: Avoidance outcomes – WSA

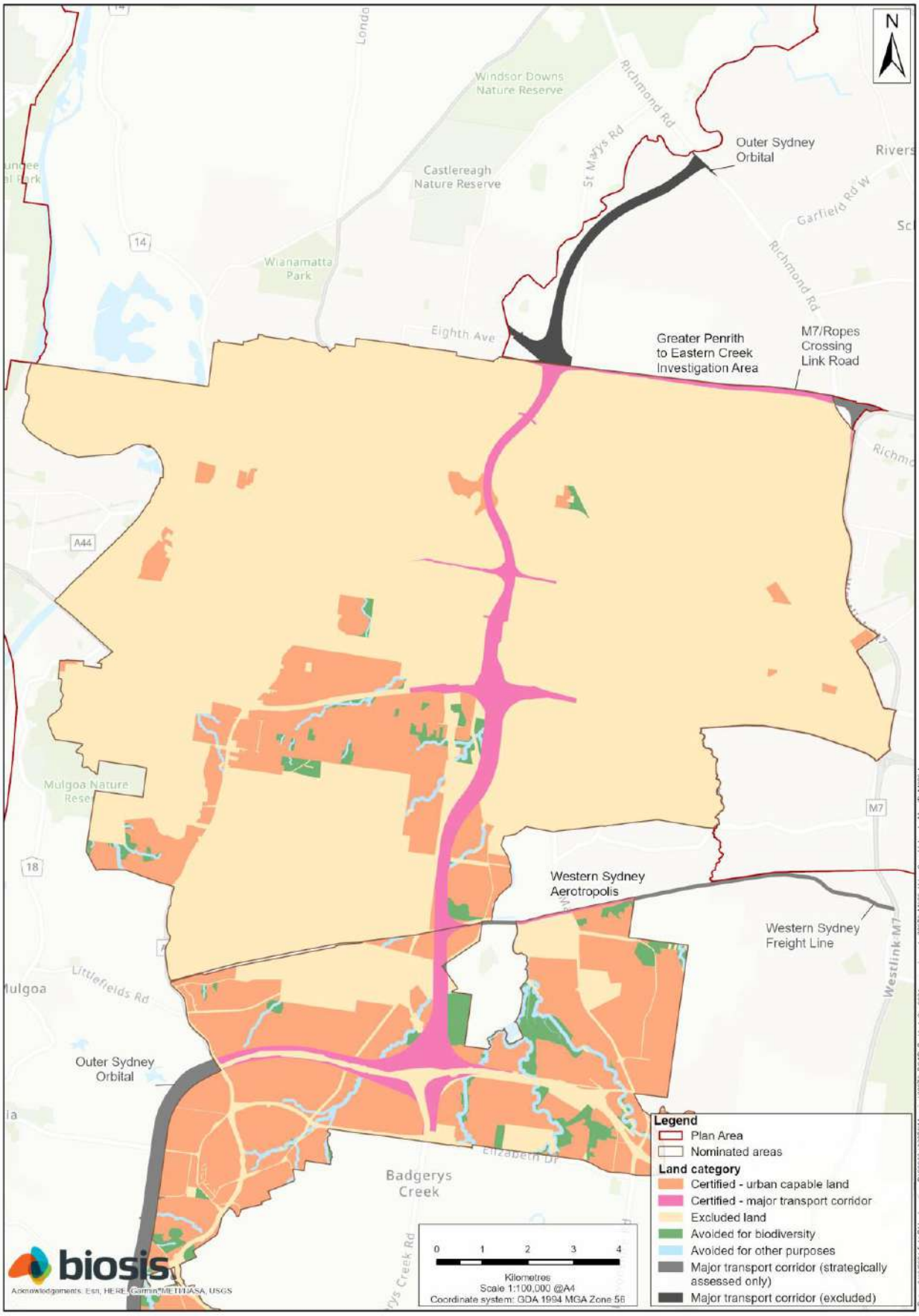


Figure 14-4: Avoidance outcomes – GPEC

SERIOUS AND IRREVERSIBLE IMPACT ENTITIES

The NSW and Commonwealth-listed SAII entities that may be subject to serious and irreversible impacts and that are potentially impacted by the development under the Plan are:

- TECs:
  - Cooks River/Castlereagh Ironbark Forest (NSW and Cth listed)
  - Cumberland Plain Woodland (NSW listed)/Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Cth listed)
  - Shale Sandstone Transition Forest (NSW and Cth listed)
- Flora:
  - *Allocasuarina glareicola* (NSW and Cth listed)
  - *Hibbertia fumana* (NSW listed)
  - *Melaleuca deanei* (NSW and Cth listed)
  - *Micromyrtus minutiflora* (NSW and Cth listed)
- Fauna:
  - Green and Golden Bell Frog (NSW and Cth listed)
  - Large-eared Pied Bat (NSW and Cth listed)
  - Little Eagle (NSW listed)
  - Red-crowned Toadlet (NSW listed)
  - Square-tailed Kite (NSW listed)
  - Swift Parrot (NSW and Cth listed)
  - White-bellied Sea-Eagle (NSW listed)

Table 14-4 and Table 14-5 summarise the avoidance outcomes for each SAII entity within the nominated areas. Avoidance outcomes are discussed in more detail in Chapter 25 for NSW-listed SAII entities and in Chapter 31 for Commonwealth-listed TECs and Chapters 29 and 30 for Commonwealth-listed species.

Avoidance effort for SAII entities has generally focused on TECs and habitat in higher condition (see Box 1 and Table 14-4 and Table 14-5) and/or of higher long-term viability (see Chapter 31). In many cases, impacts to larger patches are avoided. Where these impacts do occur, they are often on the edges of larger, contiguous patches associated with waterways and gullies and gorges, which minimises fragmentation and impacts on habitat connectivity, particularly in Wilton and GMAC (see Chapter 25 and Chapters 29 to 31 for more details).

Despite this overall conclusion, for some SAII entities, about half or less of the TEC or potential species habitat was avoided and residual impacts remain. This includes:

- Cumberland Plain Woodland
- Cooks River/ Castlereagh Ironbark Forest
- *Allocasuarina glareicola* and *Micromyrtus minutiflora*
- Green and Golden Bell Frog
- Swift Parrot

For these TECs, the scale of impacts is not substantial when considering the extent of these TECs across the Plan Area and the majority of intact condition and/or higher long-term viability TECs has generally been avoided (see Chapter 31). The offsets proposed by the Plan for these TECs (Commitment 8) will substantially increase the level of protection of these TECs in the Plan Area and address key threats identified in BioNet profiles and Conservation Advices.

For *Allocasuarina glareicola* and *Micromyrtus minutiflora* there are no impacts to records or important populations of the species (for each species, one important population occurs on excluded lands and will not be impacted).

While there will be direct impacts to small areas of Green and Golden Bell Frog habitat in GPEC, recent surveys along Ropes Creek indicate a population does not exist in that locality (see Supporting Document I).

For the Swift Parrot, the Plan provides a commitment (Commitment 9) to secure offsets of 100 ha of important habitat for the species to address residual impacts. The Plan also includes a range of other measures to mitigate risks to the species and increase its protection within the Plan area.

Table 14-4: Avoidance outcomes for SAII TECs within the nominated areas

SAII entity	Listing	Summary of TEC avoidance within nominated areas (without excluded lands)				Comment on avoidance outcomes within the nominated areas
		Total in nominated areas (ha)	Total avoided (ha / %)	Avoided for bio. reasons (ha / %)	Avoided for other reasons (ha / %)	
Cooks River/ Castlereagh Ironbark Forest	NSW	63.4 ha	25.8 ha / 40.7%	25.7 ha / 40.5%	0.2 ha / 0.2%	Between 40 - 45% of the TEC has been avoided For the NSW-listed TEC, of the 34.9 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (18.9 ha or 54.2%) has been avoided (see Chapter 25) For the Commonwealth-listed TEC, of the 34.6 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (18.9 ha or 54.6%) has been avoided (see Chapter 31)
	Cth	55.6 ha	24.7 ha / 44.5%	24.6 ha / 44.3%	0.1 ha / 0.2%	
Cumberland Plain Woodland	NSW	1,252.8 ha	321.3 ha / 25.6%	269.9 ha / 21.5%	51.4 ha / 4.1%	Between 25 - 45% of the TEC has been avoided For the NSW-listed TEC, of the 89.4 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (57.9 ha or 64.8%) has been avoided (see Chapter 25) For the Commonwealth-listed TEC, of the 32 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (22.3 ha or 69.6%) has been avoided (see Chapter 31)
	Cth	247.2 ha	111.5 ha / 45.1%	85.9 ha / 34.8%	25.6 ha / 10.3%	
Shale Sandstone Transition Forest	NSW	2,640.2 ha	2,180.5 ha / 82.6%	1,929.2 ha / 73.1%	251.3 ha / 9.5%	Between 81% - 91% of the TEC has been avoided For the NSW-listed TEC, of the 1,492.6 ha of intact condition TEC within the nominated areas (not including excluded land), the vast majority (1,446.8 ha or 96.9%) has been avoided For the Commonwealth-listed TEC, of the 1,485 ha of intact condition and 1,362.1 ha of high viability TEC within the nominated areas (not including excluded land), 1,437 ha of intact condition (or 97.1%) and 1,330.6 ha of high viability (or 97.7%) TEC, have been avoided Commitment 2.1 limits the cumulative direct impacts over the life of the Plan from essential infrastructure to this TEC
	Cth	2,197.4 ha	2,016.7 ha / 91.8%	1,769.1 ha / 80.5%	247.6 ha / 11.3%	

Table 14-5: Avoidance outcomes for SAII flora and fauna within the nominated areas

SAII entity	Summary of habitat avoidance (without excluded lands)				Comment on avoidance outcomes
	Total in nominated areas (ha)	**Total avoided (ha / %)**	**Avoided for bio. reasons (ha / %)**	**Avoided for other reasons (ha / %)**	
Flora					
Allocasuarina glareicola	32.3 ha	14.9 ha / 46.1%	14.8 ha / 45.7%	0.1 ha / 0.3%	About half the potential habitat has been avoided There are no impacts to records or important populations of the species (one important population occurs on excluded lands and will not be impacted)
Hibbertia fumana	1,299 ha	1,225.3 ha / 94.3%	1,083.7 ha / 83.4%	141.6 ha / 10.9%	Almost all potential habitat has been avoided There are no impacts to records of the species
Melaleuca deanei	1,750.3 ha	1,644.1 ha / 93.9%	1,545.2 ha / 88.3%	98.9 ha / 5.6%	Almost all potential habitat has been avoided There are no impacts to records of the species
Micromyrtus minutiflora	69 ha	37.3 ha / 54%	37.1 ha / 53.7%	0.2 ha / 0.3%	Over half the potential habitat has been avoided There are no impacts to records or important populations of the species (one important population occurs on excluded lands and will not be impacted)
Fauna					
Green and Golden Bell Frog	24.6 ha	11.3 ha / 45.8%	11.2 ha / 45.7%	<0.1 ha / 0.1%	About half the potential habitat has been avoided. It is important to note that much of the potential habitat mapped comprises existing urban areas (houses and roads), as the mapping was done by applying a buffer to records along Ropes Creek (see Chapter 25) There will be direct impacts to potential habitat in GPEC. However, recent surveys along Ropes Creek indicate a population does not exist in this locality
Large-eared Pied Bat*	882.2 ha	876.5 ha / 99.3%	452 ha / 51.2%	424.5 ha / 48.1%	Almost all potential breeding habitat has been avoided An important population has been partially avoided. Population 424 occurs as a single important population across the Plan Area and surrounds. The majority of records occur outside of nominated areas. Nine records occur within excluded lands and 2 records are located on avoided lands within central GMAC
Little Eagle*	2,935.5 ha	2,907.3 ha / 99%	2,237.5 ha / 76.2%	669.8 ha / 22.8%	Almost all potential breeding habitat has been avoided There are no impacts to known breeding sites (stick nests)

SAII entity	Summary of habitat avoidance (without excluded lands)				Comment on avoidance outcomes
	Total in nominated areas (ha)	**Total avoided (ha / %)**	**Avoided for bio. reasons (ha / %)**	**Avoided for other reasons (ha / %)**	
Red-crowned Toadlet	869 ha	859.7 ha / 98.9%	645.1 ha / 74.2%	214.6 ha / 24.7%	Almost all potential habitat has been avoided There are no impacts to records of the species
Square-tailed Kite*	2,919.2 ha	2,874.6 ha / 98.5%	2,220.2 ha / 76.1%	654.4 ha / 22.4%	Almost all potential breeding habitat has been avoided There are no impacts to known breeding sites (stick nests)
Swift Parrot	83.7 ha important habitat	40.4 ha / 48%	19.9 ha / 23.8%	20.6 ha / 24.6%	Approximately half of important habitat has been avoided No avoidance of potential important areas has occurred, although it is recognised that only a small area of potential important areas is located within the nominated areas Approximately 75 per cent of potential foraging habitat for the species has been avoided There are not impacts to breeding areas as the species breeds in Tasmania The Plan includes a commitment (Commitment 9) to secure 4,410 ha of potential foraging habitat for the Swift Parrot, including 100 ha of important habitat to offset residual impacts
	2.8 ha potential important areas	0 ha / 0% potential important areas	0 ha / 0% potential important areas	0 ha / 0% potential important areas	
	4,514.3 ha potential foraging habitat	3,414.6 ha / 75.6% potential foraging habitat	2,568.8 ha / 56.9% potential foraging habitat	845.8 ha / 18.7% potential foraging habitat	
White-bellied Sea Eagle*	1,616.6 ha	1,598.9 ha / 98.9%	1,031.8 ha / 63.8%	567.2 ha / 35.1%	Almost all potential breeding habitat has been avoided There are no impacts to known breeding sites (stick nests)

*Impacts relate to potential breeding habitat only

PRESCRIBED IMPACTS

The following prescribed impact types are relevant to the development:

- Karst, caves, crevices, cliffs, and other geological features of significance
- Rocks
- Human-made structures
- Non-native vegetation
- Habitat connectivity and movement
- Water bodies and hydrological processes
- Vehicle strikes

Avoidance and minimisation of prescribed impacts is summarised in Table 14-6. Further details about avoidance outcomes are provided in the assessment of prescribed impacts in Chapter 24.

Table 14-6: Avoidance outcomes for prescribed impacts within the nominated areas

Prescribed impact	Comment on avoidance outcomes
Karst, caves crevices, cliffs, and other geological features of significance	Most areas where karst, caves, crevices, cliffs, and other geological features are likely to occur have been avoided and do not occur within urban capable land or major transport corridors
Rocks	Areas where rocks are most likely to occur, particularly in Wilton and GMAC, are on the edges of the nominated areas and in the gully lines where the underlying sandstone is exposed. These areas are generally steep and unsuitable for urban development and have generally been avoided. The relevant species associated with rocky areas – Broad-headed Snake and Red-crowned Toadlet – are generally associated with rocky areas in native vegetation. Approximately 67.2 per cent of native vegetation, including 95.2 per cent of intact condition vegetation, has been avoided in the nominated areas (not including excluded land)
Human-made structures	Human-made structures are likely to occur throughout each of the nominated areas and it was not possible to determine avoidance outcomes for human-made structures. The Plan includes several specific mitigation measures that will avoid and minimise impacts to species identified at risk from this prescribed impact (micro-bat species)
Non-native vegetation	The avoidance criteria included prioritising avoidance of known habitat for species as indicated by BioNet records or surveys undertaken for the project, including any relevant areas of non-native vegetation where species records occur. Only very small amounts of non-native vegetation comprising suitable habitat for flora species associated with non-native vegetation will be impacted. While large areas of non-native vegetation will be impacted that may affect several bats and bird species, these species are generally more reliant on native vegetation, which was appropriately the focus of avoidance effort
Habitat connectivity and movement	See section 'Areas important for connectivity' below
Water bodies and hydrological processes	Urban capable land has avoided riparian corridors along waterways that are likely to be the preferred movement and foraging habitat for many of the species associated with water bodies and this will also minimise impacts to hydrological processes
Vehicle strikes	The Plan includes a range of commitments and actions, as well as specific mitigation measures in Appendix E of the Plan, to avoid the risk of vehicle strike through mitigation. This includes a range of measures specific to Koala. These measures are expected to adequately address the risk of vehicle strikes on species associated with this prescribed impact

NATIVE VEGETATION

Of the 5,352.4 ha of native vegetation occurring (not including excluded land) within the nominated areas:

- 2,714.4 ha (50.7 per cent) has been avoided for biodiversity purposes (as per the BAM definition)
- An additional 884.4 ha (16.5 per cent) has been avoided for other purposes and is not directly impacted by the Plan

Section 8.1.1.3 (b) of the BAM specifies that impacts can be avoided and minimised by locating development in areas where native vegetation is in the poorest condition, or by avoiding the highest condition native vegetation. For the purposes of this assessment high condition has been defined as vegetation mapped in the 'intact' condition state.

Table 14-7 indicates that the vast majority of the urban capable land for the nominated areas has been located in poorer condition native vegetation and avoided areas with the highest (intact) condition.

Of the high condition (intact) native vegetation in the nominated areas (2,398.5 ha, not including excluded lands):

- 1,630.5 ha (or 67.9 per cent) has been avoided for biodiversity purposes
- A total of 2,283.5 ha (or 95.2 per cent) has been avoided

Avoidance outcomes of intact native vegetation for GPEC are lower than for other nominated areas. This is due to:

- The impacts of the transport corridors – the OSO within GPEC directly impacts about 37.6 ha of intact native vegetation (65.9 per cent of total area of intact vegetation in GPEC, not including excluded lands), while the urban capable land directly impacts about 1.1 ha of intact vegetation. It is important to note that avoidance within the transport corridors has not yet occurred (see section 14.4) and it is likely that further avoidance of intact native vegetation within the OSO footprint will occur during strategic planning and detailed design
- A relatively small urban capable land area within a nominated area that is largely already developed for urban purposes, meaning the opportunities for avoidance across the nominated area is generally more constrained

Table 14-7: Avoidance of high condition (intact) native vegetation in nominated areas

Nominated area	Area of high condition PCTs (ha) in nominated areas			Area of high condition PCTs avoided (ha) in nominated areas			
	Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	Per cent avoided# (%)
Wilton	994.0	171.6	822.4	536.2	273.8	809.9	98.5
GMAC	1,944.7	501.0	1,443.7	1,031.3	361.5	1,392.7	96.5
WSA	80.3	4.9	75.4	48.3	14.1	62.5	82.9
GPEC	924.6	867.5	57.1	14.7	3.7	18.4	32.3
Total	**3,943.6**	**1,545.1**	**2,398.5**	**1,630.5**	**653.0**	**2,283.5**	**95.2**

* As per BAM definition of avoidance

Not including excluded lands

THREATENED ECOLOGICAL COMMUNITIES

Section 8.1.1.3 (c) of the BAM specifies that impacts can be avoided and minimised by locating proposed development in areas that avoid critically endangered and endangered TECs.

Table 14-8 and Table 14-9 show avoidance and minimisation outcomes for each NSW-listed TEC and Commonwealth-listed TEC for each condition category across all the nominated areas.

Table 14-10 and Table 14-11 show avoidance and minimisation outcomes aggregated across critically endangered and endangered NSW-listed TECs and Commonwealth-listed TECs for each condition category within each nominated area.

The tables indicated that:

- The NSW-listed or Commonwealth-listed TECs with the largest avoidance achieved (per cent total avoided) are:
  - Moist Shale Woodland in the Sydney Basin Bioregion in good (intact) or moderate (thinned) condition
  - Shale Sandstone Transition Forest of the Sydney Basin Bioregion in good (intact) or moderate (thinned) condition
  - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions in good (intact) or moderate (thinned) condition
- The NSW-listed or Commonwealth-listed TECs with the least avoidance achieved (per cent total avoided) are:
  - Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions in moderate (thinned) or poor (scattered trees) condition
  - Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion in moderate (thinned) or poor (scattered trees) condition
  - Cumberland Plain Woodland in the Sydney Basin Bioregion in moderate (thinned) or poor (scattered trees) condition
- Of the 4,620.7 ha of critically endangered and endangered NSW-listed TECs (not including excluded land) 51.75 per cent has been avoided for biodiversity purposes, and a total of 62.1 per cent has been avoided
- Of the 2,811.1 ha of critically endangered and endangered Commonwealth-listed TECs (not including excluded land) 69.3 per cent has been avoided for biodiversity purposes, and a total of 83.3 per cent has been avoided

Table 14-8: Avoidance of each NSW-listed TEC in nominated areas by condition category

NSW status	TEC name and condition	Area of TEC in nominated areas (ha)			Area of TEC avoided in nominated areas (ha)			Per cent total avoided# (%)
		Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
E	***Shale Gravel Transition Forest in the Sydney Basin Bioregion***							
	Intact condition	72.5	57.9	14.6	7.4	0.0	7.4	**50.5%**
	Thinned condition	183.1	52.9	130.2	54.8	0.1	54.9	**42.1%**
	Scattered trees	40.4	3.7	36.7	10.9	0.0	10.9	**29.8%**
E	***Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion***							
	Intact condition	107.2	72.4	34.9	18.9	0.0	18.9	**54.2%**
	Thinned condition	49.6	24.0	25.6	6.8	0.1	6.9	**26.9%**
	Scattered trees	9.5	6.5	3.0	0.0	0.0	0.0	**1.5%**
E	***Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions***							
	Thinned condition	69.8	65.5	4.2	0.0	0.0	0.0	**0.6%**

NSW status	TEC name and condition	Area of TEC in nominated areas (ha)			Area of TEC avoided in nominated areas (ha)			Per cent total avoided# (%)
		Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
E	*Moist Shale Woodland in the Sydney Basin Bioregion*							
	Intact condition	5.0	2.8	2.2	1.4	0.7	2.1	**98.1%**
	Thinned condition	16.2	1.9	14.3	9.9	4.3	14.3	**100.0%**
	DNG	0.2	0.2	0.0	0.0	0.0	0.0	**0.0%**
E	*River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*							
	Intact condition	394.4	345.7	48.7	17.4	17.4	34.8	**71.5%**
	Thinned condition	737.1	464.6	272.5	45.3	77.2	122.6	**45.0%**
	Scattered trees	55.2	23.9	31.4	1.8	7.4	9.3	**29.6%**
	DNG	0.1	0.1	0.0	0.0	0.0	0.0	**0.0%**
CE	*Cumberland Plain Woodland in the Sydney Basin Bioregion*							
	Intact condition	613.5	524.0	89.4	47.6	10.4	57.9	**64.8%**

NSW status	TEC name and condition	Area of TEC in nominated areas (ha)			Area of TEC avoided in nominated areas (ha)			Per cent total avoided# (%)
		Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
	Thinned condition	1,869.8	1,289.8	580.0	195.0	39.6	234.6	**40.5%**
	Scattered trees	335.0	191.6	143.4	10.3	0.9	11.2	**7.8%**
	DNG	539.9	99.9	440.1	17.0	0.5	17.5	**4.0%**
V	***Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion***							
	Intact condition	6.4	6.4	0.0	0.0	0.0	0.0	**0.0%**
	Thinned condition	1.0	1.0	0.0	0.0	0.0	0.0	**0.0%**
CE	***Shale Sandstone Transition Forest in the Sydney Basin Bioregion***							
	Intact condition	1,841.4	348.9	1,492.6	1,229.7	217.2	1,446.8	**96.9%**
	Thinned condition	986.8	270.8	716.0	538.1	32.3	570.5	**79.7%**
	Scattered trees	125.3	50.7	74.6	32.8	0.8	33.6	**45.0%**
	DNG	403.7	46.7	357.0	128.6	1.0	129.6	**36.3%**

NSW status	TEC name and condition	Area of TEC in nominated areas (ha)			Area of TEC avoided in nominated areas (ha)			Per cent total avoided# (%)
		Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
E	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*							
	Intact condition	20.9	6.5	14.4	8.5	5.2	13.7	**95.5%**
	Thinned condition	201.3	110.1	91.2	8.5	58.7	67.2	**73.7%**
	Scattered trees	4.8	1.2	3.6	0.4	1.6	2.0	**56.5%**

* As per BAM definition of avoidance

Not including excluded lands

Table 14-9: Avoidance of each Commonwealth-listed TEC in nominated areas by condition category

Common-wealth status	TEC name and condition	Area of TEC in nominated areas (ha)			Area of TEC avoided in nominated areas (ha)			Per cent total avoided# (%)
		Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
CE	***Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest***							
	Intact condition	422.3	390.3	32.0	19.9	2.4	22.3	**69.7%**
	Thinned condition	851.6	640.7	210.9	66.0	23.2	89.2	**42.3%**
	Scattered trees	19.9	15.5	4.4	0.0	0.0	0.0	**0.0%**
CE	***Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion***							
	Intact condition	106.1	71.5	34.6	18.9	0.0	18.9	**54.6%**
	Thinned condition	26.2	6.9	19.3	5.8	0.1	5.9	**30.6%**
	Scattered trees	1.7	0.0	1.7	0.0	0.0	0	**0.0%**
CE	***Western Sydney Dry Rainforest and Moist Woodland on Shale***							
	Intact condition	4.60	2.40	2.20	1.40	0.70	2.10	**95%**

Common-wealth status	TEC name and condition	Area of TEC in nominated areas (ha)			Area of TEC avoided in nominated areas (ha)			Per cent total avoided# (%)
		Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
	Thinned condition	14.00	1.00	13.00	9.10	3.90	13.00	**100%**
CE	***Shale Sandstone Transition Forest of the Sydney Basin Bioregion***							
	Intact condition	1832	347	1485.0	1226.9	215.5	1442.4	**97.1%**
	Thinned condition	944.3	260.5	683.8	527.7	31.6	559.3	**81.8%**
	Scattered trees	60.4	31.8	28.6	14.5	0.5	15.0	**52.4%**
CE	***River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria***							
	Intact condition	386.9	340.7	46.2	15.0	17.4	32.5	**70.3%**
	Thinned condition	569.6	374.3	195.4	39.1	67.1	106.1	**54.3%**
	Scattered trees	28.3	10.4	17.8	0.6	5.8	6.4	**40.0%**
E	***Coastal Swamp Oak Casuarina glauca Forest of New South Wales and South East Queensland ecological community***							
	Intact condition	0.2	0.0	0.2	0.0	0.2	0.2	**100.0%**

Common-wealth status	TEC name and condition	Area of TEC in nominated areas (ha)			Area of TEC avoided in nominated areas (ha)			Per cent total avoided# (%)
		Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
	Thinned condition	98.0	63.7	34.3	2.7	24.0	26.7	**77.8%**
	Scattered trees	1.7	0.0	1.7	0.1	1.0	1.1	**64.7%**

* As per BAM definition of avoidance

Not including excluded lands

Table 14-10: Avoidance of endangered (E) and critically endangered (CE) NSW-listed TECs in nominated areas

Nominated area	Area of TECs in nominated areas (ha)						Area of TECs avoided in nominated areas (ha)						Per cent total CE and E TECs avoided# (%)
	Total area (ha)		Area in excluded lands (ha)		Area not including excluded lands (ha)		Avoided for biodiversity purposes*		Avoided for other reasons		Total avoided		
	CE	E	CE	E	CE	E	CE	E	CE	E	CE	E	
Wilton	**1,875.5**	**0**	**246.3**	**0**	**1,629.2**	**0**	**927**	**0**	**73.5**	**0**	**1,000.5**	**0**	**61.4**
Intact condition	546.9	0	72.7	0	474.2	0	405.3	0	56.4	0	461.7	0	**97.4**
Thinned condition	594.5	0	93.1	0	501.4	0	391.2	0	16	0	407.2	0	**81.2**
Scattered trees	89.7	0	33.6	0	56.1	0	13.2	0	0.4	0	13.6	0	**24.2**
DNG	644.4	0	46.9	0	597.5	0	117.3	0	0.7	0	118	0	**19.7**
GMAC	**2,567.1**	**210.8**	**891.3**	**170.3**	**1,675.8**	**41.3**	**1,140.2**	**19.6**	**198.8**	**13.1**	**1,339.1**	**32.7**	**79.9**
Intact condition	1448.1	61.4	373.6	45.8	1074.5	15.6	855.1	7.3	169.8	7	1024.9	14.3	**95.3**
Thinned condition	746.9	140.7	353.2	116	393.7	25.5	231.8	12.2	28	6.1	259.8	18.3	**66.3**
Scattered trees	155.2	8.5	71.5	8.3	83.7	0.2	26.6	0.1	0.8	0	27.4	0.1	**32.8**
DNG	216.9	0.2	93	0.2	123.9	0	26.7	0	0.2	0	27	0	**21.8**
WSA	**445.3**	**431**	**54.4**	**61.4**	**390.9**	**369.7**	**83.6**	**121**	**23**	**121.2**	**106.7**	**242.3**	**45.9**

Nominated area	Area of TECs in nominated areas (ha)						Area of TECs avoided in nominated areas (ha)						Per cent total CE and E TECs avoided# (%)
	Total area (ha)		Area in excluded lands (ha)		Area not including excluded lands (ha)		Avoided for biodiversity purposes*		Avoided for other reasons		Total avoided		
	CE	E	CE	E	CE	E	CE	E	CE	E	CE	E	
Intact condition	29.1	51.2	0.3	4.6	28.8	46.6	16.5	31.9	1.4	12.7	17.9	44.6	**82.9**
Thinned condition	281.7	330.3	34.6	45.8	247.1	284.5	63	85.2	20.6	99.6	83.7	184.8	**50.5**
Scattered trees	85.5	49.4	13.8	10.9	71.7	38.6	3.1	3.9	0.5	8.9	3.6	12.9	**15.0**
DNG	49	0.1	5.7	0.1	43.3	0	1	0	0.5	0	1.5	0	**3.5**
GPEC	**1,827.8**	**1,325.6**	**1,630.2**	**1,015.5**	**197.5**	**316.3**	**48.3**	**51.5**	**7.4**	**38.8**	**55.7**	**90.2**	**28.4**
Intact condition	430.8	487.5	426.2	441.3	4.6	52.5	0.3	14.4	0	3.7	0.3	18.1	**32.2**
Thinned condition	1233.6	786.2	1079.6	558.1	153.9	228	47.2	27.9	7.3	34.9	54.5	62.8	**30.7**
Scattered trees	130	51.9	123.5	16.1	6.5	35.8	0.2	9.2	0.1	0.2	0.3	9.3	**22.7**
DNG	33.4	0	0.9	0	32.5	0	0.6	0	0	0	0.6	0	**1.8**
Total	**6,715.7**	**1,967.4**	**2,822.2**	**1,247.2**	**3,893.4**	**727.3**	**2,199.1**	**192.1**	**302.7**	**173.1**	**2,502**	**365.2**	**62.1**

* As per BAM definition of avoidance

Not including excluded lands

Table 14-11: Avoidance of endangered (E) and critically endangered (CE) Commonwealth-listed TECs in nominated areas

Nominated area	Area of TECs in nominated areas (ha)						Area of TECs avoided in nominated areas (ha)						Per cent total TECs (CE and E) avoided# (%)
	Total area (ha)		Area in excluded lands (ha)		Area not including excluded lands (ha)		Avoided for biodiversity purposes*		Avoided for other reasons		Total avoided		
	CE	E	CE	E	CE	E	CE	E	CE	E	CE	E	
Wilton	**1,080.8**	**0.0**	**171.2**	**0.0**	**909.6**	**0.0**	**756.6**	**0.0**	**69.1**	**0.0**	**825.7**	**0.0**	**90.8**
Intact condition	539.0	0.0	70.2	0.0	468.8	0.0	402.5	0.0	54.6	0.0	457.1	0.0	97.5
Thinned condition	511.7	0.0	84.5	0.0	427.1	0.0	347.6	0.0	14.2	0.0	361.9	0.0	84.7
Scattered trees	30.1	0.0	16.5	0.0	13.6	0.0	6.5	0.0	0.2	0.0	6.8	0.0	49.7
GMAC	**2,079.6**	**2.5**	**686.6**	**2.5**	**1,393.0**	**0.0**	**1,062.8**	**0.0**	**195.0**	**0.0**	**1,257.8**	**0.0**	**90.3**
Intact condition	1,402.8	0.0	347.5	0.0	1,055.3	0.0	844.5	0.0	170.2	0.0	1,014.7	0.0	96.2
Thinned condition	628.0	2.5	308.9	2.5	319.1	0.0	210.3	0.0	24.4	0.0	234.7	0.0	73.6
Scattered trees	48.7	0.0	30.1	0.0	18.6	0.0	8.0	0.0	0.3	0.0	8.3	0.0	44.6
WSA	**291.0**	**33.2**	**30.6**	**6.8**	**260.4**	**26.4**	**66.5**	**2.6**	**76.6**	**22.2**	**143.1**	**24.8**	**58.5**
Intact condition	34.1	0.2	1.2	0.0	32.9	0.2	23.1	0.0	7.5	0.2	30.6	0.2	93.0
Thinned condition	228.5	31.4	20.6	6.8	207.9	24.6	42.8	2.4	63.3	21.0	106.1	23.4	55.7

Nominated area	Area of TECs in nominated areas (ha)						Area of TECs avoided in nominated areas (ha)						Per cent total TECs (CE and E) avoided# (%)
	Total area (ha)		Area in excluded lands (ha)		Area not including excluded lands (ha)		Avoided for biodiversity purposes*		Avoided for other reasons		Total avoided		
	CE	E	CE	E	CE	E	CE	E	CE	E	CE	E	
Scattered trees	28.3	1.7	8.8	0.0	19.5	1.7	0.6	0.1	5.8	1.0	6.4	1.2	35.8
GPEC	**1,816.3**	**64.1**	**1,604.4**	**54.4**	**211.8**	**9.7**	**59.0**	**0.3**	**27.6**	**3.0**	**86.5**	**3.3**	**40.6**
Intact condition	775.8	0.0	732.9	0.0	42.8	0.0	12.0	0.0	3.7	0.0	15.7	0.0	36.7
Thinned condition	1,037.4	64.1	869.2	54.4	168.2	9.7	46.9	0.3	23.9	3.0	70.8	3.3	41.7
Scattered trees	3.1	0.0	2.3	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
Total	**5,267.6**	**99.8**	**2,492.9**	**63.8**	**2,774.7**	**36.1**	**1,944.8**	**2.9**	**368.3**	**25.2**	**2,313.1**	**28.1**	**83.3**

* As per BAM definition of avoidance

Not including excluded lands

SPECIES POTENTIAL HABITAT

Section 8.1.1.3(c) of the BAM specifies that the proposed development should avoid areas of habitat for species with a high biodiversity risk weighting. Risk-weightings are identified by EES for each species and used in credit calculations as part of assessing the impacts of a development on each species. Risk-weightings are based on the combination of the sensitivity of the species to loss at the development site, and sensitivity of the species to potential gain at an offset site.

Table 14-12 sets out the amounts of potential habitat avoided for NSW-listed candidate species credit species (SCS) with a high or very high biodiversity risk weighting in the nominated areas.

The table indicates that within the nominated areas the average avoidance of potential habitat is:

- 69.9 per cent for the four candidate SCS with a very high-risk weighting (not including excluded lands) (*Allocasuarina glareicola*, *Hibbertia fumana, Lathamus discolor* and *Chalinolobus dwyeri*)
- 77.1 per cent for the candidate SCS with a high-risk weighting (not including excluded lands)

Avoidance outcomes for each Commonwealth-listed species are further described in Chapters 29 and 30.

Table 14-12: Avoidance of species potential habitat in nominated areas, showing avoidance of species with very high or high biodiversity risk-weighting (BRW)

Scientific name	Common name	NSW status	BRW	Cth status	Area of habitat in nominated areas (ha)			Area of habitat avoided in nominated areas (ha)			Per cent total avoided# (%)
					Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
Flora											
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	E	2	V	3,392.3	756.9	2,635.3	2,061.3	139.7	2201.0	83.5
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	V	2	V	7,360.1	3,472.5	3,887.6	2,320.9	245.4	2566.2	66.0
Allocasuarina glareicola		E	3	E	200.0	167.7	32.3	14.8	0.1	14.9	46.1
Dillwynia tenuifolia		V	2		772.8	501.1	271.7	95.5	2.3	97.8	36.0
Eucalyptus benthamii	Camden White Gum, Nepean River Gum	V	2	V	73.4	72.9	0.5	0.0	0.5	0.5	100.0
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	2	V	796.5	211.9	584.6	427.5	141.3	568.7	97.3
Hibbertia fumana		CE	3		1,716.4	417.3	1,299.0	1,083.7	141.6	1225.3	94.3
Hibbertia puberula		E	2		1,712.7	421.8	1,290.9	1,072.2	140.9	1213.1	94.0
Marsdenia viridiflora subsp. *viridiflora - endangered population*		E	2		4,420.3	3,157.8	1,262.5	610.4	226.7	837.1	66.3
Maundia triglochinoides		V	2		250.0	151.7	98.3	16.1	59.5	75.6	76.9

Scientific name	Common name	NSW status	BRW	Cth status	Area of habitat in nominated areas (ha)			Area of habitat avoided in nominated areas (ha)			Per cent total avoided# (%)
					Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
Melaleuca deanei	Deane's Melaleuca	V	2	V	2,321.4	571.1	1,750.3	1,545.2	98.9	1644.1	93.9
Micromyrtus minutiflora		E	2	V	256.4	187.4	69.0	37.1	0.2	37.3	54.0
Persicaria elatior	Tall Knotweed	V	2		265.3	179.2	86.0	11.4	24.7	36.1	42.0
Persoonia bargoensis	Bargo Geebung	E	2	V	3,124.9	751.6	2,373.3	1,695.0	594.8	2289.8	96.5
Persoonia nutans	Nodding Geebung	E	2	E	492.2	251.2	241.0	98.7	0.3	99.0	41.1
Pimelea curviflora var. *curviflora*		V	2	V	523.8	457.5	66.3	13.5	0.4	13.9	21.0
Pimelea spicata	Spiked Rice-flower	E	2	E	3,814.3	2,370.1	1,444.2	498.9	74.9	573.8	39.7
Pomaderris brunnea	Rufous Pomaderris	E	2	V	1,285.5	332.8	952.7	730.1	183.6	913.7	95.9
Pterostylis saxicola	Sydney Plains Greenhood	E	2	E	2,741.9	588.7	2,153.2	1,527.4	578.7	2106.0	97.8
Pultenaea parviflora		E	2	V	395.8	204.2	191.6	85.7	0.3	86.0	44.9
Pultenaea pedunculata	Matted Bush-pea	E	2		1,972.9	1,184.6	788.3	533.5	46.3	579.8	73.5
Amphibians											
Litoria aurea	Green and Golden Bell Frog	E	2	V	1,654.5	1,629.9	24.6	11.2	0.0	11.3	45.8

Scientific name	Common name	NSW status	BRW	Cth status	Area of habitat in nominated areas (ha)			Area of habitat avoided in nominated areas (ha)			Per cent total avoided# (%)
					Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
Birds											
Callocephalon fimbriatum	Gang-gang Cockatoo	V	2		920.1	398.6	521.5	290.6	227.2	517.8	99.3
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	2		1,309.0	222.1	1,086.9	737.8	340.2	1078.0	99.2
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	2		2,432.9	816.3	1,616.6	1,031.8	567.2	1598.9	98.9
*Lathamus discolor***	Swift Parrot	E	3	CE	493.4	409.7	83.7	19.9	20.6	40.4	48.2
Ninox connivens	Barking Owl	V	2		515.1	105.2	409.9	20.1	389.7	409.9	100.0
Ninox strenua	Powerful Owl	V	2		519.3	110.3	409.0	20.0	388.9	408.9	100.0
Tyto novaehollandiae	Masked Owl	V	2		541.5	120.0	421.5	20.9	400.0	420.9	99.8
Invertebrates											
Meridolum corneovirens	Cumberland Plain Land Snail	E	2		6,720.1	3,448.4	3,271.7	2,154.4	397.2	2551.6	78.0
Mammals											
Cercartetus nanus	Eastern Pygmy-possum	V	2		3,689.1	1,394.4	2,294.7	1,582.1	645.6	2227.7	97.1
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V	3	V	4,255.1	1,104.8	3,150.3	2,189.6	679.2	2868.8	91.1

Scientific name	Common name	NSW status	BRW	Cth status	Area of habitat in nominated areas (ha)			Area of habitat avoided in nominated areas (ha)			Per cent total avoided# (%)
					Total area (ha)	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
Myotis macropus	Southern Myotis	V	2		3,695.1	1,348.2	2,346.8	1,105.0	482.6	1587.7	67.7
Petaurus norfolcensis	Squirrel Glider	V	2		6,467.4	3,271.5	3,195.9	2,234.5	660.0	2894.5	90.6
*Phascolarctos cinereus***	Koala	V	2	V	4,046.0	896.3	3,149.7	2,222.1	685.5	2,907.6	92.3

* As per BAM definition of avoidance

Not including excluded lands

** Important habitat

IMPORTANT POPULATIONS

Table 14-13 summarises the avoidance outcomes for important populations for each Commonwealth-listed species.

In total 19 species have mapped important populations within the nominated areas, of which the important populations identified for 13 species are not entirely included on excluded land. Of 13 species with important populations identified outside excluded land 11 have important populations represented (either wholly or partially) on land avoided for biodiversity purposes. It is important to note that in some cases, records that form part of the important population may be located across several land categories (urban capable land, excluded land, or avoided land).

The avoidance outcomes and extent of direct impacts under the Plan to each important population are further described in the assessments for each Commonwealth-listed species in Chapters 29 and 30. The location of each important population is also shown in the habitat maps for each species provided in those chapters.

Table 14-13: Summary of avoidance of important populations for Commonwealth-listed species

Scientific name	Important populations in nominated areas			Important populations avoided			Location of avoided population records
	Total number	Number in excluded lands	Number not including excluded lands	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
Acacia bynoeana	1	1	0	0	0	0	N/A
Allocasuarina glareicola	1	1	0	0	0	0	N/A
Anthochaera phrygia	1	1	0	0	0	0	N/A
Chalinolobus dwyeri^	1	1	1	0	0	0	N/A
Dasyurus maculatus maculatus^	2	1	1	1	0	1	Population 500 contains 4 records within and adjacent to GMAC. Of these, 1 record occurs within avoided lands in the east of GMAC
Genoplesium baueri	1	0	1	1	0	1	Population 21 contains 1 record within the Plan Area. The whole population occurs within avoided lands in the south-east of GMAC next to Appin Road
Grevillea parviflora subsp. *parviflora*^	4	2	2	2	0	2	Population 104 contains 13 records. Of these, 8 occur within avoided lands in the north-west of Wilton. Population 518 contains 1 record, and the entire population occurs within avoided lands in the north-west of Wilton
Lathamus discolor^	1	1	1	1	0	1	Population 186 is a single mapped important population across the Plan Area and surrounds. The population contains 266 records. Of these, 4 records occur within land avoided for biodiversity purposes within GPEC, GMAC and Wilton.
Litoria aurea^	3	2	2	1	0	1	Population 190 contains 6 records. Of these, 1 record occurs within avoided lands in the north of GPEC
Melaleuca deanei	1	1	0	0	0	0	N/A

Scientific name	Important populations in nominated areas			Important populations avoided			Location of avoided population records
	Total number	Number in excluded lands	Number not including excluded lands	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
Micromyrtus minutiflora	1	1	0	0	0	0	N/A
Persoonia bargoensis^	1	1	1	1	0	1	Population 114 contains 343 records within the southern part of the Plan Area and surrounds. Of these, 3 records occur within avoided lands in the north-west and east of Wilton
Persoonia nutans^	4	3	2	1	0	1	Population 60 contains 11 records and 1 record occurs within avoided lands in the east of WSA
Phascolarctos cinereus	1	1	1	1	1	1	Population 184 contains 895 records within and adjacent to the Plan Area, focused on the south-west corner of the Plan Area. Of these, 58 records occur within avoided lands along the eastern part of GMAC, east of Appin Road and 8 records are located on avoided land in Wilton
Pimelea spicata	7	5	2	1	0	1	Population 533 contains 2 records, with one of the records located within avoided lands on the edge of GMAC, east of Appin Road, and the other records located outside of the nominated area
Pomaderris brunnea	4	2	2	3	1	3	Population 586 contains 7 records. Of these, 3 records occur on avoided land in the centre of GMAC. Population 587 contains 2 records. The entire population occurs within avoided lands in the south-west of GMAC. Population 513 contains 15 records, of which four are avoided for biodiversity purposes and 11 are avoided for other purposes in GMAC
Pteropus poliocephalus^	1	1	1	1	1	1	Population 537 is a single population across the entire Plan Area and surrounds. 3 records occur within land avoided for biodiversity purposes and one record occurs within land avoided for other purposes.

Scientific name	Important populations in nominated areas			Important populations avoided			Location of avoided population records
	Total number	Number in excluded lands	Number not including excluded lands	Avoided for biodiversity purposes*	Avoided for other reasons	Total avoided	
Pultenaea parviflora	7	4	3	0	0	0	N/A
Rostratula australis	1	1	0	0	0	0	N/A

* As per BAM definition of avoidance

Not including excluded lands

AREAS IMPORTANT FOR CONNECTIVITY

Section 8.1.1.3(d) of the BAM specifies that the development should avoid areas important for maintaining habitat connectivity. BIO Map core areas and corridors (OEH, 2015) provide a surrogate measure of habitat connectivity and a useful approach to evaluating avoidance outcomes in terms of connectivity.

The purpose of BIO Map is to identify areas on the Cumberland subregion where investment in conservation actions will have maximum benefit. It is acknowledged that BIO Map is not intended to be used for land-use planning, as it does not identify all significant vegetation. However, BIO Map core areas represent the habitat most likely to support species persistence and the maintenance of interactions between species and landscape scale ecological processes, and BIO Map corridors play a crucial role in maintaining connectivity between species populations.

Table 14-14 and Table 14-15 set out the amounts of Bio Map core areas and corridors avoided in the nominated areas. The tables indicate that of the core areas and corridors within the nominated areas (not including excluded land):

- 68.8 per cent of core areas have been avoided for biodiversity purposes, and a total of 88.7 per cent has been avoided
- 54.6 per cent of corridors have been avoided for biodiversity purposes, and a total of 83.7 per cent has been avoided

In relation to Koala, all primary and secondary Koala corridors have been avoided in Wilton and GMAC. Following public exhibition, more land was avoided along the Nepean River in Wilton and the Nepean River and Menangle Creek in GMAC to protect the integrity and functionality of the Koala corridors in these areas, and to ensure that the corridors are on average 390-425 m wide (as recommended by the NSW Chief Scientist)

As described above in the section 'Native vegetation', avoidance outcomes of intact native vegetation for GPEC are lower than for other nominated areas. Despite this, it is considered that development under the Plan will generally avoid the areas that are most likely to be important for habitat connectivity within GPEC. The majority of BIO Map regional corridors/core areas have been avoided and will not be directly impacted. The main direct impacts occur:

- Within Wianamatta Regional Park where the OSO severs the eastern part of the regional park that is connected to Ropes Creek with the western part of the park
- Along Wianamatta (South Creek) where the OSO directly impacts the riparian corridor and severs the narrow connection along the corridor that links Wianamatta Regional Park and Orchard Hills

The other areas of potential habitat connectivity within GPEC comprise connected patches of vegetation (within 100 m of another patch) or isolated patches of vegetation (greater than 100 m from another patch) (there are no other areas of contiguous native vegetation forming habitat corridors outside Bio Map core areas/corridors). The development will result in the clearing of many small patches of connected vegetation, as well as the edges of several larger connected patches. This may reduce habitat connectivity across the area for more mobile species, such as bats and birds. Impacts to larger connected patches will reduce the size of the patches but will not generally sever connectivity between this connected vegetation and other areas of native vegetation, such as BIO Map corridors/core areas.

Table 14-14: Avoidance of areas important for habitat connectivity (BIO Map core areas)

Nominated area	Area of Bio Map core areas in nominated areas (ha)			Area of Bio Map core areas avoided in nominated areas (ha)			Per cent avoided# (%)
	Total area (ha)*	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes* (ha)	Avoided for other reasons (ha)	Total avoided (ha)	
Wilton	560.6	19.7	540.9	389.6	84.3	473.9	**87.6**
GMAC	1330.5	237.1	1093.4	780.8	252.8	1033.6	**94.5**
WSA	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
GPEC	2284.5	2207.9	76.7	7.1	2.3	9.4	**12.3**
Total	**4175.6**	**2464.6**	**1710.9**	**1177.6**	**339.4**	**1517.0**	**88.7**

* As per BAM definition of avoidance

Not including excluded lands

Table 14-15: Avoidance of areas important for habitat connectivity (BIO Map corridors)

Nominated area	Area of Bio Map corridors in nominated areas (ha)			Area of Bio Map corridors avoided in nominated areas (ha)			Per cent avoided# (%)
	Total area (ha)*	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes* (ha)	Avoided for other reasons (ha)	Total avoided (ha)	
Wilton	424.7	28.0	396.7	241.7	153.1	394.7	**99.5**
GMAC	484.4	226.1	258.3	218.5	38.8	257.3	**99.6**

Nominated area	Area of Bio Map corridors in nominated areas (ha)			Area of Bio Map corridors avoided in nominated areas (ha)			Per cent avoided# (%)
	Total area (ha)*	Area in excluded lands (ha)	Area not including excluded lands (ha)	Avoided for biodiversity purposes* (ha)	Avoided for other reasons (ha)	Total avoided (ha)	
WSA	317.6	53.6	264.0	114.4	97.2	211.7	**80.2**
GPEC	1027.9	852.6	175.4	22.9	29.9	52.8	**30.1**
Total	**2254.6**	**1160.3**	**1094.4**	**597.5**	**319.0**	**916.5**	**83.7**

* As per BAM definition of avoidance

Not including excluded lands

CONCLUSION

The avoidance and minimisation process described in Section 14.4.1 to design the urban and industrial development, intensive plant agriculture and infrastructure within urban capable land has led to substantial avoidance outcomes and is considered to be consistent with the guidance under the BAM and requirements of the ToR.

The avoidance process was detailed and robust and based on the best available data on biodiversity values. The urban capable land was located by establishing a planning process that took into account biodiversity values and prioritised the avoidance of high biodiversity values through a set of criteria.

Where biodiversity priorities were inconsistent with urban development priorities, the decision-making process sought to balance these priorities. This was achieved through negotiations on options between the Department's strategic assessment team and the Department's planning team to:

- Explain and justify urban development and avoidance priorities
- Explore alternative development locations to achieve the urban development priorities
- Make decisions on final urban capable land boundaries (see Box 2)

The process to avoid and minimise impacts has led to substantial avoidance outcomes for native vegetation, high (intact) condition native vegetation, the majority of Commonwealth-listed and NSW-listed TECs, including the most endangered TECs and potential habitat for species with a very high and high biodiversity risk weighting (>3). Within the nominated areas, total avoidance for biodiversity and other purposes (not including excluded lands) includes:

- Approximately 67.2 per cent of all native vegetation, including 95.2 per cent of intact condition vegetation
- Approximately 83.3 per cent of critically endangered and endangered Commonwealth-listed TECs and 62.1 per cent of critically endangered and endangered NSW-listed TECs
- An average of 69.9 per cent of potential habitat for four species with a very high biodiversity risk weighting (>3), and an average of 77.1 per cent of potential habitat for 31 species with a high biodiversity risk weighting (≥2)
- Of 13 species with important populations identified outside excluded land 11 have important populations represented (either wholly or partially) on land avoided for biodiversity purposes
- Approximately 88.7 per cent of Bio Map core areas and 83.7 per cent of Bio Map corridors

The avoidance outcomes of the Plan are supported by several commitments that ensure:

- The amount of avoidance to be achieved under the Plan is certain – the Plan commits to avoiding 4,795 hectares of high biodiversity value areas within avoided land
- Avoided land is protected and the impacts of any future urban development proposed on avoided land is minimised through development controls under the SEPP (Strategic Conservation Planning) and the preparation of a Ministerial Direction under section 9.1 of the EP&A Act
- Asset protection zones will be located wholly within certified - urban capable land
- The impacts of any proposed development on avoided land will be monitored

14.5.2 MAJOR TRANSPORT CORRIDORS

Avoidance and minimisation of impacts from the major transport corridors is being undertaken in two stages:

- Strategic planning to determine the locations of the major transport corridors
- Future detailed design to determine the location of the infrastructure within the transport corridor footprint

The strategic planning process to determine the location of the major transport corridors is considered to have resulted in adequate avoidance and minimisation outcomes. The process involved a detailed set of steps that considered environmental constraints, including biodiversity values, alongside other infrastructure, social and economic outcomes to balance overall planning outcomes. In making decisions on corridor selection, infrastructure agencies undertake a constraints analysis and multi-criteria comparison of options. Key factors considered included:

- Proximity to current and planned locations of employment
- The cost of infrastructure provision including roads, water, sewerage, public transport, schools, and health facilities
- The economic and social cost to communities of having poor access to employment and services, including transport

- Environmental constraints, including biodiversity values

In some cases, infrastructure, social and economic considerations outweighed biodiversity considerations, including in relation to the location of the OSO through Wianamatta Regional Park. It is important to note that this decision was undertaken in close consultation with EES.

Commitment 3 and Commitment 4 will ensure the future detailed design to determine the location of the infrastructure within the transport corridors will lead to additional avoidance and minimisation outcomes for biodiversity values. These commitments are considered adequate to ensure the corridors avoid and minimise the risk of unacceptable impacts on biodiversity values. These commitments will ensure:

- For the major transport corridors (strategically assessed only) outside the nominated areas, impacts are avoided and minimised in accordance with the NSW State Significant Infrastructure (or equivalent) approvals process and BAM under the BC Act (or equivalent). The assessment process is considered to be robust as it will be undertaken under NSW planning and assessment laws current at the time the development is proposed
- Avoidance outcomes are achieved consistent with the Plan's 'avoidance criteria' (see Box 1) or are assessed and determined in accordance with the BAM (for the major transport corridors outside the nominated areas)
- Impacts to known key biodiversity values within the corridors are avoided and minimised where possible, including specific species and habitat, and/or specific locations of high biodiversity value
- Avoidance of biodiversity values as well as the costs of offsets is taken into account in the evaluation of the route options (e.g. multi-criteria analysis) during the planning phase of each project
- Governance arrangements are in place to ensure avoidance outcomes achieved and the residual impacts of the infrastructure within the transport corridor footprints are reported transparently to DPIE

14.5.3 ESSENTIAL INFRASTRUCTURE

A description of the avoidance requirements and process for essential infrastructure is provided in Chapter 37. A summary of the avoidance outcomes for essential infrastructure is provided below.

The guidelines for essential infrastructure development in Appendix A of the Plan and commitments under the Plan (Commitment 2.1 and 2.2) are considered adequate to ensure essential infrastructure avoids and minimises unacceptable impacts on biodiversity values in avoided land. These requirements will ensure:

- Only a limited amount of essential infrastructure development can occur within avoided land
- Each essential infrastructure project must consider environmental impacts under the EP&A Act, and apply an 'avoid, minimise and mitigate' process to strategic planning and detailed design
- The cumulative direct impacts to TECs identified at risk of impacts in the Assessment Report (see Chapter 37) are capped within each nominated area to levels that are considered acceptable
- Avoidance and minimisation of impacts to populations of species identified at risk of impacts in the Assessment Report (see Chapter 37) is given high priority
- Governance arrangements are in place to ensure the Department can appropriately monitor the outcomes

Furthermore, the impacts of each project will be assessed under the BC Act and BAM (where triggered under the Act), which requires an avoid, mitigate, and offset process to be applied to ensure outcomes are acceptable.

15 Managing indirect impacts

15.1 INTRODUCTION

The BAM and the Commonwealth ToR require indirect impacts to be identified and assessed.

Indirect impacts are any impacts that could adversely affect biodiversity values, such as native vegetation, TECs and threatened species habitat, beyond the urban capable land. Indirect impacts may also result from changes to land-use patterns, such as an increase in vehicular access and human activity.

This Chapter:

- Sets out the regulatory requirements for managing indirect impacts under the BAM and ToR
- Describes the approach applied to identify and assess indirect impacts
- Describes the indirect impacts relevant to the Plan, including their nature, extent, and duration
- Identifies the threatened species and TECs at risk of indirect impacts
- Describes the general mitigation measures and processes that will be implemented to address each indirect impact
- Assesses the potential indirect impacts on each species and TEC taking into account the general mitigation measures that will be implemented under the Plan, and identifies whether there are any residual indirect impacts
- Describes any additional species or TEC specific mitigation measures to address any residual indirect impacts
- Identifies the threat abatement plans under the EPBC Act relevant to the Plan and how they relate to the Plan

This Chapter also covers the assessment of indirect impacts on NSW-listed TECs and species as required under the BAM.

Detailed assessments of the potential indirect impacts on each Commonwealth-listed TEC and species, as well as other EPBC Act protected matters, are presented in the following chapters:

- Chapter 29 – Commonwealth-listed flora
- Chapter 30 – Commonwealth-listed fauna
- Chapter 31 – Commonwealth-listed TECs
- Chapter 32 – Migratory species
- Chapter 33 – Ramsar wetlands
- Chapter 34 – World and National Heritage
- Chapter 35 – Commonwealth Land

15.2 REGULATORY REQUIREMENTS

15.2.1 BC ACT REQUIREMENTS

Section 9 of the BAM requires the Assessment Report to assess the potential indirect impacts of the Plan on biodiversity values. The Assessment Report must:

- Describe the nature, extent, and duration of short-term and long-term impacts
- Identify the species and TECs likely to be affected
- Predict the consequences of the impacts for the bioregional persistence of the species and TECs
- Document mitigation measures proposed to manage impacts
- Identify any measures for which there is risk of failure
- Evaluate the risk and consequence of any residual impacts likely to remain after mitigation measures are applied
- Document any adaptive management strategy that is proposed (this is described in Chapter 16)

15.2.2 EPBC ACT REQUIREMENTS

Section 4.5 of the Commonwealth ToR requires the Assessment Report to consider potential indirect impacts on MNES and describe what mitigation will be implemented to reduce indirect impacts.

Section 5.3 of the ToR requires the Assessment Report to consider the likely effectiveness of the conservation measures under the Plan in protecting and managing MNES and any related risks and uncertainties.

15.3 APPROACH TO THE ASSESSMENT

The steps taken to assess indirect impacts involved:

Step 1: Identify the range of indirect impact types associated with the development and describe the nature, extent, and duration of each indirect impact type. This involved:

- Nature of impacts – qualitatively describe each indirect impact type, including cause and scope of the impact
- Extent of impacts – identify the general location and extent of indirect impacts
- Duration – identify whether the impacts are short-term or long-term

Step 2: Identify the species and TECs likely to be affected by each indirect impact within each nominated area and the transport corridors. All indirect impact types identified through Step 1 were considered. The relevance of an indirect impact type was determined by drawing on ecological and life history information in BioNet profiles, conservation advices, recovery plans, as well as species records and habitat maps prepared for this Assessment Report

Step 3: Describe the general mitigation measures and processes that will be implemented to mitigate indirect impacts

Step 4: Assess the potential indirect impacts on each species and TEC and identify any potential residual impacts. This was done taking into account:

- Likely presence/abundance of species/TEC and importance of the location at a local and regional scale
- Life history traits and susceptibility of the species/TEC to the indirect impact
- Location of the species/TEC relative to the likely extent of the indirect impact
- Amount and quality of un-impacted habitat remaining
- Levels of existing protection
- The effectiveness of the general mitigation measures and processes described through step 3

Step 5: Describe any additional specific mitigation measures needed to address potential residual indirect impacts identified through step 4 to particular species or TECs

15.4 NATURE, EXTENT AND DURATION OF INDIRECT IMPACTS

15.4.1 SUMMARY OF DEVELOPMENT UNDER THE PLAN

The types of development under the Plan that have the potential to cause indirect impacts on biodiversity values are described in detail in Part 2 and include:

- Urban and industrial development in the nominated areas
- Infrastructure in the nominated areas
- Intensive plant agriculture in the Agribusiness precinct in Western Sydney Aerotropolis
- Major transport corridors

URBAN AND INDUSTRIAL DEVELOPMENT

Urban and industrial development will occur within the urban capable land in the nominated areas. This development may include:

- Mixed residential, commercial, and industrial development
- Major town centres with a full range of shops, and public and private recreational facilities and services

- Social infrastructure such as education facilities, cultural facilities, childcare services, sports facilities, entertainment facilities, places of public worship, libraries, and community centres
- Essential services such as health facilities and emergency services facilities
- General industrial facilities such as retail outlets, manufacturing industries, training facilities, information and technology facilities, light industries, high-tech industries, material supply centres and distribution centres
- Supporting infrastructure for parks and public reserves (environmental facility, information and education facility, kiosk, recreation area, recreation facilities (outdoor), water recreation structure)
- Agribusiness, including businesses associated with the production, processing, marketing, and distribution of agricultural products
- Wholesale markets, including retail, accommodation, and large distribution centres, trading floor and associated infrastructure such as cold stores, ripening rooms, treatment facilities and waste management
- Advanced food manufacturing and logistics
- Warehouse, freight and logistics, including distribution centres, freight transport facilities and heavy industrial storage establishments and storage premises
- Airport and ancillary uses to support the delivery and operation of the new airport

INFRASTRUCTURE

Infrastructure development will predominantly be located within urban capable land and may include:

- Electricity transmission or distribution networks
- Gas pipelines
- Road or road infrastructure facilities, including public transport facilities
- Railways and rail infrastructure facilities
- Water reticulation systems, water storage facilities, water treatment facilities, or a water supply system
- Telecommunications facilities or telecommunication network
- Stormwater management system
- Resource recovery facility, waste disposal facility, waste or resource management facility and waste or resource transfer station
- Organic waste and composting facilities
- Koala exclusion fencing as described in the Strategic Conservation Planning SEPP
- Fauna crossings as described in the Strategic Conservation Planning SEPP.

INTENSIVE PLANT AGRICULTURE IN THE AGRIBUSINESS PRECINCT

The Agribusiness Precinct in WSA will provide for the movement and storage of agricultural commodities at the northern and western edges of the Western Sydney International (Nancy-Bird Walton) Airport. Development in this area may include the following:

- Intensive plant agriculture, including protective cropping structures used primarily for horticultural applications to control specific environmental conditions and facilitate high-quality, high-quantity production of a defined fruit, vegetable, or flower. Note: turf farms are prohibited under the Aerotropolis SEPP
- The cultivation of irrigated crops for commercial purposes (other than irrigated pasture or fodder crops)
- Horticulture and viticulture

MAJOR TRANSPORT CORRIDORS

Transport development includes all activities associated with the design, construction, and operation of major infrastructure corridors. These activities include, but are not limited to:

- Vegetation clearing
- Earthworks
- Utility works
- Landscaping

- Erosion and sediment control
- Laydown areas
- Road and rail construction
- Tunnel construction
- Construction of supporting infrastructure such as stations, car parks and pedestrian access
- Electricity infrastructure
- Site offices and access roads
- Dust and noise suppression
- Stormwater management (including detention basins, ponds, and dams)
- Vehicle and train movements
- Maintenance and upgrade activities
- Installation and maintenance of traffic control and safety infrastructure

15.4.2 IMPACTS ASSOCIATED WITH EACH DEVELOPMENT TYPE

Table 15-1 identifies each indirect impact type associated with each type of development under the Plan, and the nature, extent, and duration of the indirect impacts.

The nature, extent and duration of the impacts are described broadly. Due to the large scale of the development and the staging of construction precinct by precinct over the life of the Plan, it is not possible to be specific about the nature and extent of impacts in relation to specific vegetation zones at any particular location, or the exact timing of the development at any particular location. The approach taken is considered appropriate for assessment at a strategic scale.

The nature of each indirect impact type is described in more detail in Sections 15.4.3 to 15.4.12.

Table 15-1: Indirect impact types and nature, extent and duration of indirect impacts associated with the Plan

Indirect impact type	Development types relevant to the indirect impact				Nature of indirect impact	Extent/general location of indirect impact and/or high-risk areas	Duration of indirect impact
	Urban and industrial	Infrastructure	Intensive plant agriculture	Transport corridors			
Hydrological/ soil disturbance	✓	✓	✓	✓	Changes to surface water and groundwater flows and water quality due to development and infrastructure disrupting natural flows; the introduction of pollutants particularly associated with urban/agriculture; and soil erosion/disturbance associated with all development types	Waterways, wetlands, flood-prone areas within or downstream of development	Short term to long-term
Ground settling or subsidence				✓	Settlement/subsidence of ground in the vicinity of transport tunnels due to the tunnel void or groundwater removal, which may cause disturbance to the land surface	Land within or in vicinity of the transport tunnels	Long-term
Spread of infection/disease	✓	✓	✓	✓	Spread of pathogens from contaminated clothing and equipment or surface water runoff	Native vegetation and habitat retained within or adjacent to development	Likely long-term
Spread of weeds	✓	✓	✓	✓	Spread of invasive species due to edge effects, surface water run-off, or changed fire regimes	Native vegetation and habitat retained within or adjacent to development	Likely long-term
Predation/ competition by pest/domestic fauna	✓	✓	✓	✓	Increased predation and competition of species by pest/domestic fauna	Habitat retained within or adjacent to development including well-connected habitat corridors	Likely long-term

Indirect impact type	Development types relevant to the indirect impact				Nature of indirect impact	Extent/general location of indirect impact and/or high-risk areas	Duration of indirect impact
	Urban and industrial	Infrastructure	Intensive plant agriculture	Transport corridors			
Altered fire regimes	✓	✓	✓	✓	Altered fire regimes as a result of increased burns for asset protection, reduced ability to burn due to risk to surrounding urban areas or increased risk of unmanaged fires or accidental fires	Native vegetation and habitat retained within or immediately adjacent to development, particularly asset protection zones	Long-term
Disturbance from increased public access to natural areas	✓	✓			Trampling of species or habitat, removal of wood or bush rock, damage from mountain-biking and four-wheel driving	Publicly accessible natural areas retained within or immediately adjacent to development	Short term to permanent
Fauna mortality, displacement, and barriers to movement	✓	✓	✓	✓	Potential for mortality of threatened fauna species by vehicle strike and reduced movement and connectivity between habitat areas due to the introduction of new barriers	Habitat intersected by development that poses a barrier to movement or accessibility	Long-term
Fauna disturbance due to noise, dust, or light	✓	✓	✓	✓	Noise, dust, or light created by equipment during construction or by new structures or activities during operation	Habitat retained within or adjacent to development	Short-term to long-term
Inadvertent impacts on adjacent habitat or vegetation	✓	✓	✓	✓	Damage to adjacent habitat during construction activities or during ongoing management and use	Native vegetation and habitat immediately adjacent to development	Short-term to long-term

15.4.3 HYDROLOGICAL/SOIL DISTURBANCE

REDUCTION IN SURFACE WATER QUALITY AND CHANGES TO SURFACE WATER FLOWS

Development under the Plan may lead to changes to hydrology and water quality. This is primarily related to:

- Disruption to natural flows and processes
- New irrigation schemes and construction of dams for agricultural purposes
- Increase of hard surfaces leading to an increased volume of water entering downstream waterways
- Introduction of contaminants into surface water, such as nutrients, chemicals, and sediment from urban, agriculture and other development and land uses, including disturbance of soils/contaminated soils during construction

Changes to surface water quality and hydrology can impact a range of listed species and TECs. Species that rely on aquatic environments such as swamps and riparian corridors are particularly at risk from these types of impacts.

CHANGES TO GROUNDWATER

Development under the Plan may affect groundwater quality, including from salinity and contamination. This is primarily related to:

- Clearing for construction
- Construction works involving large excavations
- Use of groundwater for agricultural purposes
- Dewatering or structures buried below the water table, including groundwater removal from the tunnel voids associated with the transport corridor tunnels
- Diversion of surface water, including installation of buildings and hard surfaces

Changes to groundwater can affect groundwater-sensitive species and habitats and dependent ecosystems.

SOIL DISTURBANCE

Development under the Plan may cause soil erosion and sedimentation and disturbance to contaminated soils, which can lead to changes in water quality. This is primarily related to:

- Vegetation clearing for construction or planting
- Construction works involving large excavations
- The management of spoil during construction, particularly for the construction of the transport corridor tunnels

15.4.4 GROUND SETTLEMENT/SUBSIDENCE

Construction of the transport corridor tunnels involves the creation of a tunnel void and removal of groundwater from the void. This may cause ground settlement and subsidence to the land surface above and in the vicinity of the tunnel, causing disturbance to any biodiversity or other values in the affected area.

15.4.5 SPREAD OF INFECTION/DISEASE

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

Spread of infection/disease can affect species and have associated impacts on TECs.

Key threatening processes listed under the BC Act and EPBC Act relevant to this indirect impact type are:

- Infection of amphibians with chytrid fungus resulting in chytridiomycosis (EPBC Act)/infection of frogs by amphibian chytrid causing the disease chytridiomycosis (BC Act)

- Infection and dieback caused by the root-rot fungus *Phytophthora cinnamomi* (EPBC Act)/infection of native plants by *Phytophthora cinnamomi* (BC Act)
- Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales pathogenic* on plants of the family *Myrtaceae* (BC Act)
- Novel biota and their impact on biodiversity (EPBC Act)
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species (EPBC Act/BC Act)

15.4.6 SPREAD OF WEEDS

Development under the Plan has the potential to increase the spread of invasive species and weeds. This is primarily related to:

- New environmental conditions at the edges of developments such as altered light levels, windspeed, and temperature, that may facilitate the spread of weeds
- Use of inappropriate species in landscaping and revegetation
- Accidental dispersal of weed seeds and plant material
- Altered fire regimes

Species are most susceptible to this threat where new urban growth or transport corridors occur adjacent to known populations or habitat. Weeds can reduce the viability of adjacent habitat or vegetation for listed species and TECs and can reduce the health of important habitat features. Invasive species of particular concern are:

- African lovegrass (*Eragrostis curvula*)
- African olive (*Olea europaea* subsp. *cuspidata*)
- Asparagus fern (*Asparagus aethiopicus*)
- Black nightshade (*Solanum nigrum)*
- Bridal creeper (*Asparagus asparagoides*)
- Buffalo grass (*Stenotaphrum secundatum*)
- Castor-oil plant (*Ricinus communis*)
- Coolatai Grass (*Hyparrhenia hirta*)
- Kikuyu grass (*Cenchrus clandestinus*)
- Lantana (*Lantana camara*)
- Long-leaf willow primrose (*Ludwigia longifolia*)
- Rhodes grass (*Chloris gayana*)
- Whisky grass (*Andropogon virginicus*)

Key threatening processes listed under the BC Act and EPBC Act relevant to this indirect impact type are:

- Invasion and establishment of exotic vines and scramblers (BC Act)
- Invasion, establishment and spread of Lantana (*Lantana camara*) (BC Act)
- Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (BC Act)
- Invasion of native plant communities by exotic perennial grasses (BC Act)
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants (EPBC Act/BC Act)
- Novel biota and their impact on biodiversity (EPBC Act)

15.4.7 PREDATION/COMPETITION/LAND DEGRADATION BY PEST/DOMESTIC FAUNA

Development under the Plan has the potential to increase the spread of pest fauna and/or access to natural areas by domestic fauna, leading to increased predation and competition with native fauna. This is primarily related to:

- Clearing that creates new movement pathways that can be used by pest fauna to expand their range
- Clearing that changes conditions at the edges of habitat that favour pest fauna
- Direct predation of native fauna by pest/domestic fauna
- Pest fauna destroying habitat and spreading disease

Domestic animals in this context are primarily related to increased numbers of cats, dogs and rabbits.

Key threatening processes listed under the BC Act and EPBC Act relevant to this indirect impact type are:

- Aggressive exclusion of birds from potential woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala* (EPBC Act/BC Act)
- Competition and land degradation by rabbits (EPBC Act)/Competition and grazing by European rabbit (BC Act)
- Competition and land degradation by unmanaged goats (EPBC Act)/Competition and habitat degradation by Feral Goats, *Capra hircus* (BC Act)
- Competition from feral honeybees (EPBC Act/BC Act)
- Herbivory and environmental degradation caused by feral deer (BC Act)
- Predation and hybridisation by Feral Dogs, *Canis lupus familiaris* (BC Act)
- Predation by feral cats (EPBC Act/BC Act)
- Predation by the European red fox (EPBC Act/BC Act)
- Predation by the plague minnow (*Gambusia holbrooki*) (BC Act)
- Predation, habitat degradation, competition, and disease transmission by feral pigs (*Sus scrofa*) (EPBC Act/BC Act)
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Rhinella marina*) (EPBC Act)/Invasion and establishment of the Cane Toad (*Rhinella marina*) (BC Act)

15.4.8 ALTERED FIRE REGIMES AND INCREASED FIRE RISK

Development under the Plan has the potential to alter fire regimes and increase fire risk. This is primarily related to:

- Arson or the accidental lighting of fires
- Increased burns for hazard reduction to protect assets, particularly within Asset Protect Zones
- Reduced burns in some areas due to risk to urban areas

Changed fire regimes can reduce habitat suitability for TECs and threatened species, affect foraging resources, and prey species, and cause direct mortality from heat and smoke.

The key threatening process listed under the BC Act relevant to this indirect impact type is:

- Ecological consequences of high frequency fires (BC Act)

15.4.9 DISTURBANCE FROM INCREASED PUBLIC ACCESS TO NATURAL HABITAT AREAS

Development under the Plan will increase human activity in the vicinity of the nominated areas, which can impact avoided lands, conservation lands secured under the Plan and existing reserves. This is primarily related to:

- Trampling of threatened flora species/habitat for threatened fauna species
- Track creation
- Bush rock removal and disturbance
- Rubbish dumping and disturbance from associated clean-up activities
- Timber collection, removal of dead wood
- Illegal collection of threatened species
- Dog walking
- Recreational activities such as mountain-biking, four-wheel driving, and fishing

Species and TECs most at risk from this threat occur on public land because these areas are publicly accessible.

Key threatening processes listed under the BC Act relevant to this indirect impact type are:

- Bushrock removal (BC Act)
- Removal of dead wood and dead trees (BC Act)

15.4.10 FAUNA MORTALITY AND INJURY, FAUNA DISPLACEMENT AND THE INTRODUCTION OF BARRIERS TO FAUNA MOVEMENT

Development under the Plan may increase the likelihood of fauna mortality and fauna displacement and will introduce barriers to fauna movement. This is primarily related to:

- Direct mortality as a result of collisions with vehicles or new structures, shooting, poaching, or secondary poisoning during pest control
- Displacement due to clearing for the development
- Introduction of linear barriers such as fences, roads, and railways, which can affect fauna movement and predation

Koala, birds, invertebrates, and arboreal mammals are particularly susceptible to these impacts.

15.4.11 FAUNA DISTURBANCE DUE TO NOISE, DUST OR LIGHT

Development under the Plan will increase noise, dust, and light. This is primarily related to:

- Clearing for the development
- Construction activities, including use of heavy vehicles and machinery
- Increased noise levels from traffic due to new roads or increased traffic on existing roads
- Artificial light from urban and commercial areas, and along transport routes

Increased noise can particularly impact on species that vocalise or rely on hearing for hunting or breeding. Artificial light can affect the behaviour of nocturnal and diurnal species, including disorientation, attraction to light sources resulting in collisions and mortality, and effects on light-sensitive life cycles (e.g. flowering, breeding, and migration). Increased light can also influence the abundance, behaviour, and movement of some predator species.

15.4.12 INADVERTENT IMPACTS ON ADJACENT HABITAT OR VEGETATION

Development under the Plan may cause inadvertent impacts on adjacent habitat, vegetation, or important habitat features, such as hollow bearing trees. This could occur during construction or operation and is primarily related to:

- Impacts adjacent to construction sites
- Road, trail, and power line maintenance
- High frequency land management such as mowing and slashing or weed control

This can affect threatened species' habitat which is close to urban capable land and transport corridors.

15.5 SPECIES AND TECS LIKELY TO BE AFFECTED BY INDIRECT IMPACTS

Attachment A identifies the NSW-listed threatened species and TECs potentially impacted by each indirect impact. Indirect impacts were identified as being relevant to a species or TEC if:

- The indirect impact is identified as a threat in a relevant profile, conservation advice or recovery plan, *and*
- The threat is present in the Cumberland subregion, *and/or*
- The Plan has the potential to introduce or exacerbate the threat in a way that may affect the known occurrence of a species, TEC, or associated habitat

Relevant indirect impacts were identified by drawing on distribution, ecological and life history information in BioNet and other species profiles, conservation advices, and recovery plans, and species records and habitat maps prepared for this Assessment Report.

Note that ground settlement and subsidence is only relevant under the Plan to several species and TECs that occur in the vicinity of the transport corridor tunnels. The indirect impacts of the tunnels on these matters are assessed in Chapter 36.

Identification of the potential indirect impacts relevant to Commonwealth-listed TEC and species, as well as other EPBC Act protected matters, are presented in the following detailed assessment chapters:

- Chapter 29 – Commonwealth-listed flora

- Chapter 30 – Commonwealth-listed fauna
- Chapter 31 – Commonwealth-listed TECs
- Chapter 32 – Migratory species
- Chapter 33 – Ramsar wetlands
- Chapter 34 – World and National Heritage
- Chapter 35 – Commonwealth Land

15.6 GENERAL MITIGATION MEASURES AND IMPLEMENTATION PROCESSES

This section:

- Describes the relevant commitments and actions under the Plan to mitigate indirect impacts for each of the different types of development, as well as specifically for Koala
- Describes the processes to implement the mitigation measures for each of the different types of development
- For the urban and industrial development and intensive plant agriculture, identifies a set of 'general mitigation measures' that will be implemented to mitigate indirect impacts

The Plan includes commitments to mitigate the indirect impacts of the urban, industrial, infrastructure, intensive plant agriculture and transport development on biodiversity values and other protected matters. The processes to implement the mitigation measures are different for the types of development under the Plan:

- For the urban and industrial development and intensive plant agriculture, mitigation measures will be implemented through the precinct planning and development application process under the NSW planning system
- For infrastructure development and the major transport corridors, mitigation measures will be implemented through future environmental assessment and approval processes applied at the time of the development

These different implementation processes are described in section 15.6.1, section 15.6.2 and section 15.6.3.

15.6.1 MITIGATION OF URBAN AND INDUSTRIAL DEVELOPMENT AND INTENSIVE PLANT AGRICULTURE

COMMITMENTS AND ACTIONS

The Plan includes a commitment to mitigate indirect and prescribed impacts from urban and industrial development and intensive plant agriculture on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan (Commitment 5).

Note Commitment 5 also applies to infrastructure, but the commitment is implemented differently for this type of development, and this is discussed in section 15.6.2.

The key actions under Commitment 5 to implement the mitigation measures for urban and industrial development and intensive plant agriculture are set out in Table 15-2.

Table 15-2: Actions to mitigate indirect impacts for urban and industrial development and intensive plant agriculture

Implementation mechanism or process	Actions under Commitment 5 to mitigate indirect impacts
Development Control Plans (DCPs), implemented through development application process under EP&A Act	1. Incorporate development controls in the State-led DCPs for each nominated area setting out development controls that need to be addressed by neighbourhood plans and development applications to mitigate indirect and prescribed impacts on threatened species. This includes: a. Specific controls that apply to the nominated areas to mitigate indirect and prescribed impacts on specific threatened species or ecological communities or other environmentally sensitive areas in accordance with Appendix E of the Plan

Implementation mechanism or process	Actions under Commitment 5 to mitigate indirect impacts
	b. A common set of development controls to mitigate indirect and prescribed impacts across the four nominated areas that inform general biodiversity protection as listed in Chapter 15 of the Assessment Report [see Table 15-4 to Table 15-13] 2. Work with local councils to incorporate development controls in relevant council-based DCPs for the nominated areas 3. Provide ongoing support to local councils in the application of DCP controls within the nominated areas, including the sharing of knowledge, maps and data 4. Audit DCPs to ensure the Cumberland Plain Conservation Plan DCP Template development controls are incorporated in accordance with the DCP requirements for each nominated area 5. Monitor the implementation of development controls through approval conditions by the relevant consent authority. If monitoring finds that controls are not being implemented, review and redraft new controls to update relevant State DCPs and re-educate councils to ensure stronger consideration of the controls through their assessment process

IMPLEMENTATION PROCESS FOR MITIGATION MEASURES

The key mechanism to implement mitigation measures to address the indirect impacts of the urban and industrial development and intensive plant agriculture on biodiversity values is Development Control Plans (DCPs).

DCPs will be prepared for each nominated area and will set out development controls to address indirect impacts. The development controls in DCPs will be implemented through the standard development application process under the EP&A Act that occurs prior to urban and industrial development and intensive plant agriculture proceeding.

DCPs will incorporate the following types of development controls:

- Development controls identified in the Plan and this Assessment Report, including:
  - Common set of controls that apply across the nominated areas that inform general biodiversity protection. These controls are commonly implemented by planning authorities to manage indirect impacts through the development application process. These are identified in Table 15-4 to Table 15-13
  - Specific controls that apply to specific species and TECs in certain locations. These controls have been identified through this Assessment Report and are needed to address the residual risks that remain after the common set of controls are applied. These are identified in Appendix E of the Plan and section 15.8 of this Assessment Report
- A broader set of development controls that address indirect impacts on environmental values generally. These controls are commonly implemented by planning authorities through the development application process to manage indirect impacts on environmental values generally, such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise, and traffic

Development Control Plans

What is the legal framework for DCPs?

DCPs are non-legally binding planning policies that provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act.

Section 3.46 of the EPA Act provides that the purpose of a DCP is to:

- Give effect to the aims of any environmental planning instrument that applies to the development
- Facilitate development that is permissible under any such instrument
- Achieving the objectives of land zones under any such instrument

A DCP provides detailed guidelines and environmental standards for new development. DCPs are used by councils in the assessment of development applications. When designing development proposals, applicants need to address the relevant requirements of any DCPs which apply to their land or proposal.

Any development assessed under Part 4 of the EP&A Act must consider the relevant DCP.

Who prepares the DCP?

A DCP will be prepared for each nominated area. DCPs will be prepared either by the Department (in the case of Department led precincts) or by the relevant councils in collaboration with the Department.

Council will lead the preparation of DCPs for GMAC and GPEC.

What is the process for preparing the DCP?

DCPs will be prepared in accordance with:

- A DCP template prepared by the Department to support implementation of the Plan – this is described below (see under section 'Implementation of mitigation measures for biodiversity values identified in the Plan')
- Standard format for DCPs and a set of model provisions that apply across NSW
- Any processes and guidelines for preparing DCPs specific to each Council
- Current best practice standards, guidelines or targets (e.g. water quality standards for urban runoff)

Draft DCPs must be exhibited for public consultation, whether prepared by the council or the Department. This provides an opportunity for stakeholders to raise issues and improve the DCP.

DCPs will be reviewed in five-year intervals and updated if necessary. This process allows new development controls to be incorporated into the DCP or controls to be amended to ensure they meet best practice standards.

How will the controls in the DCP be implemented?

Councils will be responsible for imposing conditions on developers requiring the implementation of development controls under the DCP through the development application process.

The Department will work with councils to ensure appropriate conditions are incorporated within each subdivision plan and development approval to support the implementation of the mitigation measures.

What assurance measures are in place to ensure mitigation measures are implemented and risks of failure addressed?

The Plan puts in place several assurance measures to ensure implementation of mitigation measures occurs consistent with the Plan and to address any uncertainty or risks of failure. These measures include:

- Monitoring the implementation of the development controls through approval conditions by councils. If monitoring finds that development controls are not being implemented, the Department will review and redraft new controls to update relevant State DCPs or re-educate councils to ensure stronger consideration of the controls through the development application process (see Commitment 5, Action 4)
- Implementing an evaluation program (Commitment 25) that will monitor and report and evaluate the delivery of commitments and actions. This provides a process to ensure the commitment to mitigate indirect and prescribed impacts (Commitment 5) is achieved and actions and processes are adjusted, if necessary, through adaptive management processes (see Chapter 9 and Chapter 16)

Who will ensure compliance?

The NSW planning system provides an existing compliance framework under which planning authorities can take action under the EP&A Act to ensure compliance with the Plan's requirements for addressing indirect impacts. This allows planning authorities to enforce development controls in the DCP template that are incorporated as conditions of consent by planning authorities through the development application process.

The Plan also commits to implementing a compliance program (Commitment 26) to ensure compliance with the requirements of the Plan and conditions of approval (see Chapter 9). As part of this, a compliance strategy will be

prepared. This provides a process to ensure procedures and roles and responsibilities for compliance action in relation to implementation of development controls is clear and co-ordinated across planning authorities.

The Plan will also fund six full-time compliance officers to work with local councils to carry out compliance activities in the Plan Area, and includes additional actions to:

- Share knowledge, maps and data and provide ongoing support and training to council staff to assist councils with carrying out implementation and compliance activities
- Publish a compliance report as part of the yearly update on implementation of the Plan and provide to local councils for review and investigation
- Prepare reports at least every two years on any identified breaches with Plan commitments and approval conditions, such as auditing development consent conditions

Implementation of mitigation measures for biodiversity values identified in the Plan

The assessment of the indirect impacts led to the identification of a common set of development controls (identified in Table 15-4 to Table 15-13) and a specific set of development controls (identified in Appendix E of the Plan and section 15.8 to address residual impacts) that are needed to address indirect impacts on biodiversity values.

DCP template

The Department has prepared a DCP template that provides model provisions to help ensure the mitigation measures identified in the Plan are incorporated into DCPs and applied consistently across the nominated areas.

The DCP template includes both the:

- Common set of controls identified in Table 15-4 to Table 15-13
- Specific controls identified in Appendix E of the Plan and section 15.8

The Department will incorporate the development controls in the DCP template into Department led DCPs. For GMAC and GPEC that do not have a Department-led DCP in place, the Department has prepared the *Cumberland Plain Conservation Plan Mitigation Measures Guidelines* (Mitigation Measures Guidelines). The Mitigation Measures Guidelines apply the same mitigation measures that would otherwise be implemented through Department-led DCPs in accordance with Appendix E of the Plan. The guidelines do not include the common set of controls included in the DCP template.

Implementation of the development controls in the DCP template and Mitigation Measures Guidelines requires planning authorities to make decisions around the circumstances, design specifics and exact locations where the controls should be applied. This is appropriate due to the scale of the development under the Plan and the long timeframe over which it will be implemented.

The Department will support councils to make these decisions (see Commitment 5, Action 3) through providing information in the Assessment Report on the risks of indirect impacts to specific species and TECs and locations, data on biodiversity values collected as part of this Assessment Report, guidance on best practice standards, and specific advice related to Koala mitigation through the Koala working group (see section 15.6.4).

The Department will also audit the DCP prepared by councils to ensure the controls in the DCP template and Mitigation Measures Guidelines are incorporated in accordance with the Plan's requirements (see Commitment 5, Action 5).

Implementation of mitigation measures for broader environmental values

Planning authorities typically incorporate a range of controls in DCPs that are broader in scope to those identified in Table 15-4 to Table 15-13 to manage the indirect impacts of development on broader environmental values, such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

Examples of these types of controls included in the draft Wilton DCP are provided in Table 15-3.

These controls are not identified in the DCP template as it is standard practice to incorporate these sorts of controls into DCPs across NSW to manage the impacts of development on the environment.

Councils will be responsible for making decisions about the specifics of these controls in each DCP and through the development application process based on best practice standards and guidelines.

This Assessment Report assumes these types of controls will be incorporated into each DCP for each nominated area where planning authorities consider these necessary. These controls will be important to manage the indirect impacts of the urban and industrial development and intensive plant agriculture on biodiversity values within the nominated areas and downstream and outside of the nominated areas, including the Towra Point Ramsar wetland and Commonwealth land. These controls are discussed further in Chapter 33 (Ramsar wetlands) and Chapter 35 (Commonwealth land).

Table 15-3: Summary examples of broader environmental controls commonly included in DCPs (from draft Wilton DCP)

Control type	Summary of example control in draft Wilton DCP
Water cycle management	• Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles • Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise run-off and sediment and pollutants to waterways
Water quality	• Stormwater systems must be constructed/maintained to achieve EES water quality targets
Soil erosion and sedimentation	• Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development • Soil and Water Management Plans must be prepared in accordance with *Managing Urban Stormwater* (Landcom, 2004) and included in development applications
Disturbance to saline soils	• Salinity Management Plans must be prepared in accordance with the *Western Sydney Salinity Code of Practice 2004* (WSROC, 2004) and included in development applications
Contaminated land	• Development is to be in accordance with the *Contaminated Land Management Act 1997* and *State Environmental Planning Policy 55 – Remediation of Land* • Development applications must be accompanied by a Stage 1 Preliminary Site Investigation. Where this identifies potential site contamination, a Stage 2 detailed site investigation must be prepared • A Remediation Action Plan (RAP) must be prepared for areas identified as contaminated land in the Stage 2 Site Investigation
Air quality	• Development must comply with the *Protection of the Environment Operations Act 1997* and supporting regulations. An Odour Impact Assessment must be submitted when required • Provide a barrier to mitigate dispersion of air pollutants, noise, or odour where necessary
Noise	• Provide a barrier to mitigate dispersion of air pollutants, noise, or odour • Development must include buffers to limit noise impacts on surrounding areas • An acoustic report must be submitted to address the impact of noise generation
Traffic/construction traffic	• Ensure the road networks are designed to control traffic speeds to appropriate limits • Provide a traffic report/statement to address the impact of the development on the local road system and address traffic safety issues

GENERAL MITIGATION MEASURES

General environmental controls that are commonly implemented by planning authorities in NSW through the development application process and are included in the DCP template are summarised in:

- Table 15-4 for mitigation of construction impacts
- Table 15-5 for protection of waterways and riparian corridors
- Table 15-6 for mitigation of the spread of disease/infection
- Table 15-7 for mitigation of spread of weeds
- Table 15-8 for mitigation of pest/domestic fauna impacts
- Table 15-9 for mitigation of altered fire regimes
- Table 15-10 for mitigation of fauna mortality, fauna displacement and impacts from linear barriers
- Table 15-11 for mitigation of fauna disturbance due to noise, dust, and light
- Table 15-12 for mitigation of inadvertent impacts on adjacent habitat or vegetation

- Table 15-13 for retention of key habitat features

The tables summarise the general environmental controls and identify any relevant standards, targets or guidelines that apply to the design or implementation of the controls.

The specific controls that apply to specific species and TECs in certain locations in the nominated areas, which are identified in Appendix E of the Plan, are described in section 15.8.

Construction impacts

Table 15-4: Development controls specific to mitigation of indirect impacts from construction

Summary of key controls	Relevant standards, targets, or guidelines

• Prepare a Construction Environmental Management Plan (CEMP) setting out measures to protect the environment during construction, including:
  ○ Pre-clearance assessment for native fauna prior to any clearing native vegetation
  ○ Best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust
  ○ Site rehabilitation and installation of nest boxes for development adjacent to natural areas
  ○ Tree felling protocol to avoid impacts to species relying on tree hollows, dreys, dens, and other nests in trees that are to be cleared
• Submit a weed eradication and management plan with development applications for subdivision outlining weed control measures during and after construction
• Construction traffic to utilise clearly defined access and egress points to and from a development site to avoid remnant wildlife corridors and native vegetation communities
• Parking and equipment and laydown areas to be located away from land with biodiversity values
• Temporary fencing to be erected to manage inadvertent impacts on adjacent natural areas
	Relevant council specifications
	Arrive Clean, Leave Clean: Guidelines (Commonwealth of Australia, 2015)

Waterways and riparian corridors

Table 15-5: Development controls to manage waterways and riparian corridors

Summary of key controls	Relevant standards, targets, or guidelines
• Maintain waterways of Strahler order 2 or higher in a natural state, including the maintenance and restoration of riparian corridors • Where development will affect a waterway of Strahler order 2 or higher, rehabilitate the waterway to return it to a natural state • Design road crossings of waterways to minimise impacts to vegetated riparian corridors and species movements Note under the EPA Act, development within 40 m of a watercourse is Integrated Development and requires approval under the *Water Management Act 2000*	• Relevant councils design and construction specifications • Strahler ordering scheme for waterways

Spread of infection/disease

Table 15-6: Development controls to manage the spread of infection/disease

Summary of key controls	Relevant standards, targets, or guidelines
• Prepare a Construction Environmental Management Plan (CEMP) setting out the measures and methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust	Arrive Clean, Leave Clean: Guidelines (Commonwealth of Australia, 2015)

Spread of weeds

Table 15-7: Development controls to manage the spread of weeds

Summary of key controls	Relevant standards, targets, or guidelines
• Submit a weed eradication and management plan with development applications for subdivision outlining weed control measures during and after construction • Subdivision design and bulk earthworks to minimise environmental weed spread and include measures to eradicate these weeds in accordance with relevant council weed policies • Weeds of National Significance and on the National Environmental Alert List under the National Weeds Strategy to be managed and eradicated. Proponent to reference NSW Weed Wise for current weed identification and management approaches	Relevant council weed policies National Weeds Strategy NSW Weed Wise Plan's weed control strategy

Predation/competition/land degradation by pest/domestic fauna

Table 15-8: Development controls to manage the impacts from pest/domestic fauna

Summary of key controls	Relevant standards, targets, or guidelines
Domestic animals • Ensure that domestic animals are appropriately contained at urban/bushland interfaces • Property boundaries should have appropriate fencing to contain domestic animals within the landholders' property	
Pest animals • Appropriately manage and control pest animals as relevant to the site • Pest control techniques implemented during and post construction to be in accordance with regulatory requirements for chemical use	Plan's pest animal control strategy

Altered fire regimes and increased fire risk

Table 15-9: Development controls to manage impacts from altered fire regimes and increased fire risk

Summary of key controls	Relevant standards, targets, or guidelines
• APZs for bushfire protection purposes are to be located wholly within the urban capable land for new development and not within land with biodiversity values As part of commitment 2, the Plan includes an action that specifies APZs are to be located wholly within urban capable land (see section 'Asset Protection Zones' below). The appropriate APZ distance is determined by the Rural Fire Service Standards for Asset Protection based on vegetation type, slope and the nature of the development and is measured from the edge of the retained habitat	RFS Standards for Asset Protection

Fauna mortality and injury, fauna displacement and the introduction of linear barriers

Table 15-10: Development controls to manage fauna mortality, fauna displacement and impacts from the introduction of linear barriers

Summary of key controls	Relevant standards, targets, or guidelines
• Implement traffic calming measures in development areas not subject to koala exclusion fencing, including speed limit restrictions for areas adjacent to land with biodiversity values, and installation of wildlife signposting and speed humps and audible surfacing in accordance with relevant standards • Install and maintain fauna-friendly road design structures in appropriate areas adjacent to fauna habitat, such as underpasses, fauna bridges and overpasses	TfNSW Biodiversity Guidelines Relevant council guidelines Relevant Australian Standards

Fauna disturbance due to noise or light

Table 15-11: Development controls to manage fauna disturbance due to noise and light

Summary of key controls	Relevant standards, targets, or guidelines
• Where noise or light impacts from development on land adjacent to natural areas may affect wildlife, mitigation measures to manage impacts should be implemented, such as managing the timing of activities and/or installing appropriate noise barriers • High-intensity outdoor lighting, including commercial lighting, or sports fields lighting, should be designed to avoid light spill into adjoining natural areas • Development within 100 m of known microbat colonies or habitat likely to support microbat colonies must include street lighting that does not attract insects	Australian Standard AS 4282 Commonwealth's *Draft Light Pollution Guidelines for Wildlife*

Inadvertent impacts on adjacent habitat or vegetation

Table 15-12: Development controls to manage inadvertent impacts on adjacent habitat or vegetation

Summary of key controls	Relevant standards, targets, or guidelines
• Parking and equipment and laydown areas to be located away from land with biodiversity values • Temporary fencing to be erected to manage inadvertent impacts on adjacent natural areas	

Retention of key habitat features or important sites

Table 15-13: Development controls to retain key habitat features

Summary of key controls	Relevant standards, targets, or guidelines

• Establish ecological setbacks in accordance with distances in the DCP to provide a buffer to adjacent development for:
  ○ Raptor nests
  ○ Grey-headed Flying Fox camps	

The role of asset protection zones in buffering indirect impacts

An asset protection zone (APZ) is a buffer zone between a bushfire hazard and buildings or other infrastructure that needs to be protected. It is managed to minimise fuel loads and reduce potential radiant heat levels, flames, localised smoke, and ember attack. The width of the APZ is generally between a minimum of 20 m and 60 m. This is determined based on vegetation type, slope, and the nature of the development, in accordance with Rural Fire Service standards. As part of the subdivision design, the APZ may include perimeter roads or open space areas.

Commitment 2 of the Plan includes an action that specifies APZs are to be located wholly within urban capable land when preparing new precinct plans for nominated areas.

This commitment is given legal effect in the Strategic Conservation Planning SEPP (see Chapter 9). Clause 12 of the SEPP specifies that development consent must not be granted on urban capable land unless any asset protection zone is located wholly within the urban capable land.

APZs will act as a buffer between the urban and industrial development and intensive plant agriculture and adjacent biodiversity values, including avoided lands and other areas containing TECs and species habitat. This buffer will reduce the risk, and support the mitigation of, several indirect impacts, including in relation to:

- Waterways and riparian corridors
- Water quality
- Weed invasion
- Altered fire regimes
- Inadvertent impacts on adjacent habitat or vegetation

OTHER REGULATION RELATING TO INTENSIVE PLANT AGRICULTURE

Intensive plant agriculture is regulated by other legislation in addition to the EP&A Act that is relevant to managing potential indirect impacts associated with the use of water resources and chemicals and pesticides. This additional legislation includes the *Water Management Act 2000* (WM Act) and the *Pesticides Act 1999*.

Under the WM Act, proponents of intensive plant agriculture seeking to use surface or groundwater will be required to obtain a licence from Water NSW. The licence will be granted in accordance with the relevant Water Sharing Plan (*Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*). The licence process ensures water extraction occurs within sustainable limits set under the plan. Water Sharing Plans are reviewed and updated every 10 years to ensure the rules, including extraction limits, continue to meet the objectives of each plan.

The regulation of pesticides in NSW is part of a national scheme co-ordinated under Commonwealth legislation that provides a framework for approval, registration, labelling and management of pesticides in Australia. The framework has been adopted in NSW under the *Agricultural and Veterinary Chemicals (New South Wales) Act 1999*.

The use of pesticides in NSW is further regulated by the *Pesticides Act 1999*. Under this Act, a proponent of intensive plant agriculture may need a permit to use pesticides, and the Act includes a range of offences for using pesticides in contravention of any instruction or label, causing harm to any non-target animals or plants, including specific provisions for threatened species, and for negligent misuse of pesticides. The NSW Environment Protection Authority can make pesticide control orders to prohibit or control the use of a pesticide and protect the environment, as well as issue prevention notices or clean up notices. The Act also establishes a specific licensing regime for aerial spraying. Only a person with the necessary qualifications can obtain an aerial spraying licence.

Intensive plant agriculture will need to meet the requirements of the WM Act and *Pesticides Act* 1999 in addition to being regulated under the EP&A Act. It is expected these existing legislative frameworks will adequately address potential indirect impacts from intensive plant agriculture in relation to the use of water resources and chemicals and pesticides.

15.6.2 MITIGATION MEASURES FOR INFRASTRUCTURE

COMMITMENTS AND ACTIONS

The Plan includes a commitment to mitigate indirect impacts from infrastructure on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan (Commitment 5).

The key actions under Commitment 5 to implement the mitigation measures for infrastructure are set out in Table 15-14.

Note Commitment 5 also applies to urban and industrial development and intensive plant agriculture, but the commitment is implemented differently for these types of development, and this is discussed in section 15.6.1.

Table 15-14: Actions to mitigate indirect impacts for infrastructure development

Implementation mechanism or process	Actions under Commitment 5 to mitigate indirect impacts
Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, implemented through future environmental assessment and approval processes under EP&A Act	1. Introduce Cumberland Plain Conservation Plan Guidelines for Infrastructure Development to be addressed by a public authority that includes mitigation measures for indirect and prescribed impacts to biodiversity from infrastructure activities in accordance with Appendix E of the Plan 2. Identify and implement mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the requirements of the NSW approval processes under the EP&A Act, as well as published, best practice guidelines

IMPLEMENTATION PROCESS FOR MITIGATION MEASURES

The key mechanism to implement mitigation measures to address the indirect impacts of infrastructure is the *Cumberland Plain Conservation Plan Guidelines for Infrastructure Development* (infrastructure guideline).

The infrastructure development guideline will set out development controls to address indirect impacts. The development controls in the guideline will be implemented through future environmental assessment and approval processes under the EP&A Act that will apply to each infrastructure project prior to it proceeding.

The infrastructure development guideline is supported by the SEPP (Strategic Conservation Planning). The SEPP requires local development under Part 4 of the EP&A Act to take the guideline into consideration. The SEPP and the EP&A Regulation 2000 also specify notification requirements.

Note that infrastructure under the Plan will generally be limited to urban capable land within the nominated areas. Infrastructure that meets the definition of 'essential infrastructure' (see Part 2) may be carried out on avoided land without further approval under the EPBC Act if certain requirements are met. The direct and indirect impacts of essential infrastructure and commitments to address these impacts are assessed in Chapter 37.

Future environmental assessment processes

Infrastructure will be subject to future environmental assessment and approval processes under the EP&A Act at the time the projects are proposed. Infrastructure covering the broad types under the Plan (see Part 2) is subject to different environmental assessment processes. These are summarised in Table 15-15.

SEPP (Infrastructure) 2007 provides a framework for determining how most types of infrastructure are assessed and approved under the EP&A Act. The SEPP sets out:

- What type of infrastructure is approved by council, the Minister for Planning, or Department under a traditional development consent process under Part 4 of the EP&A Act (this is known as 'development with consent')
- What type of infrastructure development is approved by a public authority under a separate process under Part 5 of EP&A Act (this is known as 'development without consent')
- What type of development is exempt from requiring approval (known as 'except development') or may be undertaken provided certain conditions are met (known as 'complying development')

Table 15-15: Potential assessment and approval processes for infrastructure under the Plan

	Approval	Assessment	Assessment mechanism	Approval body
Part 4	Approval required under Part 4 of EP&A Act	Must include an assessment of the 'likely impacts of the development, including environmental impacts on both the natural and built environments and social and economic impacts…' (s 79C(1))	Environmental Impact Statement (for State Significant Development) Statement of Environmental Effects (for other development)	Normally council For State Significant Development, may be: • Minister for Planning • Planning Assessment Commission • The Department
Part 5	Approval required under Part 5 of EP&A Act	Must 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity' (s 111)	Review of Environmental Factors Environmental Impact Statement	Normally a public authority
SSI	Approval required under Part 5.1 of EP&A Act	Must prepare an Environmental Impact Statement in accordance with assessment requirements specified by the Department	Environmental Impact Statement	Minister for Planning

Implementation of mitigation measures for biodiversity values identified in the Plan

The assessment of the indirect impacts of infrastructure in section 15.7 led to the identification of several mitigation measures that apply to specific species and TECs in certain locations in the nominated areas to address the indirect impacts of infrastructure on biodiversity values.

These mitigation measures are identified in Appendix E of the Plan and section 15.8 of this Assessment Report.

The Department will prepare a guideline under clause 228 of the EP&A Regulation – the *Cumberland Plain Conservation Plan Guidelines for Infrastructure Development* (infrastructure guideline).

The objectives of the infrastructure guideline are to:

- Ensure infrastructure provision is consistent with biodiversity conservation approvals under the Plan
- Mitigate impacts of infrastructure on certified—urban capable land

The infrastructure guideline must be taken into account when public authorities consider the likely impact of infrastructure on the environment under the EP&A Act. The guideline supports implementation of the Plan by ensuring the mitigation measures in the Plan are considered and implemented through the future environmental assessment and approval processes under the EP&A Act that will be undertaken for each infrastructure project.

Part 3.3 of the infrastructure guidelines apply to infrastructure proposed under Part 5 of the EP&A Act on urban capable land. It identifies mitigation requirements that must be addressed to ensure consistency with the Plan's requirements for mitigating the indirect impacts of infrastructure projects. The guideline includes:

- Objectives that align with the commitments in the Plan, including Commitment 5, to address indirect impacts

- A set of mitigation measures relevant to addressing the indirect impacts of infrastructure. These measures have been identified through this Assessment Report (see section 15.8) and are reflected in Appendix E of the Plan

Implementation of mitigation measures for broader environmental values

Public authorities typically incorporate a broader set of mitigation measures to those identified in Appendix E of the Plan to manage the indirect impacts of infrastructure development on the environment generally, including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise, and traffic.

As required under Commitment 5, Action 2, the future environmental assessment and approval processes under the EP&A Act undertaken by public authorities for each infrastructure project will lead to the identification and implementation of these broader mitigation measures based on the detailed design of each project.

These broader mitigation measures are not identified in Appendix E of the Plan and section 15.8 as it is a requirement of the assessment processes under the EP&A Act to identify and implement these sorts of measures and incorporate them into approval conditions for infrastructure projects. Commitment 2, Action 2 provides additional assurance that this process will occur as part of this future assessment process for each infrastructure project.

Public authorities will be responsible for making decisions about the specifics of these mitigation measures for each project through the future environmental assessment processes based on best practice standards and guidelines.

15.6.3 MITIGATION MEASURES FOR THE TRANSPORT CORRIDORS

COMMITMENTS AND ACTIONS

The Plan includes a commitment to mitigate indirect impacts on TECs, species and their habitat within major transport corridors, including the Outer Sydney Orbital and Metro Rail Future Extension tunnel sections (Commitment 6), in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval for certified-major transport corridors
- Major infrastructure corridors class of action description and the BC Act (or equivalent) for non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E

The key actions under Commitment 6 to implement the mitigation measures for infrastructure are set out in Table 15-16.

Table 15-16: Actions taken under the Plan to mitigate indirect impacts from the transport corridors

Implementation mechanism or process	Actions under Commitment 6 to address indirect impacts
Actions under Commitment 6, implemented through or alongside future environmental assessment processes for each transport project under EP&A Act and/or BC Act	Transport for NSW will, across all major transport corridors: 1. Assess the impacts on biodiversity values listed under the BC Act (for non-certified major transport corridors) and other environmental values (for certified- and non-certified major transport corridors) based on detailed design 2. Implement specific mitigation measures prescribed in Appendix E and identify and implement additional mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the SSI (or equivalent) approval process, as well as best practice guidelines, including the RMS Biodiversity Guidelines 3. Apply further mitigation according to the BC Act and BAM (or equivalent) for non-certified major transport corridors (strategically assessed), including the tunnels 4. Offset impacts to biodiversity values, including MNES, in accordance with the BAM (or equivalent) and *EPBC Act Environmental Offsets Policy* should there be long-term detrimental impacts from subsidence due to the tunnel sections 5. Identify potential design options for major watercourse crossings to reduce disruption to connectivity and the risk of vehicle strikes 6. Establish baseline monitoring data and undertake ongoing monitoring of high-value environmental areas, and review and adjust mitigation measures (where practical) in response to monitoring outcomes, in accordance with the SSI (or equivalent) approval 7. Report to the Department and executive implementation committee on mitigation measures proposed to manage impacts of each transport project, including proposed techniques, timing, frequency and responsibility for implementing each measure and any offsets to be secured in accordance with the BAM (or equivalent) and *EPBC Act Environmental Offsets Policy* due to subsidence impacts of the tunnels

IMPLEMENTATION PROCESS FOR MITIGATION MEASURES

The key processes to implement mitigation measures to address the indirect impacts of the major transport corridors is a series of actions that Transport for NSW is required to implement under Commitment 6.

These actions will be implemented through or alongside future environmental assessment and approval processes under the EP&A Act and/or the BC Act that will apply to each transport project prior to it proceeding. The assessment process will depend on whether the transport project is proposed for certification under the Plan:

- For the certified major transport corridors, the environmental assessment process will comprise the SSI (or equivalent) assessment process under the EP&A Act
- For the non-certified major transport corridors (strategically assessed), the environmental assessment process will comprise both the SSI (or equivalent) and the BC Act and BAM (or equivalent) assessment processes

The actions under Commitment 6 ensure Transport for NSW identifies and implements mitigation measures to address indirect impacts based on the detailed design of each transport project (Action 1) through or alongside the future environmental assessment and approval processes under the EP&A Act and/or the BC Act.

For the certified major transport corridors (where indirect impacts on biodiversity values are assessed in this Assessment Report), this involves identifying and implementing mitigation measures to address indirect impacts on broader environmental values based on the outcomes of the SSI (or equivalent) assessment process.

For the non-certified major transport corridors (strategically assessed) (where indirect impacts on biodiversity values are only assessed under the EPBC Act in this Assessment Report), further mitigation measures are required to be identified and implemented based on the outcomes of the assessment and approval under the BC Act and BAM.

Action 2 requires the specific mitigation measures in Appendix E under the Plan to be implemented alongside the future assessment processes for both the certified and non-certified major transport corridors.

Transport for NSW is also required to offset impacts to biodiversity values, including MNES, in accordance with the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnel sections. The indirect impacts of the tunnel sections are assessed in Chapter 36

Commitment 6 also includes several actions that provide additional assurance in relation to the implementation of the mitigation measures in Appendix E of the Plan and the SSI assessment process. These are:

- Monitoring of high environmental value areas and adjusting of mitigation measures where practical in accordance with the requirements of the SSI (or equivalent) assessment process (Action 6)
- Reporting to the Department and executive implementation committee on the implementation of the mitigation measures for each transport project (Action 7)

These actions provide additional assurance that the SSI and BAM assessment processes will lead to the implementation of mitigation measures to address indirect impacts of the major transport corridors in accordance with Commitment 7.

SSI assessment and approval process

How does the process work?

The EP&A Act provides the primary legislative basis for assessing and approving the impacts of transport development on the environment. The EP&A Act includes provisions to ensure that all potential environmental impacts of a development, including indirect impacts, are assessed and considered in the decision-making process.

Major road and rail projects, including the major transport corridors, are dealt with under the SSI provisions (Division 5.2 of the EP&A Act) and require approval of the Minister for Planning. Under this Division, proponents must:

- Prepare an Environmental Impact Statement (EIS) for the project that assesses the impacts of the development
- Prepare the EIS in accordance with the Planning Secretary's environmental assessment requirements

The Department has prepared a standard set of environmental assessment requirements for SSI projects (DPIE, 2020b). The SEARs reflect the Department's preferred approach to conditioning projects through the provision of performance or outcome focused conditions, and currently requires the assessment to:

- Assess and identify impacts, including indirect impacts
- Propose measures to mitigate impacts
- Nominate and commit to performance outcomes for managing impacts
- Identify the detail of proposed management plans and monitoring programs

Will all relevant indirect impacts be mitigated?

The SSI process requires the EIS to identify all relevant indirect impacts, propose measures to mitigate impacts, commit to performance outcomes, and identify proposed management plans and monitoring programs (DPIE, 2020b).

The Department has prepared indicative standard conditions for linear SSI projects (DPIE, 2020b). These conditions include requirements to prepare construction and operational environmental management plans to set out how performance outcomes, commitments and mitigation measures identified in the EIS, including in relation to managing indirect impacts, will be implemented and achieved. These plans must include:

- A program for ongoing analysis of the key environmental risks associated with the development
- Details of how the development will be undertaken to meet the performance outcomes identified in the environmental impact assessment and manage the risks identified in the risk analysis
- A protocol for managing and reporting any non-compliances with the approval

Are mitigation standards best practice and can they be adapted over time?

The Department's preferred approach to conditioning major projects such as transport development is through performance or outcome focused conditions where appropriate. Under this approach, performance outcomes are identified that must be complied with to achieve an appropriate environmental outcome, but how those outcomes are best achieved through mitigation measures is flexible. An advantage of this approach is that it allows flexibility over time about what mitigation measures are implemented to best achieve the outcome.

The Department has prepared guidelines for identifying mitigation measures to manage impacts in environmental impact assessments, including guidance on implementing performance-based approaches to mitigation (DPE, 2017).

What measures are in place to address any risk of failure of mitigation measures?

The indicative standard conditions for linear SSI projects (DPIE, 2020b) include requirements to prepare construction and operational monitoring programs to monitor performance outcomes, commitments and mitigation measures identified in the EIS. The purpose of the programs is to compare actual performance against predicted performance in the EIS so that adjustments to performance outcomes, commitments and mitigation measures can be made if necessary.

The monitoring programs must provide details of:

- Baseline data to be obtained
- Parameters of the project to be monitored
- Frequency and location of monitoring
- Reporting on monitoring results
- Procedures to identify and implement additional mitigation measures where necessary

Who will ensure compliance?

The indicative standard conditions for linear SSI projects (DPIE, 2020b) provide a detailed set of conditions for each SSI project. Any breach of these conditions is a breach of the approval and is enforceable under EP&A Act.

The set of conditions require the preparation of compliance reports that report on the monitoring and compliance program and the compliance status of a project in relation to compliance with the conditions of approval. Compliance reports must be prepared in accordance with detailed guidelines on compliance reporting (DPE, 2018a). The Department will review the compliance report and respond to any non-compliances in accordance with powers under the EP&A Act and processes outlined in the Department's Compliance Policy (DPE, 2018b).

Implementation of mitigation measures for biodiversity values identified in the Plan

The assessment of the indirect impacts of the major transport corridors in section 15.7 led to the identification of several mitigation measures that apply to specific species and TECs in certain locations in the nominated areas to address the indirect impacts of the transport corridors on biodiversity values.

These mitigation measures are identified in Appendix E of the Plan and section 15.8 of this Assessment Report.

Commitment 6, Action 2 requires Transport for NSW to implement the mitigation measures in Appendix E for the certified major transport corridors and non-certified major transport corridors (strategically assessed).

Implementation of mitigation measures for broader environmental values

Proponents typically incorporate a range of other mitigation measures that are broader in scope to those identified in Appendix E of the Plan to manage the indirect impacts of transport development on broader environmental values including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

As required under Commitment 6, Action 2, the future SSI assessment and approval process undertaken by Transport for NSW for each transport project will lead to the identification and implementation of these broader environmental mitigation measures based on the detailed design of each transport project.

These broader environmental mitigation measures are not identified in Appendix E of the Plan as it is a requirement of the future SSI assessment process to identify and implement these sorts of measures. Commitment 6, Action 2 provides additional assurance that this process will occur as part of the future assessment process for each transport project.

Proponents and regulators will be responsible for making decisions about the specifics of these broader measures for each project through the future SSI assessment process based on best practice standards and guidelines.

15.6.4 MITIGATION MEASURES FOR KOALA

The Plan includes a range of commitments and actions to protect Koalas from indirect impacts. These include:

- Commitment 2.2 to prioritise the avoidance of impacts from essential infrastructure on non-certified land to important Koala corridors within Wilton and GMAC
- Commitment 7 to mitigate indirect and prescribed impacts from urban, industrial and infrastructure development on the Southern Sydney population to best practice standards and in line with advice from the NSW Chief Scientist, and in accordance with Appendix E of the Plan. This includes actions to:
    - Install exclusion fencing between Koala habitat and urban capable land in GMAC and Wilton to separate Koalas from urban threats, or in areas where exclusion fencing is not feasible, implement additional development controls to minimise impacts to Koalas
    - Install exclusion fencing on both sides of Appin Road to mitigate risk of road mortality
    - Establish a Koala working group to support implementation of Koala commitments and actions
    - Work with relevant stakeholders to manage the threats posed by dogs
    - Provide safe fauna crossings in a range of locations to ensure provision of habitat connectivity for the species
- Commitment 9 to secure a minimum of 570 ha of important habitat for the Koala as an offset under the Plan
- Commitment 10 to establish the Georges River Koala Reserve. This includes an action undertake restoration of up to 80 ha of cleared land to increase Koala habitat. Note that this reserve will contain up to approximately 1,800 ha of habitat for the Koala
- Commitment 12 to protect Koala corridors in the Cumberland subregion, including those along the Nepean River, Georges River, Cataract River and Ousedale Creek
- Commitment 13, Action 4, to deliver ecological restoration to restore Koala habitat in the Georges River Koala Reserve and other priority areas including Ouesdale Creek and around Appin
- Commitment 20, Action 4, to invest in the NSW Koala Strategy to raise awareness of the Southern Sydney Koala population and encourage community participation in Koala conservation
- Commitment 22, Action 2, to support NSW Government programs for research that increases ecological knowledge of the Southern Sydney Koala population
- Commitment 23 to support rehabilitation measures to help maintain Koala health and welfare

Appendix E of the Plan also includes a range of Koala-specific measures to manage threats to the species. These include:

- Measures to protect Koalas during construction and land clearing operations
- Measures to ensure the integrity of Koala exclusion fencing where linear infrastructure occurs
- Measures to ensure that habitat connectivity within Koala habitat corridors is maintained
- Measures to minimise the risk of road mortality to Koalas
- Measures to minimise the level of threat posed by urban areas to Koalas, and which reduce the likelihood that Koalas would enter urban areas
- Measures to minimise the risk of spread of diseases which can impact Koala habitat (such as Phytophthora)

IMPLEMENTATION PROCESS FOR MITIGATION MEASURES

The key mechanisms or processes to implement mitigation measures to address the indirect impacts of the development under the Plan on Koala are:

- DCPs, implemented through the standard development application process under the EP&A Act
- Infrastructure guideline, implemented through future environmental assessment processes under the EP&A Act
- Koala exclusion fencing – a program administered by the Department

Additional mechanisms or processes to implement Koala mitigation measures will also be implemented under the Plan. For detailed information on the Plan's implementation, refer to Part 2.

The assessment of the indirect impacts of the urban and industrial development and infrastructure on koala in section 15.7 led to the identification of several mitigation measures that apply to koala in certain locations.

These mitigation measures are identified in Appendix E of the Plan and section 15.8 of this Assessment Report.

Development Control Plans

The key mechanism to implement mitigation measures to address the indirect impacts of the urban and industrial development on Koala is DCPs. The process for preparing and implementing DCPs is described in section 15.6.1.

DCPs will be prepared for each nominated area and will set out development controls to address indirect impacts on Koala. The development controls in DCPs will be implemented through the standard development application process under the EP&A Act that occurs prior to urban and industrial development proceeding.

The Department has prepared a DCP template that provides model provisions to help ensure the mitigation measures identified in the Plan are incorporated into DCPs and applied consistently across the nominated areas. The DCP template includes the specific controls for Koala identified in Appendix E of the Plan and section 15.8.

Infrastructure guideline

The key mechanism to implement mitigation measures to address the indirect impacts of infrastructure on Koala is the infrastructure guideline. The infrastructure guideline is described further in section 15.6.2.

The infrastructure guideline will set out development controls to address indirect impacts on Koala. The development controls in the infrastructure guideline will be implemented through future environmental assessment and approval processes under the EP&A Act that will apply to each infrastructure project prior to it proceeding.

The Department will prepare the infrastructure guideline under clause 228 of the EP&A Regulation.

The infrastructure guideline must be taken into account when public authorities consider the likely impact of infrastructure on the environment under the EP&A Act. The guideline supports implementation of the Plan by ensuring the mitigation measures in the Plan are considered and implemented through the future environmental assessment and approval processes under the EP&A Act that will be undertaken for each infrastructure project.

Part 3.3 of the infrastructure guideline applies to infrastructure proposed under Part 5 of the EP&A Act on urban capable land. It identifies mitigation requirements that must be addressed to ensure consistency with the Plan's requirements for mitigating the indirect impacts of infrastructure projects on Koala. The guideline includes:

- Objectives that align with the commitments in the Plan, including Commitment 7, to address indirect impacts
- A set of mitigation measures relevant to addressing the indirect impacts of infrastructure on Koala. These measures have been identified through this Assessment Report (see section 15.8) and are reflected in Appendix E of the Plan

Koala exclusion fencing

Koala exclusion fencing will be implemented through a program administered by the Department and funded under the Plan. The program will include a feasibility study (Commitment 7, Action 2) to help inform the design, locations, and construction of the fencing. Exclusion fencing will separate Koalas from urban capable land.

The exact location of exclusion fencing will be determined during implementation of the Plan and will be informed by the feasibility study and advice from the koala working group.

Further details of the fencing program are provided in sub plan B.

15.7 ASSESSMENT OF POTENTIAL INDIRECT IMPACTS

The potential indirect impacts from the urban, industrial, infrastructure, intensive plant agriculture and transport development on each NSW-listed species and TEC are assessed in this section.

Note that the location of infrastructure within the urban capable land is not yet known and will be determined through future planning processes. Infrastructure was therefore assessed as part of a single urban capable land footprint that includes the urban and industrial development and intensive plant agriculture.

This assessment considered:

- The nature, extent, and duration of relevant indirect impacts, as described in Section 15.4
- The general mitigation measures to address indirect impacts, where these are relevant to a species or TEC
- Likely presence/abundance of species and TEC and importance of the location at a local and regional scale
- Life history traits and susceptibility of the species and TEC to the indirect impact
- Location of the species and TEC relative to the likely extent of the indirect impact
- Amount and quality of un-impacted habitat remaining
- Levels of existing protection

A conclusion is provided about whether any residual risks remain for each species and TEC. Additional species or TEC specific mitigation measures under the Plan to address residual risks are described in Section 15.8.

The assessment of potential indirect impacts is set out in the following tables:

- Fauna – Table 15-17
- Flora – Table 15-18
- TECs – Table 15-19

This section covers the assessment of indirect impacts on NSW-listed TECs and species as required under the BAM. Detailed assessments of the potential indirect impacts on each Commonwealth-listed TEC and species, as well as other EPBC Act protected matters, are undertaken in the following chapters:

- Chapter 29 – Commonwealth-listed flora
- Chapter 30 – Commonwealth-listed fauna
- Chapter 31 – Commonwealth-listed TECs
- Chapter 32 – Migratory species
- Chapter 33 – Ramsar wetlands
- Chapter 34 – World and National Heritage
- Chapter 35 – Commonwealth Land

15.7.1 FAUNA

Table 15-17: Assessment of indirect impacts – fauna

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
BIRDS							
Anthochaera phrygia	Regent Honeyeater	CE	CE	ECS SCS	Removal of trees and firewood collection Spread of weeds Inappropriate fire regimes	The Regent Honeyeater is endemic to the south-eastern Australian mainland with a distribution from south-east Queensland to central Victoria. However, the species only regularly breeds at four locations: Bundarra-Barraba (NSW), Capertee Valley (NSW) and Hunter Valley (NSW), and the Chiltern area (VIC) (DoE, 2016). Its breeding areas generally consist of a nest tree and surrounding food sources, and its breeding times and, similarly, movement patterns are correlated with the flowering of certain eucalypt and mistletoe species (DoE, 2015a). While generally associated with box ironbark eucalypt woodland and dry sclerophyll forest, the species has also been found in riparian corridors with she-oak (*Casuarina* spp.) The Regent Honeyeater occurs throughout the Strategic Assessment Area with the majority of records associated with the larger patches of vegetation towards the north. There are a total of 92 records within the Strategic Assessment Area Until very recently, all records related to foraging birds. However, at the end of 2019 a pair was observed successfully breeding near Mulgoa at Fernhill Estate, just west of the boundary between the WSA and GPEC. The nest was recorded in vegetation mapped as Shale Sandstone Transition Forest. It is connected to the much broader areas of intact vegetation west of the Strategic Assessment Area; although the nest site itself is towards the interface of this vegetation and cleared rural land. The site is protected and managed in perpetuity under a biobanking agreement The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in each nominated area As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the specific risk relating	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						to the removal of large mature trees that the species is reliant upon may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, an additional specific mitigation measure has been identified to mitigate residual risks to this species	
Artamus cyanopterus cyanopterus	Dusky Wood-swallow	N/A	V	ECS	Weed invasion	Within Australia, the Dusky Wood-swallow is widespread in eastern, southern, and south-western Australia. The species occurs throughout most of NSW, and breeding occurs on the western slopes of the Great Dividing Range. The species' primary habitat consists of dry, open eucalypt forests and woodlands with an open or sparse understory and groundcover of grasses or sedges and fallen woody debris. The diet consists of invertebrates, mainly insects that are captured from both above and under the canopy or over water. There is some evidence of site fidelity for breeding (OEH, 2017g) Records of the species occur throughout the Cumberland Plain subregion but are similarly widespread across NSW (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in each nominated area. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur throughout the bioregion • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion. These measures are expected to manage any residual impacts to the species	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
Botaurus poiciloptilus	Australasian Bittern	E	E	ECS	Hydrological changes Predation by introduced vertebrates Weed invasion Inappropriate fire regimes	The Australasian Bittern occurs in Australia, New Caledonia, and New Zealand. Within NSW, the Australasian Bittern is found along the coast and has been recorded in the Murray-Darling Basin and the Cumberland subregion (TSSC, 2019). The species inhabits shallow freshwater or brackish swamps with a preference for the presence of sedges, rushes, and reeds (Garnett et al., 2011). Nests are built on a bed of reeds in densely-vegetated wetlands and placed approximately 30 cm above the water level (TSSC, 2019) There are five records of the species within the Strategic Assessment Area: • Four occur at Pitt Town Lagoon in the north of the Strategic Assessment Area near to the Hawkesbury River (approximately 15 km from the nearest development area) • One occurs near Wianamatta (South Creek) in Oran Park (approximately 9 km from the nearest development area) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Most records of the species surround the subregion, and the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including hydrological changes, predation, weed invasion, inappropriate fire regimes. These measures are expected to manage any residual impacts to the species	No
Calidris ferruginea	Curlew Sandpiper	CE Mig.	E	ECS	None	The Curlew Sandpiper occurs along most of Australia's coast and the entire coast of NSW, particularly in the Hunter Estuary and occasionally in freshwater wetlands in the Murray-Darling Basin. The species breeds in Siberia and migrates to Australia, as well as Africa and Asia, for the non-breeding period (OEH, 2021b)	N/A

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						The species generally inhabits littoral and estuarine habitats. In NSW, the species is mainly found in intertidal mudflats of sheltered coasts (OEH, 2021b) The majority of records in the Cumberland Plain subregion are concentrated around Parramatta and north of Penrith, east of Kurrajong (OEH, 2021a) As discussed in the Migratory Species Impact Assessment – Chapter 32, there are no important habitat areas for the species which are at risk of indirect impacts from development under the Plan	
Callocephalon fimbriatum	Gang-gang Cockatoo	N/A	V	ECS SCS	Inappropriate hazard reduction burns Weed invasion	The Gang-gang Cockatoo occurs from southern Victoria through south- and central-eastern New South Wales. In NSW, the species is distributed from the south-east coast to the Hunger region and inland to the Central Tablelands and south-west slopes (OEH, 2017n) In spring and summer, the species is found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species moves to lower altitudes in drier, more open, eucalypt forests and woodlands or in dry forest in coastal areas and in urban areas. For nesting and roosting, the species favours old growth forest and woodland attributes (OEH, 2017n) Records are sparsely scattered across the Cumberland Plain subregion and more heavily concentrated in areas outside the boundary (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in GPEC, Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Most records of the species surround the subregion, and the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and weed invasion. These measures are expected to manage any residual impacts to the species	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
Calyptorhynchus lathami	Glossy Black-cockatoo	N/A	V	ECS SCS	Loss of hollow bearing trees due to land management Weed invasion	The Glossy Black-cockatoo is uncommon but widespread from the central Queensland coast to East Gippsland in Victoria and inland to the southern tablelands and central western plains of NSW. The species' primary habitat is open forest and woodlands of the coast and the Great Dividing Range where strands of she-oak occur. The species exclusively feeds on species of she-oak (OEH, 2017o) There are a few records in the Cumberland Plain subregion, although most are distributed outside the boundary (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Most records of the species surround the subregion, and the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion. These measures are expected to manage any residual impacts to the species	No
Chthonicola sagittata	Speckled Warbler	N/A	V	ECS	Weed invasion Nest failure due to predation by native and non-native birds, cats, dogs, and foxes	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria. The species is found in the hills and tablelands of the Great Dividing Range. Primary habitat includes a wide range of *Eucalyptus* dominated communities that have a grassy understorey. The species are often found on rocky ridges or in gullies. Breeding pairs are sedentary and occupy a territory of approximately 10 ha with a slightly larger home-range when not breeding (OEH, 2017aa) Records are scattered throughout the western part of the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species (as indicated by records) that occur adjacent to urban capable land and transport	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						corridors in the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because many records of the species surround the subregion or occur in protected lands in the subregion, and the subregion does not appear to be a stronghold for the species As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and predation. These measures are expected to manage any residual impacts to the species	
Circus assimilis	Spotted Harrier	N/A	V	ECS	Loss of mature trees from rural landscapes Secondary poisoning from the use of pindone in rabbit control and rodenticides	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment, and ranges, and rarely in Tasmania. In NSW, individuals are widely dispersed and comprise a single population. The species is found in grassy open woodland, including Acacia and mallee remnants, inland riparian woodland, and grassland and shrub steppe. Primary habitat is native grassland but is also found in agricultural land (OEH, 2017ab) Records are sparse across the Cumberland Plain subregion with the majority in the northwest area and a few in the south (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas This species is reliant on mature trees and at risk from secondary poisoning. There is a risk that these issues may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	Yes
Climacteris picumnus victoriae	Brown Treecreeper	N/A	V	ECS	Weed invasion Degradation of habitat, particularly loss of tree hollows	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands, such as the Snowy River Valley, Cumberland Plains, Hunter Valley, and parts of the Richmond and Clarence Valleys (OEH, 2017c) The species is considered mostly sedentary and mainly found in woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						grassy understory. Breeding occurs in pairs or co-operatively in territories which range in size from 1.1 to 10.7 ha (OEH, 2017c) Records are sparsely scattered in the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species (as indicated by records) that occur adjacent to the urban capable land and transport corridors in the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur throughout the bioregion • The subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion. In addition, there is a specific measure in the Plan for some other species to retain large trees during precinct planning, which is likely to benefit the Brown Treecreeper. These measures are expected to manage any residual impacts to the species	
Daphoenositta chrysoptera	Varied Sittella	N/A	V	ECS	Weed invasion Inappropriate fire regimes	The Varied Sittella occurs throughout most of mainland Australia except in treeless deserts and open grasslands. In NSW, the species' distribution is nearly continuous from the coast to the far west. Primary habitat includes eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee, and *Acacia* woodland. The species feeds on arthropods gleaned from crevices in mostly dead, tree bark. Nesting occurs in upright tree forks high in the living tree canopy and often re-uses the same fork or tree in successive years (OEH, 2017af) Records occur throughout the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species (as indicated by records) that occur adjacent to the urban capable land and transport corridors in the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because:	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						• Records occur throughout the bioregion • Many records in the subregion occur in protected lands • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and inappropriate fire regimes. These measures are expected to manage any residual impacts to the species	
Ephippiorhynchus asiaticus	Black-necked Stork	N/A	E	ECS	Modification or degradation of wetlands	The Black-necked Stork is found in Australia and New Guinea with another subspecies in India and south-east Asia. In Australia, the species is widespread in coastal and subcoastal northern and eastern Australia but rarely occurs south of Sydney. In NSW, the species inhabits floodplain wetlands of the major coastal rivers. Storks usually forage in water 5-30 cm deep for vertebrate and invertebrate prey and nest in tall trees close to water. Breeding territories are large and variable in size (OEH, 2017b) Records are sparsely spread across the Cumberland Plain subregion with a few concentrated in the Penrith area (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in WSA. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur throughout the bioregion; the subregion doesn't appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species,	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						including impacts to hydrological processes. These measures are expected to manage any residual impacts to the species	
Epthianura albifrons	White-Fronted Chat	N/A	V	ECS	None	The White-Fronted Chat is endemic to Australia and distributed across the southern half of Australia from southern Queensland to southern Tasmania. The species is found in mostly temperate to arid climates in foothills and lowlands up to 1000 m above sea level. In NSW, the species occurs mostly in the southern half of the state in damp open habitats along the coast and near waterways in the western part of the state. Foraging occurs on bare or grassy ground in wetland areas, feeding mainly on flies and beetles caught from or close to the ground. Nests are built in low vegetation, generally about 23 cm above the ground (OEH, 2017ag) A few records occur near the edges of the Cumberland Plain subregion with a concentration in Parramatta (OEH, 2021a) While the Plan has the potential to exacerbate several threats to the species, this species is unlikely to be indirectly impacted because the species is wide-ranging with areas of habitat (as indicated by records) occurring some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted	N/A
Glossopsitta pusilla	Little Lorikeet	N/A	V	ECS	Weed invasion Inappropriate fire regimes Loss of old hollow-bearing trees	The Little Lorikeet is found across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. Foraging occurs primarily in the canopy of open *Eucalyptus* forest and woodland but also in *Angophora*, *Melaleuca*, and other tree species, particularly in riparian habitats. Roosting occurs in treetops distanced from feeding areas, while nesting generally occurs close to feeding areas in the limb or trunk of smooth-barked eucalypts. These nesting sites are repeatedly used for decades with a preference for riparian trees (OEH, 2017u) Records are widespread throughout the Cumberland Plain subregion but primarily along riparian corridors (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species (as indicated by records) that occur adjacent to urban capable land and transport corridors in Wilton and GMAC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and inappropriate fire regimes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the specific risk relating to the removal of old hollow bearing trees that the species is reliant upon may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, an additional specific mitigation measure has been identified to mitigate residual risks to this species	
Grantiella picta	Painted Honeyeater	V	V	ECS	None	The Painted Honeyeater is distributed across and breeds on the inland slopes of the Great Dividing Range in NSW, Victoria, and southern Queensland. Primary habitat includes *Acacia pendula*, *A. harpophylla*, and box-gum woodlands and box-ironbark forests. The species is a specialist and only feeds on the fruits of mistletoes growing on woodland eucalypts and acacias with a preference for the mistletoes of *Amyema*. Nesting occurs in the outer canopy of drooping eucalypts, she-oak, paperbark, or mistletoe branches (OEH, 2017w) Four records exist towards the north of the Cumberland Plain subregion (OEH, 2021a) While the Plan has the potential to exacerbate several threats to the species, this species is unlikely to be indirectly impacted because: • the species is wide-ranging • there are few records within the subregion, all associated with habitat (as indicated by records) that occurs some distance away from the urban capable land and transport corridors and which is unlikely to be subject to indirect impacts	N/A
Haliaeetus leucogaster	White-bellied Sea-Eagle	N/A	V	ECS SCS	Reduction of suitable nesting habitat Non-target poisoning during vertebrate pest control	The White-bellied Sea-Eagle is distributed across the Australian coastline and well inland along rivers and wetlands of the Murray Darling Basin. In NSW, the species is widespread along the east coast and major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. The species breeds in mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest near foraging habitat. Nest trees are typically large emergent eucalypts (OEH, 2019r)	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
					Disturbance by humans or human activity when nesting	Records are distributed throughout the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. In particular, development controls to establish ecological setbacks between development and raptor nests These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, there is a risk that issues relating to mature trees and secondary poisoning may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	
Hieraaetus morphnoides	Little Eagle	N/A	V	ECS SCS	Degradation of breeding habitat Secondary poisoning from rabbit baiting	The Little Eagle is found throughout the Australian mainland except in the most densely forested parts of the Dividing Range escarpment. The species inhabits open eucalypt forest, woodland, or open woodland in addition to she-oak or *Acacia* and riparian woodlands. Nesting occurs in tall living trees (OEH, 2017t) Records are distributed throughout the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas This species is reliant on mature trees and at risk from secondary poisoning, and there is a risk that these issues may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	Yes
Irediparra gallinacea	Comb-crested Jacana	N/A	V	ECS	Loss and degradation of wetland habitat Predation on breeding birds and their nests by feral	Globally, the species is found in Australia, Borneo, the Philippines, and other Pacific Islands. In Australia, the species is distributed across northern and eastern Australia in coastal and subcoastal regions. Primary habitat includes permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation or fringing and aquatic vegetation (OEH, 2018d)	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
					predators such as the European red fox	A few records exist along the north-western boundary of the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in WSA. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur elsewhere in the bioregion; the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including impacts to hydrological processes and predation. These measures are expected to manage any residual impacts to the species	
Ixobrychus flavicollis	Black Bittern	N/A	V	ECS	Impacts to riparian vegetation Predation by foxes and feral cats	The Black Bittern is distributed from southern NSW north to Cape York and along the north coast to the Kimberley region. The species is also found in the south-west of WA. In NSW, the Black Bittern is scattered along the east coast. Primary habitat includes both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Roosting occurs in trees or on the ground amongst dense reeds (OEH, 2018c) Records are sparsely distributed across the Cumberland Plain subregion with the majority found near Kurrajong near the north-western boundary (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The species is wide-ranging, and the subregion does not appear to be a stronghold for the species • Many records in the subregion occur in existing conservation areas	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including impacts to riparian vegetation and predation. These measures are expected to manage any residual impacts to the species	
Lathamus discolor	Swift Parrot	CE	E	ECS SCS	Collision mortality Inappropriate fire regimes Predation by feral cats	The Swift Parrot breeds in Tasmania in summer and migrates to mainland Australia in winter. On the mainland, the species occurs in Victoria and eastern NSW but may also be found in south-eastern Queensland or south-eastern South Australia. In NSW, the species forages in forests and woodlands throughout the coastal and western slopes regions (TSSC, 2016a). The species forages on flowers, seeds, fruit, and psyllid lerps in *Eucalyptus* species with a preference for larger trees, which provide more reliable resources than younger trees (Saunders & Tzaros, 2011). Its distribution is primarily determined by food availability and the presence of non-aggressive competitors (Saunders & Heinsohn, 2008) Within the Recovery Plan, the Hawkesbury-Nepean and Sydney Metro Catchment Management Authority areas (which contain the Strategic Assessment Area) are identified as localities which are likely to contain priority habitats (Saunders & Tzaros, 2011) The species has been recorded throughout the Cumberland subregion and is associated with flowering woodland areas. There are 266 BioNet records within the Strategic Assessment Area with records ranging from the early 1900s to the present day The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land in the nominated areas and transport corridors As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and predation These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, because the species benefits from the feeding resources associated with large mature trees, an additional	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						specific mitigation measure has been identified to mitigate residual risks to this species	
Limicola falcinellus	Broad-Billed Sandpiper	N/A	V	ECS	None	After breeding in northern Siberia, the Broad-Billed Sandpiper migrates to Australia. In Australia, the birds are found along the northern and, occasionally, southern coast. In NSW, the species primarily occurs in the Hunter River estuary. Primary habitat includes sheltered parts of the coast, including estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes, and reefs. Roosting occurs on banks on sheltered sand, shell, or shingle beaches. Foraging occurs in the soft, wet mud (OEH, 2019e) The species has not previously been recorded in the Cumberland Plain subregion (OEH, 2021a) While the Plan has the potential to exacerbate several threats to the species, this is unlikely to result in indirect impacts to the species because there are no records of the species in the subregion and areas of habitat (as indicated by records) occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted	N/A
Limosa limosa	Black-tailed Godwit	Mig.	V	ECS	None	The Black-tailed Godwit breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer. In NSW, the species is most frequently found at Kooragang Island with occasional records along the coast and inland. The bird primarily inhabits sheltered bays, estuaries, and lagoons with large intertidal mudflats and/or sandflats. Inland, the species is found on mudflats and in water less than 10 cm deep around muddy lakes and swamps. Foraging occurs in soft mud or shallow water (OEH, 2019d) There are few records within the Cumberland Plain subregion scattered in Kurrajong and Parramatta (OEH, 2021a) As discussed in the Migratory Species Impact Assessment – Chapter 32, there are no important habitat areas for the species which are at risk of indirect impacts from development under the Plan	N/A
Lophoictinia isura	Square-tailed kite	N/A	V	ECS SCS	Disturbance to or removal of	The Square-tailed Kite is distributed along the coastal and subcoastal areas of Australia. In NSW, the species occurs along the major west-flowing river systems and migrates to the south-east to breed in the summer. The bird primarily inhabits	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
					potential nest trees near watercourses Secondary poisoning	timbered areas including dry woodlands and open forests with a preference for timbered watercourses. The species is a specialist hunter of passerines and insects in the tree canopy (OEH, 2017ac) Records occur throughout the Cumberland Plain subregion with a greater concentration in the northern half (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in WSA and GPEC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. In particular, development controls to establish ecological setbacks between development and raptor nests These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, this species is reliant on mature trees for nesting and is at risk from secondary poisoning, and there is a risk that these issues may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	
Melanodryas cucullata cucullata	Hooded Robin (South-Eastern Form)	N/A	V	ECS	Weed invasion Inappropriate fire regimes	The Hooded Robin is distributed across Australia except in the driest deserts and wetter coastal areas. The species is mostly sedentary but local seasonal movements are possible. The south-eastern form occurs from Brisbane to Adelaide and throughout much of inland NSW. Primary habitat includes lightly wooded country that is structurally diverse (OEH, 2017s) Sparse records occur in the southern part of the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species (as indicated by records) that occur adjacent to the urban capable land and transport corridors in the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The species is wide-ranging and records occur throughout the bioregion	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						• The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and inappropriate fire regimes. These measures are expected to manage any residual impacts to the species	
Melithreptus gularis gularis	Black-Chinned Honeyeater (Eastern subsp.)	N/A	V	ECS	Weed invasion Inappropriate fire regimes Removal of large trees	The Black-Chinned Honeyeater occurs in Queensland, NSW, Victoria, and rarely in South Australia. In NSW, the species is found in the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Primary habitat includes mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. The species is found in large woodland patches with home ranges of at least 5 hectares. Nesting occurs high in the crown of a tree in the uppermost lateral branches (OEH, 2017a) Records are scattered throughout the Cumberland Plain subregion. The majority concentrated in Penrith and Kurrajong (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and inappropriate fire regimes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, there is a risk that issues associated with the removal of large trees may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
Neophema pulchella	Turquoise Parrot	N/A	V	ECS	Loss of hollow-bearing trees and critical habitat feature degradation Weed invasion Inappropriate fire regimes Predation by foxes and cats	from the coastal plains to the western slopes of the Great Dividing Range. The species inhabits the edges of eucalypt woodland adjoining clearings, timbered ridges, and creeks in farmland. Foraging for seeds or grasses and herbaceous plants occurs on the ground. Nesting occurs in tree hollows, logs, or posts (OEH, 2017ae) Scattered records are located throughout the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in each nominated area. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The species is wide-ranging, and the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion, inappropriate fire regimes and predation. In addition, there is a specific measure in the Plan for some other species to retain large trees during precinct planning, which is likely to benefit the Turquoise Parrot. These measures are expected to manage any residual impacts to the species	No
Ninox connivens	Barking Owl	N/A	V	ECS SCS	Removal of old, hollow-bearing trees	The Barking Owl is widespread throughout mainland Australia except for the central arid regions. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests. The species inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Hunting can extend into closed forest and more open areas, but large permanent territories are required due to sparse prey densities (OEH, 2019b) Records in the Cumberland Plain subregion are concentrated in and around Parramatta with a few dispersed across the rest of the subregion (OEH, 2021a)	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in GPEC, Wilton and GMAC There is a risk that issues associated with the removal of large trees may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	
Ninox strenua	Powerful Owl	N/A	V	ECS SCS	Loss of hollow-bearing trees High frequency hazard reduction burning Predation of fledglings by foxes, dogs, and cats	The Powerful Owl is endemic to eastern and south-eastern Australia, primarily on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, the species is widely distributed throughout the eastern forests from the coast inland to tablelands. The species inhabits a range of vegetation types from woodland and open sclerophyll forests to tall open wet forest and rainforest. The owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Powerful Owls nest in large tree hollows, in large, old eucalypts (OEH, 2019p) Records occur throughout most of the Cumberland Plain subregion in relatively high concentrations (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in GPEC, Wilton and GMAC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and predation These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, there is a risk that issues associated with the removal of large, mature trees may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	Yes
Pandion cristatus	Eastern Osprey	N/A	V	ECS	None	The Eastern Osprey is distributed across Indonesia, Australia, and New Caledonia. In Australia, the species is found along the coastline except for Victoria and Tasmania and is uncommon to rare or absent from closely settled parts of south-eastern	N/A

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						Australia. Primary habitat includes coastal areas, especially the mouths of large rivers, lagoons, and lakes (OEH, 2018f) Records in the Cumberland Plain subregion occur in Parramatta (OEH, 2021a) While the Plan has the potential to exacerbate several threats to the species, this is unlikely to result in indirect impacts to the species because the species favours coastal areas and usually nests within 1 km of the coast. The majority of areas of habitat (as indicated by records) occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted	
Petroica boodang	Scarlet Robin	N/A	V	ECS	Weed invasion Predation by feral cats (*Felis catus*)	The Scarlet Robin is distributed from Queensland to South Australia, Tasmania, and Western Australia. In NSW, the species is found from the coast to the inland slopes. After breeding, populations may disperse to the lower valleys and plains of the tablelands and slopes. Primary habitat includes dry eucalypt forests and woodlands with an open and grassy understorey. The species is typically found in both mature and regrowth vegetation. Breeding occurs on ridges, hills, and foothills of the western slopes, the Great Dividing Range and eastern coastal regions (OEH, 2017z) Records are scattered across the Cumberland Plain subregion with the majority in the northern portion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species (as indicated by records) that occur adjacent to urban capable land and transport corridors in each nominated area. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur throughout the bioregion; the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and predation. These measures are expected to manage any residual impacts to the species	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
Petroica phoenicea	Flame Robin	N/A	V	ECS	Weed invasion	The Flame Robin is endemic to south-eastern Australia and ranges from Queensland to South Australia and Tasmania. In NSW, the species breeds in upland areas, and, in winter, many birds move to the inland slopes and plains. Breeding occurs in upland tall moist eucalypt forests and woodlands often on ridges and slopes with a preference for clearings or areas with open understoreys (OEH, 2017l) Sparse records are scattered across the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to increase weed invasion in areas of habitat for this species (as indicated by records) that occur adjacent to urban capable land and transport corridors in each nominated area. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur throughout the bioregion; the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion. These measures are expected to manage any residual impacts to the species	No
Rostratula australis	Australian Painted Snipe	E	E	ECS	Loss or degradation of wetlands Predation by feral animals Vegetation changes caused by introduced plants Inappropriate fire regimes	The Australian Painted Snipe is only found in Australia and mainly occurs in the Murray Darling Basin (DoEE, 2019; DSEWPC, 2013). Other important areas for this species include Queensland Channel Country, Fitzroy Basin of Central Queensland, south-eastern South Australia, and adjacent parts of Victoria (DSEWPC, 2013) Its habitats include both ephemeral and permanent shallow freshwater and, occasionally, brackish wetlands. The species is often found in dense covers of grass and reeds (DSEWPC, 2013). Breeding occurs year-round depending on the availability of suitable wetland conditions. The species feeds on vegetation, seeds, and invertebrates (DoEE, 2018c) There are two records for the Australian Painted Snipe within the Strategic Assessment Area in the last sixteen years. One is within GPEC from an unnamed water body outside of the urban capable land near to Wianamatta, and the other is	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						from the north of the Strategic Assessment Area in the floodplain of the Hawkesbury River. While two records occur in the Strategic Assessment Area, the area is not recognised as a key location for the species and the nominated areas include only one record (within GPEC) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The species occurs elsewhere in the bioregion, with relatively few records in the subregion • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including impacts to hydrological processes, predation, weed invasion and inappropriate fire regimes. These measures are expected to manage any residual impacts to the species	
Stagonopleura guttata	Diamond Firetail	N/A	V	ECS	Weed invasion	The Diamond Firetail is endemic to south-eastern Australia from Queensland to South Australia. The species is widely distributed in NSW and found in grassy eucalypt woodlands, open forest, mallee, natural temperate grassland, and secondary grassland derived from other communities. The firetail feeds exclusively on the ground on ripe and partly-ripe grass, herb seeds, green leaves, and insects (OEH, 2017e) A few records are found in the Cumberland Plain subregion with the majority concentrated in Picton (OEH, 2021a) The Plan has the potential to increase weed invasion in areas of habitat for this species (as indicated by records) that occur adjacent to urban capable land and transport corridors in each nominated area. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur throughout the bioregion	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						• The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion. These measures are expected to manage any residual impacts to the species	
Stictonetta naevosa	Freckled Duck	N/A	V	ECS	Hydrological disturbance	The Freckled Duck is distributed across south-eastern and south-western Australia. Breeding occurs in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. Primary habitat consists of permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum, or Tea-tree. During drier times, the duck will move from ephemeral breeding swamps to more permanent water sources (OEH, 2017m) A few records exist in the Cumberland Plain subregion with the majority found in Kurrajong (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in WSA. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur elsewhere in the bioregion; there are very few recent records in the subregion • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including hydrological disturbance. These measures are expected to manage any residual impacts to the species	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
Tyto novaehollandiae	Masked Owl	N/A	V	ECS SCS	Loss of mature hollow-bearing trees	The Masked Owl is found from the coast to the western plains in Australia. The species is widespread across NSW with no seasonal variation in its distribution. Its primary habitat includes dry eucalypt forests and woodlands. Hunting occurs along the edges of forests, including roadsides. The owl roosts and breeds in moist eucalypt forested gullies, where it uses large tree hollows and sometimes caves (OEH, 2019l) Records are scattered across the Cumberland Plain subregion with the majority of records occurring along the boundary (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas This species is reliant on mature trees and the specific measure in Table 15-20 to retain large trees may benefit the species to some extent, particularly in areas adjacent to large patches of potential habitat. This is expected to manage any residual impacts to the species However, there is a risk that issues associated with the removal of large, mature trees may not be adequately addressed through the general mitigation measures described in Section 15.6. Therefore, specific mitigation measures have been identified to mitigate potential residual impacts	Yes
MAMMALS							
Cercartetus nanus	Eastern Pygmy-possum	N/A	V	SCS	Changed fire regimes that affect the abundance of flowering proteaceous and myrtaceous shrubs Predation from cats, dogs, and foxes Road mortality	The Eastern Pygmy-possum occurs in south-eastern Australia, including Tasmania. In NSW, the species is found along the coast and inland to the western slopes. Habitats range from rainforest through sclerophyll forest and woodlands to heath. The pygmy-possum feeds mostly on nectar and pollen collected from banksias, eucalypts, and bottlebrushes and serves as an important pollinator of heathland plants, such as banksias. When flowers are unavailable, the species relies on soft fruits and insects (OEH, 2017j) There are three records in Kurrajong in the Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and predation However, the species would benefit from strengthened measures that specifically reflect the species reliance on nectar and pollen from Proteaceae shrubs and the risks of predation from cats. Therefore, additional specific mitigation measures have been identified to mitigate residual risks to this species	
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	SCS	Disturbance of roosts from human recreational activities Fire in the proximity of roosts	The Large-eared Pied Bat occurs from Shoalwater Bay in south Queensland to Ulladulla in south-eastern NSW. Within NSW, the species is found in areas of volcanic strata in the north-east at Coolah Tops, Mt Kaputar, and Warrumbungle National Park and in sandstone areas of the Sydney Basin and the western slopes and plains including Pilliga Nature Reserve. Its habitat includes well-timbered areas and low to mid-elevation dry open forests and woodland (DERM, 2011) The species requires highly specific nursery roosts with deep roofs that allow juveniles to learn to fly and roof indentations that capture heat. Its preferred roosting locations include sandstone caves, crevices in cliffs, old mine workings, and disused mud nests of the Fairy Martin (*Petrochelidon ariel*) (DERM, 2011). The species has high site fidelity and will visit the same maternity site over many years (OEH, 2019i) There are 65 records for the species within the Strategic Assessment Area. The records occur along the boundary of the Strategic Assessment Area in the south (where the largest cluster of records occurs within Wilton), east and west and are generally associated with areas of sandstone geology. These records are all considered to form part of a single population and which, more broadly, form part of the important population associated with the sandstone escarpments of the Sydney Basin The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land in the nominated areas and transport corridors. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The species occurs across the bioregion, the subregion does not appear to be a stronghold for the species • There are no known roost or breeding sites close to areas at risk of indirect impacts from the development	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including disturbance and increased fire risk. These measures are expected to manage any residual impacts to the species	
Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll, Spotted-tailed Quoll	E	V	ECS	Competition and predation from introduced predators Road mortality Inappropriate fire regimes	The Spot-tailed Quoll occurs in eastern Australia, including Victoria, NSW, and Queensland. The species is found in a variety of habitats, including rainforest, open forest, woodland, coastal heath, and inland riparian forest. As a nocturnal species, the Spot-tailed Quoll requires dens to shelter in during the day. The species' Recovery Plan notes that habitat critical to the survival of the species includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey, which make up the majority of their diet (DELWP, 2016; TSSC, 2020) Within the Strategic Assessment Area, records primarily occur around the edges where some level of landscape connectivity remains with the large areas of surrounding wilderness to the north and west of the Strategic Assessment Area and south of Sydney The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in GMAC, Wilton, and the OSO transport corridor As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including road mortality and inappropriate fire regimes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, because the species would benefit from specific measures that reflect the risks associated with predation from cats. Therefore, additional a specific mitigation measure has been identified to mitigate residual risks to this species	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
Falsistrellus tasmaniensis	Eastern False Pipistrelle	N/A	V	ECS	Loss of roosting habitat, primarily hollow-bearing eucalypts	The Eastern False Pipistrelle occurs on the south-east coast and ranges of Australia from southern Queensland to Victoria and Tasmania. The species prefers moist habitats with trees taller than 20 m. Roosting generally occurs in eucalypt hollows but also under loose bark on trees or in buildings (OEH, 2017i) Records are distributed across the Cumberland Plain subregion with a heavy concentration between Parramatta and Penrith (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in Wilton and GMAC This species is reliant on mature, hollow bearing trees and would benefit from strengthened measures to protect this habitat. Therefore, a specific mitigation measure has been identified to mitigate potential residual impacts	Yes
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	N/A	V	ECS	Loss of hollow-bearing trees Artificial light sources spilling on to foraging and/or roosting habitat Hazard reduction burns on foraging and/or roosting habitat	The Eastern Coastal Free-tailed Bat occurs along the east coast from southern Queensland to southern NSW. Primary habitat includes dry sclerophyll forest, swamp forests, and mangrove forests east of the Great Dividing Range. Roosting generally occurs in tree hollows but also under bark or in man-made structures (OEH, 2020b) Records are widespread throughout the entire Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including light pollution and inappropriate fire regimes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, additional specific measures have been identified to reflect the species reliance on large mature trees and man-made structures for roosting and address potential residual impacts to these features	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
Miniopterus australis	Little Bent-wing Bat	N/A	V	ECS	Disturbance to and loss of known maternity and roost sites such as caves, and roosts within culverts, tunnels and under bridges Hazard reduction fires Predation from cats and foxes	The Little Bent-wing Bat is distributed across the east coast and ranges of Australia from Queensland to NSW. The species inhabits moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal, and banksia scrub. Roosting occurs in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges, and occasionally buildings. In NSW, the largest maternity colony is in close association with a large maternity colony of Eastern Bent-wing Bats and may depend on the large colony to provide the high temperatures needed to rear its young (OEH, 2020e) Records are scattered across the Cumberland Plain subregion with a heavy concentration in north-eastern Parramatta (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and predation These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, specific measures are needed to reflect the species reliance on large mature trees and man-made structures for roosting and address potential residual impacts to these habitat features	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	N/A	V	ECS	Disturbance by general public accessing caves and adjacent areas Hazard reduction fires Predation by feral cats	The Large Bent-winged Bat is found along the east and north-west coasts of Australia. The bat primarily roots in caves but also utilises derelict mines, stormwater tunnels, buildings, and other man-made structures. The species form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes (OEH, 2019j) Records are densely scattered across the entire Cumberland Plain subregion and most heavily concentrated in Parramatta (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including disturbance, inappropriate fire regimes and predation These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, specific measures are needed to reflect the species use of man-made structures for roosting and address potential residual impacts to these habitat features	
Myotis macropus	Southern Myotis	N/A	V	SCS	Loss or disturbance of roosting sites Reduction in stream water quality	The Southern Myotis occurs in the coastal band from the north-west of Australia across the top-end and south to western Victoria. Roosting generally occurs close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges, and in dense foliage. The species forages over streams and pools to catch insects and small fish (OEH, 2020h) Records are densely scattered across the entire Cumberland Plain subregion (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including disturbance and impacts to hydrological processes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species However, specific measures are needed to reflect the species reliance on large mature trees and man-made structures for roosting and address potential residual impacts to these habitat features	Yes
Petaurus australis	Yellow-bellied Glider	N/A	V	ECS	Loss of hollow-bearing trees	The Yellow-bellied Glider occurs along the eastern coast to the western slopes of the Great Dividing Range from southern Queensland to Victoria. The species primarily inhabits tall mature eucalypt forest in areas with high rainfall and nutrient rich soils,	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						but forest type preferences vary with latitude and elevation. The glider feeds mainly on plant and insect exudates and dens in large tree hollows (OEH, 2017ai) Records are densely concentrated in the Kurrajong area of the Cumberland Plain subregion with a few in Penrith, Picton, and Parramatta (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur elsewhere in the bioregion; there are very few recent records in the subregion • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development). There is a specific measure in the Plan for some other species to retain large trees during precinct planning, which is likely to benefit the Yellow-bellied Glider. These measures are expected to manage any residual impacts to the species	
Petaurus norfolcensis	Squirrel Glider	N/A	V	SCS	Loss of hollow-bearing trees Inappropriate fire regimes Road mortality	The Squirrel Glider is sparsely distributed in eastern Australia from northern Queensland to western Victoria. The species inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understory in coastal areas. The glider requires tree hollows for refuge and nest sites (OEH, 2017ad) There are few records distributed across Kurrajong and the southern boundary of the Cumberland Plain subregion with a couple of records near Parramatta (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in GPEC, Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur elsewhere in the bioregion; there are very few recent records in the subregion	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						• The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and road mortality. In addition, there is a specific measure in the Plan for some other species to retain large trees during precinct planning, which is likely to benefit the Squirrel Glider. These measures are expected to manage any residual impacts to the species	
Phascolarctos cinereus	Koala	V	V	ECS SCS	Vehicle strike Effects of urban development including predation by dogs Disruption of connectivity Fire Disease (Chlamydiosis caused by infection with Chlamydia)	Koalas are distributed within coastal and inland regions of eastern Australia, from South Australia to northern Queensland. The species is a specialist folivore, highly selective of its leaf diet from only a small number of trees in their local area. Koalas eat the leaves of over 100 *Eucalyptus* species and over 30 non-*Eucalyptus* species (including genera such as *Angophora* and *Corymbia*) (OEH, 2018a) and prefer trees growing in fertile soils, which provide for higher leaf nutrient content (McAlpine et al., 2008) There are two known populations of Koalas that occur within or near to the Strategic Assessment Area. The most relevant to this assessment is the Southern Sydney population which occurs within and near to Wilton and GMAC. The other is the Blue Mountains population which has infrequent records in the western portion of the Strategic Assessment Area The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in Wilton and GMAC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including road mortality, impacts from domestic animals and inappropriate fire regimes These measures are expected to address a number of potential indirect impacts from development under the Plan on this species. However, residual risks to the species	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						have been identified and a range of specific mitigation measures are needed to mitigate these (see section 15.6.4 and Chapter 30 for the full Koala impact assessment)	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	ECS	Camp disturbance Loss of large trees for foraging and roosting	The Grey-headed Flying-fox is typically found within 200 km of the eastern coast of Australia from Queensland to Victoria. The species roosts on exposed branches located close to water sources. Roost vegetation includes rainforest patches, stands of *Melaleuca*, mangroves, and riparian vegetation. Roosting camps are used for mating, giving birth, and rearing young. The species have high site fidelity to these roosting camps with some used for over a century (DoEE, 2018c) The species feed on fruit and nectar from the canopy and use a range of vegetation communities, including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps, and *Banksia* woodlands (DoEE, 2018c) Records are heavily concentrated throughout the Cumberland Plain subregion, particularly in Parramatta and Penrith (OEH, 2021a)The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas Species specific measures are considered necessary This species is reliant on large mature trees and sensitive to camp disturbance, therefore specific mitigation measures have been identified to mitigate residual risks to this species	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	N/A	V	ECS	Disturbance to roosting and summer breeding sites Loss of hollow-bearing trees	The Yellow-bellied Sheathtail-bat is distributed across northern and eastern Australia. The species roosts in tree hollows and buildings or mammal burrows in treeless areas. Foraging for insects occurs in most habitats across its very wide range (OEH, 2017aj) Records in the Cumberland Plain subregion are primarily concentrated in Parramatta with a few in Kurrajong, Penrith, Campbelltown, and Picton (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address indirect impacts	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						This species is reliant on large mature trees for roosting and sensitive to disturbance, therefore additional specific mitigation measures have been identified to mitigate residual risks	
Scoteanax rueppellii	Greater Broad-nosed Bat	N/A	V	ECS	Disturbance to roosting and summer breeding sites Loss of hollow-bearing trees	The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range from north-eastern Victoria to the Atherton Tableland. In NSW, the species is widespread on the New England Tablelands. The species primarily inhabits tall wet forest but occurs in a wide range of habitats from woodland through to moist and dry eucalypt forest and rainforest. Roosting generally occurs in tree hollows but occasionally in buildings. Foraging occurs in open woodland habitat and dry open forest for direct flight (OEH, 2017p) Records are heavily dispersed across the Cumberland Plain subregion except for the south-west corner in Picton (OEH, 2021a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in Wilton and GMAC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts This species is reliant on large mature trees for roosting and sensitive to disturbance, therefore additional specific mitigation measures have been identified to mitigate residual risks	Yes
REPTILES							
Hoplocephalus bungaroides	Broad-headed Snake	V	E	ECS	Bush rock removal Inappropriate fire regimes Predation by cats Road mortality	The Broad-headed Snake occurs in the sandstone ranges in the Sydney Basin within a 200 km radius of Sydney. The species is found in four main areas: • Blue Mountains • Southern Sydney • An area outside of the Cumberland Plain, to the north-west • The Nowra hinterland (DoE, 2014c) Adults shelter in rocky outcrops during colder seasons and move to adjacent sclerophyll woodlands in warmer seasons with a preference for sites they have	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						previously used. In woodland areas, the species is found in large trees with multiple hollows and dead trees. Pregnant females and juveniles remain in rocky habitat, using cooler, shaded rocks, and crevices (DoEE, 2018c) There is a single current record of the Broad-headed Snake within the Strategic Assessment Area, reflecting the largely unsuitable habitat across most of the area. The record is dated from 2014 located in the southern section of the Strategic Assessment Area, near Buxton The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because • There is only one current record of the species in the Strategic Assessment Area, greater densities of records occur in surrounding areas, in particular to the south-east of the subregion • The removal of bush rock in many reserves is prohibited and management plans for reserves typically include measures to control public access within reserves, which may reduce the risk of bush rock removal for the species As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. These measures are expected to manage any potential impacts to the species	
Varanus rosenbergi	Rosenberg's Monitor	N/A	V	ECS	Removal of habitat elements, such as termite mounds and fallen timber Predation by cats and dogs	The Rosenberg's Monitor is found in Wollemi National Park to the north-west of Sydney, Cooma, Goulburn, and ACT regions. The species is also found in WA and SA. Occurring in heath, open forest and woodland, the Rosenberg's Monitor is associated strongly with termites as termite mounds are a critical habitat component. The species also finds shelter in rock crevices, hollow logs and burrows (OEH, 2017y). There is one record of the Rosenberg's Monitor that occurs towards the western boundary of the Cumberland Plain subregion although the species is widely reported to the south and southeast The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to urban capable land and transport corridors in Wilton and GMAC.	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • There are no records of the species within or nearby the nominated areas • Greater densities of records occur elsewhere in the bioregion • The species is considered unlikely to rely on the habitat at risk of indirect impacts for persistence in the subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. These measures are expected to manage any residual impacts to the species	
AMPHIBIANS							
Heleioporus australiacus	Giant Burrowing Frog	V	V	SCS	Hydrological changes Inappropriate fire regimes Predation by foxes and cats Vehicle strike Infection with amphibian chytrid fungus	The Giant Burrowing Frog is found in Victoria and NSW up to 100 km inland and 1,000 m above sea level. The species may comprise of two separate species, one in the north (Central Coast and Sydney Region) and one in the south (south of Kiama), although revision is still underway. The northern population is confined to areas of sandstone geology, and is found in ephemeral and semi-permanent streams, beside perennial creeks, on sandstone shelves in hanging swamps, and at times in artificial dams, ditches and culverts (DAWE, 2020c). Records of the species within the Strategic Assessment Area are limited and sporadic, the largest of which occurs in Gulguer Nature Reserve, along with individual records at Picton, Castlereagh, and Cambridge Park The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • There are limited records of the species in the Strategic Assessment Area and a lack of suitable habitat in the subregion • Greater densities of records occur in surrounding areas, in particular to the south-east of the subregion	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
						• The species does not appear to rely on the habitat at risk of indirect impacts for persistence in the subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including impacts to hydrological processes, inappropriate fire regimes, predation, vehicle strike and disease. These measures are expected to manage any residual impacts to the species	
Litoria aurea	Green and Golden Bell Frog	V	E	SCS	Changes to the structure and diversity of aquatic vegetation Changes to hydrology and water quality Intensification of public access to habitat Predation cats Inappropriate fire regimes Infection with amphibian *chytrid* fungus	The Green and Golden Bell Frog is recorded throughout coastal lowland areas of Victoria and NSW from Lake Wellington (south) to Yuraygir National Park (north). The species is found in the areas around Sydney and in the Cumberland subregion. The species has been recorded sporadically throughout the Strategic Assessment Area north of Liverpool, with outlying populations near Razorback, Narellan, and Campbelltown. The Green and Golden Bell Frog occurs in still, shallow, temporary, and unshaded water bodies with terrestrial habitats of low vegetation and grassy areas. Ephemeral water bodies are important for this species for breeding, habitat connectivity, and due to the absence of mosquito fish (DEWHA, 2009) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the OSO transport corridor in GPEC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, because the potential population associated with Ropes Creek corridor is on the edge of the western range for the species and could be potentially impacted by development under the Plan, species-specific commitments are required to address potential residual impacts	Yes
Pseudophryne australis	Red-crowned Toadlet	N/A	V	SCS	Changes to hydrology and pollution/	The distribution of the Red-crowned Toadlet is confined within the Sydney Basin between Pokolbin (north), Nowra (south) and Mt Victoria in the Blue Mountains. The species has been recorded within the subregion with isolated records near Pitt Town,	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
					degradation of water quality Inappropriate fire regimes Habitat degradation through four-wheel driving and trail bikes Bush rock removal	Narellan, and Picton, and is extensively recorded in the area surrounding the subregion. The species is found in open forests, and shelters under rocks or in dense vegetation or piles of leaf litter. Successful breeding is related to water quality; Red-crowned Toadlets have not been recorded in water with a pH above or below 5.5-6.5, or water that is even mildly polluted (OEH, 2019q) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • Records occur throughout the bioregion and the subregion does not appear to be a stronghold for the species • The species does not appear to rely on the habitat at risk of indirect impacts for persistence in the subregion • The removal of bush rock in many reserves is prohibited and management plans for reserves typically include measures to control public access within reserves, which may reduce the risk of bush rock removal for the species As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. These measures are expected to manage potential residual impacts	
INVERTEBRATES							
Meridolum corneovirens	Cumberland Plain Land Snail	N/A	E	SCS	Weed invasion Inappropriate fire regimes Removal of fallen logs for firewood Loss of ground shelter habitat by slashing	The Cumberland Plain Land Snail occurs in the Cumberland Plain from Richmond to Picton, and from Liverpool West to the Nepean Rivers at the base of the Blue Mountains. The species has been widely recorded throughout the entirety of the Strategic Assessment Area. The Cumberland Plain Land Snail occurs mostly in Cumberland Plain Woodland, living under litter of bark, leaves and logs, around grass clumps, and occasionally rubbish (OEH, 2019f) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in each nominated area	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Relevant indirect impacts / specific threats	Assessment of indirect impacts	Residual impacts
					Ground subsidence	As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and inappropriate fire regimes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, because the species is restricted to the subregion, additional species-specific commitments are required to address potential residual impacts and to support critical actions for the species under the Saving our Species program	
Pommerhelix duralensis	Dural Land Snail	E	E	N/A	Inappropriate fire regimes Disturbance due to weed control activities	The Dural Land Snail is endemic to NSW and occurs mostly along the north-east fringes of the Cumberland subregion. Isolated records occur within the Strategic Assessment Area near Richmond, Silverdale, Cranebrook, St Helens Park and Londonderry. The species is found on shale-sandstone-transitional landscapes and is dependent on shale availability. The Dural Land Snail inhabits forests with woody debris and native cover, it is considered intolerant of weedy and highly disturbed habitats (DoE, 2015d) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in WSA and GPEC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • There are no records close to urban capable land or transport corridors, or in areas most at risk of indirect impacts from development • The species does not appear to rely on the habitat at risk of indirect impacts for persistence in the subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and disturbance from weed control activities. These measures are expected to manage potential residual impacts	No

15.7.2 FLORA

Table 15-18: Assessment of indirect impacts – flora

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	V	E	SCS	Inappropriate habitat disturbance Weed invasion Inappropriate fire regimes	The Bynoe's Wattle is widely distributed throughout central-eastern NSW including the Cumberland IBRA subregion (OEH, 2019c). Occurrences have been widely reported in the Strategic Assessment Area near Londonderry, with outlying occurrences reported near Liverpool and Wilton. The species is recorded in open and at times slightly disturbed sites, and inhabits heath or dry sclerophyll forests on sandy soils (OEH, 2017d) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GMAC and Wilton. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of records occur away from urban capable land and transport corridors • The majority of mapped potential habitat is of low habitat value or is of limited extent within GMAC and Wilton (Douglas, 2019) • Some habitat for the species is subject to approval conditions to protect and manage it from indirect impacts, under an existing EPBC Act approval in the Bingara area. As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. These measures are expected to manage potential residual impacts	No
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	V	V	SCS	Weed invasion Habitat disturbance through illegal track creation and maintenance activities Inappropriate fire regimes	The Downy Wattle distribution is limited to the Sydney district, and is found predominantly in the Cumberland subregion (NSW NPWS, 2003). Occurrences of the species have been widely reported within the Strategic Assessment Area in the areas surrounding Liverpool and Pitt Town. The species occurs on shales, alluviums and at the intergrade between shales and sandstones. The species is typically found in open woodland and forest, throughout a variety of plant communities (DoEE, 2018c). Recruitment primarily occurs through vegetative reproduction (NSW NPWS, 2003) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in the nominated areas	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
						and transport corridors outside the nominated areas. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of records occur away from urban capable land and transport corridors • The species does not appear to rely on the habitat at risk of indirect impacts for persistence in the subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion, disturbance and inappropriate fire regimes. These measures are expected to manage potential residual impacts	
Allocasuarina glareicola		E	E	SCS	Habitat degradation from increased public access Inappropriate fire regimes Weed invasion	*Allocasuarina glareicola* is distributed within the Cumberland subregion, primarily the Castlereagh and Londonderry areas with a total extent of occurrence (EOO) of 27 km^2. The species is found in open woodland and Castlereagh woodland on soil characterised by strong acidity and low fertility. As the species is wind pollinated, the distance between populations may be a critical factor for seed set and pollination (DoEE, 2018c; OEH, 2018b) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GPEC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of records and potential habitat occur away from urban capable land and transport corridors • Several areas of potential habitat and records are managed in existing conservation reserves As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including habitat degradation, inappropriate fire regimes and weed invasion. These measures are expected to manage potential residual impacts	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
Commersonia prostrata	Dwarf Kerrawang	E	E	N/A	None	The distribution of the Dwarf Kerrawang ranges from central Gippsland (Victoria) to the NSW coast. It is known to occur in the Cumberland region, and is found near Tallong, Goulburn, Penrose, and Newcastle (DoEE, 2018a; OEH, 2017h, 2020a). Occurrence of the species in the Strategic Assessment Area has been recorded in Thirlmere Lakes National Park near Couridjah. The species is endemic to South-eastern Australia. The Dwarf Kerrawang is typically found on peaty or sandy soils in a range of habitats including but not limited to Brittle Gum Low Open Woodland at Penrose, and Snow Gum Woodland at Rose Lagoon (DoEE, 2018a; OEH, 2017h, 2020a) While the Plan has the potential to exacerbate some threats to the species, this is unlikely to result in indirect impacts to the species because the majority of areas of habitat occur some distance away from the urban capable land and transport corridors and away from associated areas that could be impacted	N/A
Cynanchum elegans	White-flowered Wax Plant	E	E	N/A	Degradation of habitat due to weed invasion, grazing and inappropriate fire management Hydrological disturbance	The distribution of the White-flowered Wax Plant ranges from Brunswick heads to the Illawarra region in Eastern NSW (DEWHA, 2008a). Occurrences of the species within the Strategic Assessment Area have been reported sporadically near Razorback, Oran Park, and Grose Vale. The species distribution overlaps with various TEC's including but not limited to Cumberland Plain Woodlands and Shale Sandstone Transition Forest. The species typically resides in the transition zone between sclerophyll forest/woodland and subtropical rainforest on steep slopes (DEWHA, 2008a) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur near to the OSO transport corridor near Cobbitty, south of WSA As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and inappropriate fire regimes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, because an important population occurs close to the OSO transport corridor, additional species-specific commitments are required to address potential residual impacts	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
Deyeuxia appressa		E	E	N/A	None	Recorded observances of the species are limited to the Sydney region, although the species may be extinct with the last observation prior to 1942. There are no current recorded occurrences of the species within the Strategic Assessment Area. Understanding of the species is limited. The species is known to grow in moist conditions in three TECs; Shale and Sandstone Transition Forest, Cumberland Plain Woodlands, and Turpentine-Ironbark Forest in the Sydney Basin Bioregion (DEWHA, 2008b; OEH, 2018e) While the Plan has the potential to exacerbate some threats to the species, this is unlikely to result in indirect impacts to the species because all three records of the species (if extant) and potential habitat occur outside the Strategic Assessment Area and some distance from the urban capable land and transport corridors and transport corridors and away from associated areas that could be impacted	N/A
Dillwynia tenuifolia		N/A	V	SCS	Inappropriate fire regimes Disturbance from human activity such as rubbish dumping and uncontrolled vehicular access Weed invasion	The core distribution of the species is within the Cumberland Plain, ranging from Windsor and Penrith to Dean Park. The species is also found in the Bulga Mountains, Kurrajong Heights, and Woodford in the Blue Mountains. Occurrences of *Dillwynia tenuifolia* in the Strategic Assessment Area have been recorded extensively in the areas surrounding Londonderry and Kemps Creek. The species may be locally abundant in scrubby/dry heath areas in Castlereagh Ironbark Forest and Shale Gravel Transition Forest in Western Sydney (OEH, 2017f) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in WSA and GPEC. As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion, disturbance, and inappropriate fire regimes These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the subregion is a key location for the species and records and potential habitat occurs close to urban capable land and transport corridors. Additional species-specific commitments are therefore required to strengthen protection and address potential residual impacts	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
Epacris purpurascens var. *purpurascens*		N/A	V	SCS	Urban run-off Inappropriate fire regimes Disturbance from human activity such as rubbish dumping, trampling and uncontrolled vehicular access Weed invasion	The species is distributed in NSW between Gosford (north), Narrabeen (east), Silverdale (West) and Avon Dam (South). Occurrences of the species within the Strategic Assessment Area have been recorded primarily in the area around Wilton. The species is found in a range of habitats characterised by the presence of shale soil (OEH, 2017k) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in Wilton and GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of the records in the subregion occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion or subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. These measures are expected to manage potential residual impacts	No
Eucalyptus benthamii	Camden White Gum, Nepean River Gum	V	V	SCS	Inappropriate fire regimes Changed hydrology Weed invasion Myrtle rust Ground subsidence	The Camden White Gum is found in the Cumberland subregion and the Blue Mountains. Occurrences of the species within the Strategic Assessment Area have been recorded sporadically with most records in the areas surrounding The Oaks and Camden. The distribution of the species overlaps with EPBC Act-listed TECs including the Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest, and the Shale Sandstone Transition Forest. The species is typically found in fertile, alluvial sands in areas with a flooding regime to allow the establishment of seedlings (DoE, 2014b) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to GPEC, GMAC and the OSO transport corridor As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species,	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
						including inappropriate fire regimes, impacts to hydrological processes, weed invasion and spread of disease These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the species has been identified as being at risk from indirect impacts from the OSO tunnel, and additional specific measures are required to address potential residual impacts in relation to this	
Genoplesium baueri	Yellow Gnat-orchid	E	E	N/A	Habitat disturbance from recreational use, rubbish dumping, and nearby urban areas	The Yellow Gnat-orchid, an endemic species to NSW, is distributed in coastal regions primarily between Ulladulla and Port Stephens. The species has also been observed outside this range in the Blue Mountains and Penrose State Forest. Records of occurrence within the Strategic Assessment Area are limited, with singular observations near Campbelltown, Appin, and Bargo. The species typically grows in either shrubby forest to heathy forest on well drained sandy and gravelly soils, or heathland to shrubby woodland on sand or sandy loams (DoE, 2014e). The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GMAC There are very few records of this species in the subregion, however, a population (no. 21) occurs close to the urban capable land in GMAC and an additional species-specific commitment is required to address potential residual impacts in this location	Yes
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	N/A	V	SCS	Inappropriate fire regimes Disturbance from human activity such as rubbish dumping, trampling and increased fire risk Weed invasion	The Juniper-leaved Grevillia is endemic to Western Sydney, with records primarily occurring in the area between Blacktown, Erskine Park, Londonderry and Windsor, and outlying records of occurrence in Kemps Creek and Pitt Town. The species is known to occur in Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest (OEH, 2019h) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in WSA and GPEC. As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the subregion is a key location for	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
						the species, records and potential habitat occur close to urban capable land and transport corridors, so additional species-specific commitments are required to address potential residual impacts	
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	SCS	Road maintenance Weed invasion Habitat disturbance from recreational activities and rubbish dumping Inappropriate fire regimes	The Small-flower Grevillea is endemic to NSW and occurs in a range of areas including Picton, Appin, Bargo, Holsworthy, the Lower Hunter Valley, the Central Coast and Port Stephens. The species is recorded sporadically throughout the Strategic Assessment Area, primarily near Holsworthy, Wilton, Bargo, and Kemps Creek. The species is typically found growing on sandy to gravelly clay soils on upper slopes, crests, or flat plains. Distribution of the Small-flower Grevillea overlaps with numerous TECs including the Cumberland Plain Woodlands, Shale Sandstone Transition Forest, Turpentine-Ironbark Forest, Castlereagh Scribbly Gum and Agnes Banks Woodland, and Cooks River/Castlereagh Ironbark Forest (DEWHA, 2008c) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur near to the urban capable land and transport corridors in Wilton As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and weed invasion. In addition, some habitat for the species is subject to approval conditions to protect and manage it from indirect impacts, under an existing EPBC Act referral (EPBC 2014/7400) in the Bingara area These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, because an important population occurs close to the urban capable land in Wilton, additional species-specific commitments are required to address potential residual impacts in that location	Yes
Hibbertia fumana		N/A	CE	SCS	Inappropriate fire regimes Weed invasion Habitat disturbance from uncontrolled	The distribution of the species ranges across greater Sydney from Richmond to Mittagong. Occurrences of *Hibbertia fumana* have been recorded in the Strategic Assessment Area near Holsworthy. The species has been known to occur primarily in the intergrade between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest, in a variety of structural habitats including disturbed sites, open areas, and within thick ground cover (OEH, 2020d)	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					movement of vehicles	The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in Wilton and GMAC, around the Kemps Creek area in WSA and in Wianamatta Regional Park in GPEC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of the records in the subregion occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted • A large number of records occur in protected areas in Moorebank to the north of GMAC, which is a proposed priority management site under the NSW Saving our Species strategy As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes, weed invasion and disturbance. These measures are expected to manage potential residual impacts	
Hibbertia puberula		N/A	E	SCS	Weed invasion Disturbance from human activity such as from trailbikes, 4WDs and mountain bikes	The species is distributed widely throughout NSW from Wollemi National Park to Morton National Park. *Hibbertia puberula* has been recorded within the Strategic Assessment Area primarily near Holsworthy, with more sporadic records between Holsworthy and Campbelltown. The species is often found on sandy soils, in dry sclerophyll woodland communities and more rarely heaths (OEH, 2017r) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GPEC, in particular the northern boundary adjacent to Shanes Park. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of the records in the subregion occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted • A large number of records occur in protected areas in Moorebank to the north of GMAC, which is a proposed priority management site under the NSW Saving our Species strategy	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
						• The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion or subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including weed invasion and disturbance. These measures are expected to manage potential residual impacts	
Leucopogon exolasius	Woronora Beard-heath	V	V	N/A	Inappropriate fire regimes Weed invasion	The Woronora Beard-heath is endemic to the Sydney and Central Coast regions of NSW. The distribution of the species is fragmented, although it is known to occur in the Cumberland IBRA subregion. Occurrences within the Strategic Assessment Area have been recorded near Campbelltown, with isolated records near Appin, Moorebank and Richmond. The species is found on sandstone and sandy alluvium areas in woodlands, and also occurs on rocky hillsides and along creek banks (DoEE, 2018c; OEH, 2017ah) The Plan has the potential to exacerbate some threats in areas of habitat for this species that occur adjacent to GMAC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of the records in the subregion occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion or subregion • The populations nearest to the nominated area have been classified as non-important populations As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and weed invasion. These measures are expected to manage potential residual impacts	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
Marsdenia viridiflora subsp. *viridiflora*		N/A	E	SCS	Stochastic events (e.g. fire) due to small population size	The species is distributed throughout NSW with known populations in Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Occurrences within the Strategic Assessment Area are scattered between Londonderry and Narellan. The species is known to grow in vine thickets and open shale woodland (OEH, 2019k) The Plan has the potential to exacerbate some threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GMAC, WSA and GPEC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including undertaking bushfire reduction measures close to the urban capable land, which is likely to reduce the likelihood of stochastic events such as wildfires affecting the species	No
Maundia triglochinoides		N/A	V	SCS	Hydrological changes Weed invasion	The distribution of *Maundia triglochinoides* is restricted to coastal NSW and southern Queensland. The Southern limit for the species is Wyong, as former sites surrounding Sydney have become extinct. There are no recorded occurrences within the Strategic Assessment Area. The species is known to grow in lagoons, dams, swamps, creeks, channels or shallow freshwater (OEH, 2019m) The Plan has the potential to exacerbate some threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GMAC and WSA As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including impacts to hydrological processes and weed invasion	No
Melaleuca deanei	Deane's Melaleuca	V	V	SCS	Inappropriate fire regimes and mechanical	The species is known to occur in the Cumberland IBRA subregion, although records primarily occur in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas (OEH, 2019g). Occurrences of the species have been recorded within the Strategic Assessment Area near Wilton and Kentlyn. The species is found on sandstone and sandy soils in ridgetop woodland and wet heath (DoEE, 2018c; OEH, 2019g). Over 50 per cent of	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					methods of bushfire removal Inappropriate habitat disturbance from construction and maintenance of tracks and easements, unrestricted access, and rubbish dumping Weed invasion	Deane's Melaleuca populations are currently protected in national parks or nature reserves (NSW DECCW, 2010) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in Wilton and GMAC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and weed invasion. However, because the species is sensitive to inappropriate habitat disturbance from construction and maintenance of tracks and easements, unrestricted access and rubbish dumping, an additional species-specific commitment is required to address potential residual impacts in relation to these issues	
Micromyrtus minutiflora		V	E	SCS	Inappropriate fire regimes Weed invasion Habitat degradation through arson, grazing, trail bike riding, and rubbish dumping	*Micromyrtus minutiflora* is endemic to the Western region of the Cumberland Plain. Occurrence of the species within the Strategic Assessment Area is recorded primarily in the area surrounding Londonderry. The distribution of the species overlaps with the following TECs, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, Cooks River/Castlereagh Ironbark Forest, and Castlereagh Scribbly Gum and Agnes Banks Woodlands. The species grows in open forests on consolidated river sediments and tertiary alluvium (DEWHA, 2008d; OEH, 2019n) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GPEC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of the records in the subregion occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion or subregion • Many records occur in existing conservation reserves in the north of the subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial and intensive plant agriculture	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
						development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes, weed invasion and disturbance. These measures are expected to manage potential residual impacts	
Persicaria elatior	Tall Knotweed	V	V	SCS	Hydrological changes Inappropriate habitat disturbance, such as through road, track and trail maintenance Weed invasion	The Tall Knotweed is distributed throughout the coastal regions of south-eastern Australia, occurring in the North Coast, Central Coast and South Coast botanical subdivisions. The species has primarily been recorded along coastal regions, although one occurrence has been recorded in the Cumberland IBRA subregion near Picton. The species grows on sandy, alluvial soil in damp places including watercourses, lakes, streams, in swamp forests, in coastal swampy areas and disturbed areas. The distribution of the species overlaps with the Coastal Swamp Oak (*Casuarina glauca*) Forest TEC (DEWHA, 2008e; DoEE, 2018c) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to GMAC, WSA, GPEC and transport corridors. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The majority of the records in the subregion are protected in an existing conservation reserve some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion or subregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including impacts to hydrological processes, disturbance and weed invasion. These measures are expected to manage potential residual impacts	No
Persoonia bargoensis	Bargo Geebung	V	E	SCS	Inappropriate fire regimes and fire maintenance activities	The distribution of Bargo Geebung is restricted to an area of south-west Sydney on the western edge of the Woronora Plateau and northern edge of the Southern Highlands. The species is also known to occur in the Cumberland, Burragorang, and Sydney Cataract regions (OEH, 2019a). Occurrence within the Strategic Assessment Area has	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					Inappropriate habitat disturbance Infection by *Phytophthora cinnamomi*	been widely recorded in the areas surrounding Wilton and Bargo. The species is found in dry sclerophyll eucalypt woodland or forest (DoEE, 2018c) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur near to the urban capable land and transport corridors in Wilton and GMAC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and weed invasion. In addition, some habitat for the species is subject to approval conditions to protect and manage it from indirect impacts, under an existing EPBC Act referral (EPBC 2014/7400) in the Bingara area These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, there is potential for some residual risks to the species relating to inappropriate fire regimes, disturbance from habitat maintenance and P*hytophthora cinnamomic*. Additional species-specific commitments are required to address these issues	
Persoonia glaucescens	Mittagong Geebung	V	E	N/A	None	The Mittagong Geebung has a restricted distribution in NSW from the Kangaroo Valley to Picton and is known to occur in the Cumberland IBRA subregion (OEH, 2019c). Several occurrences of the species have been recorded in the Strategic Assessment Area near Bargo and Buxton. The distribution of the species overlaps with various TECs including Shale Sandstone Transition Forest, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, Turpentine Iron-bark Forest, and Temperate Highland Peat Swamps. The species prefers ridge-tops and upper slopes in woodland to dry sclerophyll forest (DEWHA, 2008f; OEH, 2017v, 2019o) While the Plan has the potential to exacerbate some threats to the species, this is unlikely to result in indirect impacts to the species because the records and majority of areas of habitat occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted	N/A
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	E	E	N/A	Inappropriate fire regimes	The Hairy Geebung has a scattered distribution around the Sydney region and is known to occur in the Cumberland IBRA subregion. A number of occurrences of the species have been recorded in the Strategic Assessment Area including near to Tahmoor, Bargo,	No

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					Disturbance from recreational users Altered hydrology Weed invasion Infection by *Phytophthora cinnamomi*	and Castlereagh. The species is found in dry sclerophyll open forest and woodland on sandy to stony soils (DoE, 2014d; OEH, 2017q) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to all nominated areas and the OSO transport corridor As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes, altered hydrology and weed invasion. In addition, all known populations are on privately owned land which reduces the risk of disturbance from recreational users These measures are expected to address potential indirect impacts from development under the Plan on this species, and are expected to manage potential residual impacts	
Persoonia nutans	Nodding Geebung	E	E	SCS	Inappropriate fire regimes Habitat degradation and rubbish dumping related to unrestricted access Infection by root-rot fungus *Phytophthora cinnamomi* Weed invasion	The distribution of the Nodding Geebung is restricted to the Cumberland region, primarily near the Nepean and Georges River between Richmond and Macquarie Fields. The species is considered to occur predominantly in the Penrith area, although occurrences have been recorded within the Strategic Assessment Area near Kemps Creek, Moorebank, and Castlereagh. The species depends on aeolian and alluvial sediments, and is found in the Agnes Banks and Berkshire Park soil landscapes on low rises (DoEE, 2018c; NSW DEC, 2005) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur near to the urban capable land and transport corridors in WSA and GPEC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, because an important population and potential habitat occur close to the OSO transport corridor within Wianamatta Regional Park in GPEC, additional specific measures are required to address potential residual impacts in that area	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
Pimelea curviflora var. *curviflora*		V	V	SCS	Weed invasion Habitat degradation from recreational activities, road and trail maintenance, and bush rock removal Inappropriate fire regimes	The *Pimelea curviflora* is found in the coastal regions of Sydney and Illawarra in NSW. As of 1998, the species has been known to occur in 20 locations between Maroota and northern Sydney. A further population was identified in Shellharbour in 2011. The species has been recorded in the Strategic Assessment Area near Wilton, Windsor Downs, and Agnes Banks. The distribution of the species overlaps with various TECs including Shale Sandstone Transition Forest, Blue Gum High Forest of the Sydney Basin Bioregion, Cumberland Plain Woodlands, and Turpentine-Ironbark Forest in the Sydney Basin Bioregion. The species is found in open forest and woodland on sandy soil, shaly soil or shale/transition soil (DEWHA, 2008g; DoEE, 2018c) The Plan has the potential to exacerbate threats in areas of habitat for this species (as indicated by records) that occur adjacent to the urban capable land and transport corridors in GMAC, Wilton and GPEC. Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because: • The species occurs elsewhere in the bioregion • The majority of the records in the subregion occur some distance away from the urban capable land and transport corridors, and away from associated areas that could be impacted • The species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion or subregion • Many records are protected in existing conservation reserves As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes, disturbance and weed invasion. These measures are expected to manage potential residual impacts	No
Pimelea spicata	Spiked Rice-flower	E	E	SCS	Illegal dumping of rubbish and garden waste Weed invasion and competition	The species occurs throughout NSW in the Sydney Basin, the Cumberland Plain, and Illawarra region. The distribution of the species in the Cumberland Plain is known to range from the Marayong and Prospect Reservoir south to Narellan Vale and Douglas Park. The species has been recorded sporadically throughout the entirety of the Strategic Assessment Area. The habitat for the species is associated with the Cumberland Plain	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					High frequency land-use/management activities Inappropriate fire regimes Hydrological disturbance Ground subsidence	Shale Woodlands and Shale Gravel Transition Forest, along with Western Sydney Dry Rainforest and Moist Woodland on Shale Woodland (DEC, 2005; TSSC, 2016b) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur near to the urban capable land and transport corridors in all nominated areas and transport corridors outside the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, residual risks associated with human disturbance and indirect impacts from the OSO tunnel have been identified, so additional specific measures are required to address these issues	
Pomaderris brunnea	Rufous Pomaderris	V	E	SCS	Weed invasion Disturbance from trampling and recreational vehicle use Stormwater run-off Altered fire regimes Ground subsidence	The Rufous Pomaderris is endemic to south-eastern Australia occurring in eastern NSW, the North Coast of NSW, the New England bioregion, and eastern Victoria. The Strategic Assessment Area is considered a core location for the species, with numerous occurrences reported south of Gregory Hills. The species inhabits alluvial soils on flood plains and creek lines, and clay in moist woodlands or forests (Sutter, 2011) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GMAC and Wilton and transport corridors outside the nominated areas As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the species has been identified as being at risk from indirect impacts from the OSO tunnel, and additional specific measures are required to address potential residual impacts associated with this	Yes
Pterostylis saxicola	Sydney Plains Greenhood	E	E	SCS	Weed invasion	The distribution of the Sydney Plains Greenhood orchid is restricted to Western Sydney between Picton in the south and Freemans Reach in the north (DEWHA, 2008h; DoEE,	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					Inappropriate fire regimes Inappropriate habitat disturbance Unrestricted access	2018c). The species has been recorded sporadically throughout the Strategic Assessment Area. On the Cumberland Plain, the species occurs along an ecological gradient from clay soils on gently hilly landscapes (PCT 849), to clay to sandy soils (PCT 1395), to thin accumulations of humus-rich sandy soil on sandstone rock shelves (PCTs 1081, 1083, 1181 and 1789) (Weston, 2018) The Plan has the potential to exacerbate potential impacts in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GPEC, GMAC and Wilton Should this occur, the consequence for the persistence of the species in the bioregion is likely to be minor because the species does not appear to rely on the habitat at risk of indirect impacts from the development for persistence in the bioregion As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species. However, the species has been identified as being at risk from indirect impacts associated with habitat disturbance, and additional specific measures are required to address potential residual impacts	
Pultenaea parviflora		V	E	SCS	Inappropriate habitat disturbance from uncontrolled vehicle access and rubbish dumping Inappropriate fire regimes Weed invasion	The distribution of *Pultenaea parviflora* is restricted to the Cumberland Plain, primarily between Penrith and Windsor. Further outlying occurrences of the species have been recorded in the Strategic Assessment Area near Kemps Creek and Wilberforce. The species grows in sclerophyll woodlands, forests or in derived grasslands (DoEE, 2018c; OEH, 2017x) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GPEC and WSA As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and weed invasion These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the subregion is a key location for	Yes

Scientific name	Common name	Cth status	NSW status	BAM species type	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
						the species, and records and potential habitat occur close to urban capable land and transport corridors. Additional species-specific commitments are therefore required to address potential residual impacts	
Pultenaea pedunculata	Matted Bush-pea	N/A	E	SCS	Inappropriate fire regimes Disturbance from human activity Weed invasion	The Matted Bush-pea is widespread in south-eastern Australia, Tasmania, and Victoria. In NSW there are three disjunct populations, located on the Cumberland Plain, the coast of NSW between Bermagui and Tathra, and in Windellama. The species has been recorded within the Strategic Assessment Area near Liverpool, Narellan, and Appin. In NSW, the species is typically found in woodland vegetation and sometimes road batters and coastal cliffs (OEH, 2018g) The Plan has the potential to exacerbate threats in areas of habitat for this species that occur adjacent to the urban capable land and transport corridors in GMAC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this species, including inappropriate fire regimes and weed invasion These measures are expected to address the majority of potential indirect impacts from development under the Plan on this species. However, the subregion is a key location for the species, records and potential habitat occur close to urban capable land in GMAC. Additional species-specific commitments are required to address potential residual impacts	Yes

15.7.3 THREATENED ECOLOGICAL COMMUNITIES

Table 15-19: Assessment of indirect impacts – TECs

Cth TEC name	NSW TEC name	Cth status	NSW status	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	*Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion*	E	V	Inappropriate fire regimes Weed invasion Invasive fauna Diseases, pathogens, and dieback Damage caused by human disturbance	The distribution of the TEC is restricted to the Sydney Basin bioregion, occurring across the Cumberland subregion and the margin of the Sydney Cataract, Wollemi and Burragorang subregions. The TEC is found within the Strategic Assessment Area in larger patches in the Castlereagh area, with other occurrences in Holsworthy, Tahmoor, Kemps Creek and Longneck Lagoon. The TEC typically grows on Tertiary sands and gravels of the Hawkesbury-Nepean river system, at elevations below 80 m with mean annual rainfall of 700-900 mm (DoE, 2015b) While areas of mapped TEC occur some distance from the urban capable land and transport corridors, the Plan has the potential to exacerbate several threats to the TEC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC. These measures are expected to manage any residual impacts to the TEC	No
River-flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria	*River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	CE	E	Inappropriate fire regimes Weed invasion Changes to hydrology Invasive fauna Diseases, pathogens, and dieback Damage caused by human disturbance Urban heat island effect Ground subsidence	The TEC extends through two IBRA Bioregions, Sydney Basin and South-East Corner, and is distributed from Sale in Victoria to the north of Newcastle in NSW. The community is typically found in riparian corridors, floodplains, older floodplain terraces, and floodplain depressions at elevations below 50m. The TEC often forms mosaics with wetland and floodplain forest communities, and is important for riverbank stability and river ecosystems (DAWE, 2020b) The Plan has the potential to exacerbate threats in areas of the TEC that occur adjacent to the urban capable land in the nominated areas and in the transport corridors As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial	Yes

Cth TEC name	NSW TEC name	Cth status	NSW status	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC These measures are expected to address the majority of potential indirect impacts from development under the Plan on this TEC. However, because the TEC is at risk from dieback caused by *Phytophthora cinnamomi*, an additional specific mitigation measure has been identified to mitigate residual risks	
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	E	E	Inappropriate fire regimes Weed invasion Inappropriate habitat disturbance Changes to hydrology Diseases, pathogens, and dieback Invasive fauna	The TEC is widely distributed along the east coast of Australia from Bermagui in NSW to Curtis Island in Queensland. The occupancy of the community within the Strategic Assessment Area is limited within Cranebrook to Bow Bowing. The TEC occurs is coastal catchments within 30 km of the coast on unconsolidated sediments at elevations below 50 m (DoEE, 2018b) The Plan has the potential to exacerbate threats in areas of the TEC that occur adjacent to the urban capable land and transport corridors in WSA and GPEC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC These measures are expected to address the majority of potential indirect impacts from development under the Plan on this TEC. However, because the TEC is at risk from dieback caused by *Phytophthora cinnamomi*, an additional specific mitigation measure has been identified to mitigate residual risks	Yes
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	*Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	CE	E	Inappropriate fire regimes Weed invasion Inappropriate habitat disturbance	The TEC is confined to the Sydney Basin and distribution is primarily restricted to the Cumberland subregion. The community is found in larger patches in the Castlereagh, Kemps Creek and Holsworthy areas, with smaller patches in the eastern part of the subregion. The TEC is found in areas with an annual rainfall of 800-1000 mm at	Yes

Cth TEC name	NSW TEC name	Cth status	NSW status	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
				Changes to hydrology Diseases, pathogens, and dieback Invasive fauna	elevation below 100m, generally growing on clay soils or Wianamatta Shale soils (DoE, 2015c) The Plan has the potential to exacerbate threats in areas of the TEC that occur adjacent to urban capable land and transport corridors in WSA and GPEC. As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC These measures are expected to address the majority of potential indirect impacts from development under the Plan on this TEC. However, because the TEC is at risk from dieback caused by *Phytophthora cinnamomi*, an additional specific mitigation measure has been identified to mitigate residual risks. In addition, there is a TEC-specific commitment to undertake all control measures in line with the *Best Practice Guidelines: Cooks River/Castlereagh Ironbark Forest* and *Recovering Bushland on the Cumberland Plain: best practice guidelines on the management and restoration of bushland*	
	Cumberland Plain Woodland in the Sydney Basin Bioregion		CE	Inappropriate fire regimes Weed invasion Inappropriate habitat disturbance Changes to hydrology Diseases, pathogens, and dieback Invasive fauna Ground subsidence	The TEC occurs throughout drier regions of the Sydney Basin and was previously extensive across the Cumberland Plain. Currently, 9% of original extent remains, with remnants scattered throughout the Cumberland subregion. Larger patches have been recorded in the northern area of the Strategic Assessment Area in GPEC and near Pitt Town. The community occurs on heavy soils derived from Wianamatta Shale (OEH, 2009) The Plan has the potential to exacerbate threats in areas of the TEC that occur adjacent to the urban capable land in the nominated areas and transport corridors As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental	Yes

Cth TEC name	NSW TEC name	Cth status	NSW status	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC These measures are expected to address the majority of potential indirect impacts from development under the Plan on this TEC. However, because the TEC is at risk from dieback caused by *Phytophthora cinnamomi*, an additional specific mitigation measure has been identified to mitigate residual risks	
	Shale Gravel Transition Forest in the Sydney Basin Bioregion		E	Inappropriate fire regimes Weed invasion Inappropriate habitat disturbance Changes to hydrology Diseases, pathogens, and dieback Invasive fauna	The TEC is distributed primarily in the northern region of the Cumberland Plain. The community is recorded within the northern section of the Strategic Assessment Area near Pitt Town, Marsden Park and Richmond, with outlier areas at Kemps Creek and Liverpool. The TEC is a transitional plant community, and grades into Cumberland Plain Woodland, Cooks River/Castlereagh Ironbark Forest, or Castlereagh Scribbly Gum Woodland (OEH, 2020g) The Plan has the potential to exacerbate threats in areas of this TEC that occur adjacent to the urban capable land and transport corridors in WSA and GPEC As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC These measures are expected to address the majority of potential indirect impacts from development under the Plan on this TEC. However, because the TEC is at risk from dieback caused by *Phytophthora cinnamomi*, an additional specific mitigation measure has been identified to mitigate residual risks	Yes
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	*Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion*	CE	CE	Changes to hydrology	The TEC occurs only in the Sydney Basin bioregion within the Cumberland subregion. It is recorded in the Camden LGA, where small patches occur in cleared and mined tertiary sand deposit. The community occurs in areas with mean annual rainfall of approximately 750mm at elevations of 60-100m (DAWE, 2020a)	No

Cth TEC name	NSW TEC name	Cth status	NSW status	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
					The Plan has the potential to exacerbate threats in areas associated with the OSO and Metro Rail Future Extension tunnels. As described in section 15.6, mitigation measures will be implemented through future environmental assessment processes (for transport development) that will address potential indirect impacts from hydrological disturbance in the vicinity of the tunnel footprints. These measures are expected to manage any residual impacts to the TEC	
	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		E	Hydrological disturbance Weed invasion Inappropriate habitat disturbance	The TEC occurs throughout the majority of the NSW coast although it is distinct from Sydney Freshwater Wetlands associated with sandplains in the Sydney Basin bioregion. The community has been extensively cleared and modified, and is found within the northern region of the Strategic Assessment Area and within GPEC near Penrith (OEH, 2020c) The Plan has the potential to exacerbate threats in areas of this TEC that occur in GPEC. However, there is limited TEC mapped in the subregion and it occurs away from urban capable land and transport corridors As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC. These measures are expected to manage any residual impacts to the TEC	No
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*	CE	CE	Inappropriate fire regimes Weed invasion Inappropriate habitat disturbance Changes to hydrology Diseases, pathogens, and dieback	The TEC is distributed on the edge of the Cumberland subregion, and the adjacent areas of Hornsby, Woronora, and the Lower Blue Mountains Plateaux within the Sydney Basin bioregion. The community occurs in soils derived from shale substrates and is strongly associated with the Mittagong formation. The TEC is found in areas with a mean annual rainfall of 800-1100 mm at elevations below 200m (DoE, 2014a)	Yes

Cth TEC name	NSW TEC name	Cth status	NSW status	Key relevant indirect impacts / threats	Assessment of indirect impacts	Residual impacts
				Invasive fauna	The Plan has the potential to exacerbate threats in areas of this TEC that occur adjacent to the urban capable land and transport corridors in Wilton and GMAC. As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC These measures are expected to address the majority of potential indirect impacts from development under the Plan on this TEC. However, because the TEC is at risk from dieback caused by *Phytophthora cinnamomi*, an additional specific mitigation measure has been identified to mitigate residual risks	
	Moist Shale Woodland in the Sydney Basin Bioregion		E	Inappropriate fire regimes Weed invasion Inappropriate habitat disturbance Changed to hydrology Diseases, pathogens, and dieback Invasive fauna	The TEC occurs primarily in the southern half of the Cumberland Plain, particularly in the Wollondilly LGA. Records of the community within the Strategic Assessment Area are concentrated near Razorback, with outlier occurrences near Campbelltown, Oran Park, Kemps Creek and Kurrajong in the north. The TEC occurs in areas at higher elevations with increased rainfall, on soils derived from Wianamatta Shale (OEH, 2020f) The Plan has the potential to exacerbate threats in areas of this TEC that occur adjacent to the urban capable land in Wilton, GMAC, and the transport corridors As described in section 15.6, mitigation measures will be implemented through development controls (for urban, industrial, and intensive plant agriculture development) or future environmental assessment processes (for transport and infrastructure development) that will address relevant indirect impacts to this TEC. These measures are expected to manage any residual impacts to the TEC	No

15.8 ADDITIONAL SPECIFIC MITIGATION TO ADDRESS RESIDUAL RISKS

This section identifies additional specific mitigation measures considered necessary to address residual risks from the potential indirect impacts of the urban, industrial, infrastructure, intensive plant agriculture and transport development on Commonwealth and NSW-listed TECs and species, and other EPBC Act protected matters.

These mitigation measures are provided in Appendix E of the Plan and are incorporated into several commitments and actions under the Plan. The measures will be implemented as described above in section 15.6 through either:

- The draft DCP template
- A future environmental impact assessment process (for infrastructure and transport development)
- An action under the Plan

These additional mitigation measures, along with the package of relevant commitments in the Plan (see section 15.6) are considered to adequately address residual risks to each of these matters.

15.8.1 FAUNA

The specific mitigation measures to address residual risks to fauna are provided in Table 15-20.

Table 15-20: Specific mitigation measures to address residual risks – fauna

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
HABITAT FEATURES AND CONNECTIVITY						
Urban and industrial, infrastructure, intensive plant agriculture	Retain large trees (including dead trees but excluding noxious weeds) (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction	Large trees within urban landscapes are likely to be important for the persistence of several species within the subregion. Microbats benefit directly through roosting opportunities and indirectly through foraging opportunities. Flying-foxes and nectivorous birds benefit directly through foraging opportunities (high volumes of nectar). Owls and raptors benefit indirectly through large trees providing habitat for prey species	**Microbats:** Southern Myotis, Little Bent-winged Bat, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat **Flying-foxes and nectivorous birds:** Grey-headed Flying-fox, Regent Honeyeater, Swift Parrot, Little Lorikeet, and Black-chinned Honeyeater **Owls and raptors:** Barking Owl, Powerful Owl, Masked Owl, Little Eagle, White-bellied Sea Eagle, Square-tailed Kite, Spotted Harrier	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
Urban and industrial, infrastructure, intensive plant agriculture	Retain areas of high density Proteaceae shrubs where possible, particularly along riparian corridors	Proteaceae shrubs such as banksias are a favoured foraging resource for the species and the species is likely to use riparian corridors as habitat or for movement between other areas of suitable habitat	Eastern Pygmy-possum	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure
Urban and industrial, infrastructure, intensive plant agriculture	Undertake pre-construction surveys prior to removal or disturbance (seasonally dependent, before torpor) to human made structures to ensure any roosting habitat for microbat species including mine shafts, storm water tunnels, old or derelict buildings, bridges and culverts are retained where possible	Minimises the potential impacts of urban development to human-made structures that may be used by microbats for roosting or breeding	Eastern Coastal Free-tailed Bat Little Bent-wing Bat Large Bent-winged Bat Southern Myotis Yellow-Bellied Sheathtail-Bat	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure
Transport corridors	Incorporate artificial breeding and roosting habitat (e.g. bat boxes, structural cavities) in the design of bridges associated with the transport corridors in accordance with relevant guidelines or standards	Minimises the potential impacts of the transport corridors to human-made structures that may be used by microbats for roosting or breeding	Eastern Coastal Free-tailed bat Large Bent-winged Bat Southern Myotis Yellow-Bellied Sheathtail-bat	All transport corridors within and outside nominated areas	Commitment 6: Mitigate indirect and prescribed impacts on threatened species from major infrastructure (transport) development on threatened species and their habitat	EIA process for transport

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
Urban and industrial	Design of subdivision layout including perimeter roads, Asset Protection Zones are to reduce impacts to and protect areas of koala habitat	Minimise the potential impacts of precinct operation to koala habitat	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	DCP template Mitigation Measures Guideline
Urban and industrial	Do not plant koala feed trees, as listed in Koala SEPP Schedule 2 Koala use tree species in open space and recreation areas	Koala feed trees and/or Endangered Ecological Communities are contained to open space and recreational areas in precinct design in certified urban-capable land	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with	DCP template Mitigation Measures Guideline

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
					Appendix E of the Plan	
PEST/DOMESTIC ANIMALS						
Urban and industrial, infrastructure, intensive plant agriculture	Modify pest control techniques implemented during construction and operation of the development and under the pest control strategy to reduce the risk of secondary poisoning (e.g. from Pindone or second-generation rodenticides)	There is a risk of pest control measures causing secondary poisoning of raptors	White-bellied Sea-Eagle Little Eagle Square-tailed kite Spotted Harrier	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure
				SCAs	Commitment 17: Manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the strategic conservation area	Pest control strategy
Urban and industrial, infrastructure	Where permitted and appropriate, contain domestic cats and dogs in new residential areas during operation of the development at the urban/bushland interface consistent with relevant Council guidelines	Increased numbers of domestic cats and dogs associated with urban development increases the threat of predation to native animals	Eastern Pygmy-possum Spotted-tailed Quoll	Wilton GMAC	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations and communities	DCP
Urban and Industrial	Dog proof fenced areas are to be designated within open space and public recreation areas	Dog proof fencing provides protection to fauna including koala upfront in precinct design for public spaces	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial,	DCP template Mitigation Measures Guideline

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
					infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	
Urban and Industrial	Dog proof fencing is a design requirement for each residential lot in accordance with Council requirements	Dog proof fencing provided protection to fauna including koala upfront in precinct design for residential areas	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	DCP template Mitigation Measures Guideline

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
HUMAN DISTURBANCE						
Urban and industrial, infrastructure, intensive plant agriculture	Grey-headed flying fox camps require an 100m setback to any development. The setback area should be maintained free of flying fox roosting habitat	Minimises disturbance to known populations	Grey-headed Flying-fox	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP
Urban and industrial, infrastructure, intensive plant agriculture	Raptor nests require a 500m circular setback from where nests are located in undisturbed bushland or 250m for nests adjacent to existing development. Owl nests require a 100 m circular setback from where nests are located	Minimises disturbance to known populations	Little Eagle, White-bellied Sea Eagle, Square-tailed Kite, Spotted Harrier, Barking Owl, Powerful Owl, Masked Owl	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP
Urban and industrial, infrastructure, intensive plant agriculture	• Work with NSW Fisheries to address the risk of illegal and incidental recreational fishing capture along stretches of known habitat for Macquarie Perch in Erskine Creek, Glenbrook Creek, Georges River and Cordeaux River • Consult with relevant resource managers about installing signs/interpretive	Minimises the risk of increased recreational fishing affecting the species due to larger urban populations associated with urban development	Macquarie Perch	Erskine Creek Glenbrook Creek Georges River Cordeaux River	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	N/A

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
	displays at appropriate sites used to access fishing locations at Erskine Creek, Glenbrook Creek, Georges River and Cordeaux River to assist with identification and awareness of threats					
Urban and Industrial Infrastructure (including essential infrastructure)	Site assessment and pre-clearance survey to be undertaken prior to removal of vegetation to undertake koala survey and implement translocation plan if required	At pre-construction phase of development, a translocation plan and koala survey is to protect any koala on site	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development
Urban and Industrial Infrastructure (including essential infrastructure)	Temporary protective fencing to be erected around areas identified for conservation on or immediately adjoining the site at pre-construction phase to ensure adequate protection is in place during construction	Prior to development, at the pre-construction phase, temporary protective fencing is to be erected to protect koala entering the construction site	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
					koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	
Infrastructure (including essential infrastructure)	Where planned linear infrastructure such as gas and electricity transmission crosses existing koala exclusion fencing, consider appropriate access treatments such as gates to ensure the integrity of the koala-exclusion fencing	Minimises indirect impacts to koala populations due to urban development. This action is consistent with a critical action for this species under Chief Scientist Koala Report (2020)	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	CPCP Guidelines for Infrastructure Development
Infrastructure (including essential infrastructure)	Where public road infrastructure crosses koala corridors, ensure that:	Maintenance of connectivity in koala corridors, and separation of koalas from landscape threats including traffic, are	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial,	CPCP Guidelines for Infrastructure Development

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
	• Exclusion fencing is in place to prevent koalas from entering the road • Suitable koala connectivity structures are installed to protect corridor integrity	critical actions for this species under the Chief Scientist Koala Report (2020)			infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	
Urban and Industrial Infrastructure (including essential infrastructure)	A tree-felling protocol to be implemented to avoid impacts to koalas in trees that are to be cleared	A tree felling protocol to protect koalas in trees identified to be cleared on site is to provide protection to koala in the identified trees	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
Urban and Industrial Infrastructure (including essential infrastructure)	Roadside vegetation adjacent to koala habitat areas will be managed to minimise the height of ground cover and therefore increase the visibility of any roadside fauna. Turfed areas will be mown, low ground covers will be trimmed mechanically	Visibility of koala along roadside vegetation is enhanced along motorways and roadsides for koalas crossing roadways	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	DCP template Mitigation Measures Guideline
Urban and Industrial Infrastructure (including essential infrastructure)	An onsite ecologist is to be present though the duration of pre-clearance surveys and clearing works	To protect koalas in trees identified to be cleared on site	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
					Appendix E of the Plan	
Urban and Industrial Infrastructure (including essential infrastructure)	Implement traffic calming measures for all development not subject to wildlife and koala exclusion fencing: Apply speed limit restrictions on local roads for areas adjacent to open space and land identified as avoided under CPCP Signpost perimeter roads and roads adjacent to wildlife habitat areas in accordance with Austroads, RMS technical guidelines, Council Guidelines and relevant Australian Standards. Install traffic calming devices such as speed humps and audible surfacing along perimeter roads adjacent to wildlife habitat	To protect koalas adjacent to or along motorways, roadsides and development	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development
Urban and Industrial Infrastructure (including essential infrastructure)	Install koala friendly road design structures such as underpasses, fauna bridges and overpasses consistent with any approval conditions. Reference to the RMS Biodiversity Guidelines is to be made	To protect koalas along motorways and roadsides for koalas crossing roadways	Koala	Wilton GMAC	Commitment 7: Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
					standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan	
DISEASE						
Urban and industrial, infrastructure, intensive plant agriculture	Incorporate best practice site hygiene protocols to manage the potential spread of pathogens, such as *Phytophthora* and Myrtle Rust within or adjacent to potential habitat for relevant species	Minimises the risk of the spread of pathogens due to construction activities adjacent to potential habitat for the species	Greater Glider	All nominated areas All transport corridors within and outside nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure
Transport corridors					Commitment 6: Mitigate indirect and prescribed impacts on threatened species from major infrastructure (transport) development on threatened species and their habitat	EIA process for transport

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
OTHER						
Urban and industrial, infrastructure, intensive plant agriculture	Consult with relevant land managers to implement critical actions for Cumberland Plain Land Snail under the Save our Species program (EES, 2020) on public land adjacent to urban development during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy and the Fire Management Strategy	Minimises indirect impacts and supports maintenance of known populations adjacent to urban capable land	Cumberland Plain Land Snail	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	N/A
Urban and industrial, infrastructure, intensive plant agriculture	Implement 'open structure design' when designing structures such as roads adjacent to known populations of Cumberland Plain Land Snail where possible, consistent with the critical actions for this species under the Save our Species program (EES, 2020)	Development in the nominated areas may isolate patches of habitat. This action is consistent with a critical action for this species under the Save our Species program (EES, 2020)	Cumberland Plain Land Snail	All nominated areas	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations and communities	DCP

15.8.2 FLORA

The specific measures to address residual risks to flora are provided in Table 15-21.

Table 15-21: Specific mitigation measures to address residual risks – flora

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
WEED INVASION						
Transport corridors	Implement mitigation measures to manage weeds for flora populations and habitat adjacent to transport corridors during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy	Minimises indirect impacts to flora populations and habitat adjacent to transport corridors	*Dillwynia tenuifolia* *Pultenaea parviflora* *Persoonia nutans*	OSO (Wianamatta Regional Park) M7/Ropes Crossing link Road	Commitment 6: Mitigate indirect and prescribed impacts on threatened species from major infrastructure (transport) development on threatened species and their habitat Commitment 16: Manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land	EIA process for transport
			Grevillea juniperina subsp. *juniperina*	OSO (GPEC) M7/Ropes Crossing link Road Western Sydney Freight Line		

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
			Cynanchum elegans	OSO (Cobbitty)	secured within the strategic conservation area	
Urban and industrial, infrastructure, intensive plant agriculture	Implement mitigation measures to manage weeds for flora populations and habitat adjacent to urban capable land during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy	Minimises indirect impacts to flora populations and habitat adjacent to urban capable land and supports the general environmental controls to manage weeds	*Dillwynia tenuifolia* *Grevillea juniperina* subsp. *juniperina* *Pultenaea parviflora*	GPEC WSA	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities Commitment 16: Manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the strategic conservation area	DCP EIA process for infrastructure Weed Control Strategy
			Pultenaea pedunculata	GMAC		
			Grevillea parviflora subsp. *parviflora* (important population no. 104)	Wilton		
ALTERED FIRE REGIMES						
Urban and industrial	Consult with land managers of land containing known populations or habitat for relevant species to mitigate	Minimises indirect impacts to flora populations and habitat adjacent to urban capable land	*Dillwynia tenuifolia* *Grevillea juniperina* subsp. *Juniperina* *Pultenaea parviflora*	GPEC WSA	Commitment 5: Mitigate indirect and prescribed impacts on threatened	N/A

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
	indirect impacts from fire during construction and operation of the development, taking into account guidance in the Fire Management Strategy		*Persoonia nutans*	GPEC	species, populations, and communities Commitment 18: Manage fire in strategic locations in the Cumberland subregion to support the maintenance of biodiversity values on conservation land	
			Pultenaea pedunculata	GMAC		
			Grevillea parviflora subsp. *parviflora* (important population no. 104)	Wilton		
			Persoonia bargoensis	Wilton GMAC		
HUMAN DISTURBANCE						
Urban and industrial, infrastructure, intensive plant agriculture	Consult with land managers of land containing known populations or habitat for relevant species to mitigate indirect impacts from habitat disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and weed control, and managing rubbish dumping	Minimises indirect impacts to flora populations and habitat adjacent to urban capable land	*Dillwynia tenuifolia* *Grevillea juniperina* subsp. *Juniperina* *Pultenaea parviflora*	GPEC WSA	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities Commitment 5.3 This includes consulting with public land managers to minimise exposure to human disturbance for the specified threatened species	N/A
			Persoonia nutans	GPEC		
			Grevillea parviflora subsp. *parviflora* (important population no. 104)	Wilton		
			Pultenaea pedunculata *Genoplesium baueri* (important population no. 21)	GMAC		

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
			Persoonia bargoensis *Melaleuca deanei* *Pterostylis saxicola*	Wilton GMAC		
			Pimelea spicata For this species in particular, ensure weed management activities involving the use of herbicides will minimise risks and maintain the species	All nominated areas		
HYDROLOGY						
Transport corridors	Implement mitigation measures to manage hydrology impacts to relevant flora species and habitat adjacent to transport corridors during construction and operation of the development	Minimises the risk of hydrological impacts to the species	*Cynanchum elegans*	OSO (Cobbitty)	Commitment 6: Mitigate indirect and prescribed impacts on threatened species from major infrastructure (transport) development on threatened species and their habitat	EIA process for transport

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
SPREAD OF INFECTION/DISEASE						
Urban and industrial, infrastructure, intensive plant agriculture	Incorporate best practice site hygiene protocols to manage the potential spread of pathogens, such as Phytophthora and Myrtle Rust adjacent to potential habitat for relevant species	Minimises the risk of the spread of pathogens due to construction activities adjacent to potential habitat for the species	*Persoonia bargoensis*	Wilton GMAC	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure
			Persoonia nutans	GPEC WSA		
Transport corridors			*Persoonia nutans*	OSO (Wianamatta Regional Park)	Commitment 6: Mitigate indirect and prescribed impacts on threatened species from major infrastructure (transport) development on threatened species and their habitat	EIA process for transport

Development type	Mitigation measure	Rationale for measure	Relevant species	General location of measure	Relevant commitment	Implementation mechanism
OTHER						
Transport corridors	Manage key threats to the species, including: • Hydrological disturbance • Spread of weeds • Spread of infection/disease • Soil erosion and sedimentation • Ground settling or subsidence	Minimises the risk of indirect impacts during tunnel construction and operation	*Eucalyptus benthamii*	OSO tunnel	Commitments 6 and 6.2: Mitigate indirect and prescribed impacts on threatened species from major infrastructure (transport) development on threatened species and their habitat	EIA process for transport
			Pimelea spicata	MRFE tunnel		
			Pomaderris brunnea	OSO tunnel		

15.8.3 THREATENED ECOLOGICAL COMMUNITIES

The specific measures to address residual risks to TECs are provided in Table 15-22.

Table 15-22: Specific mitigation measures to address residual risks – TECs

Development type	Mitigation measure	Rationale for measure	Key relevant TECs	General location of measure	Relevant commitment	Implementation mechanism
Urban and industrial, infrastructure, intensive plant agriculture	When implementing mitigation measures to manage indirect impacts to Cooks River/Castlereagh Ironbark Forest, undertake mitigation in accordance with Best Practice Guidelines: Cooks River/Castlereagh Ironbark Forest (NSW DECC, 2008) within and adjacent to the TEC	Minimises the risk of several indirect impact types on the TEC adjacent to urban development and transport corridors	Cooks River/Castlereagh Ironbark Forest (NSW and Cth)	WSA (Kemps Creek)	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure
Transport corridors				OSO (Wianamatta Regional Park)	Commitment 6: Mitigate indirect and prescribed impacts on threatened species from major infrastructure (transport) development on threatened species and their habitat	EIA process for transport
Urban and industrial, infrastructure, intensive plant agriculture	Incorporate best practice site hygiene protocols to manage the potential spread of pathogens, such as *Phytophthora* and Myrtle Rust adjacent to potential habitat for relevant TECs	Minimises the risk of the spread of pathogens due to construction activities for urban development or transport corridors adjacent to TECs	Cooks River/Castlereagh Ironbark Forest (NSW and Cth)	WSA (Kemps Creek)	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure
			Cumberland Plain Woodland (NSW and Cth)	GPEC WSA		
			River-flat Eucalypt Forest (NSW)/Coastal Floodplain Eucalypt Forest (Cth)	All nominated areas		

Development type	Mitigation measure	Rationale for measure	Key relevant TECs	General location of measure	Relevant commitment	Implementation mechanism
			Shale Gravel Transition Forest (NSW)	GPEC WSA (Kemps Creek)		
			Shale Sandstone Transition Forest (Cth)	Wilton GMAC		
			Swamp Oak Floodplain Forest (NSW)/Coastal Swamp Oak Forest (Cth)	GPEC WSA		
Transport corridors			Cooks River/Castlereagh Ironbark Forest (NSW and Cth)	OSO (Wianamatta Regional Park)	Commitment 3: Avoid and minimise impacts to threatened species, populations, and communities within major infrastructure corridors in the nominated areas Commitment 4: Avoid and minimise impacts to threatened species, populations, and communities in the four major infrastructure corridors outside the nominated areas	EIA process for transport
			Cumberland Plain Woodland (NSW and Cth)	OSO (adjacent to WSA) Western Sydney Freight Line		
			River-flat Eucalypt Forest (NSW)/Coastal Floodplain Eucalypt Forest (Cth)	All nominated areas		
			Shale Gravel Transition Forest (NSW)	OSO (Wianamatta Regional Park)		
			Swamp Oak Floodplain Forest (NSW)/Coastal Swamp Oak Forest (Cth)	OSO (GPEC)		

15.8.4 OTHER PROTECTED MATTERS

The specific measure to address residual risks to other EPBC Act protected matters (Commonwealth land) is provided in Table 15-23.

A detailed assessment of potential indirect impacts relevant to Commonwealth land is provided in Chapter 35.

Table 15-23: Specific mitigation measures to address residual risks – other protected matters

Development type	Mitigation measure	Rationale for measure	Key relevant protected matter	General location of measure	Relevant commitment	Implementation mechanism
Urban and industrial, infrastructure, intensive plant agriculture	Ensure development adjacent to the southern and western boundaries of Commonwealth land comprising the Orchard Hills Defence Establishment mitigates impacts to surface water flows and the water quality of Blaxland Creek	Minimises the risk of indirect impacts from hydrological disturbance on an important waterway on Commonwealth land that occurs adjacent to urban development	Commonwealth land	Orchard Hills Defence Establishment	Commitment 5: Mitigate indirect and prescribed impacts on threatened species, populations, and communities	DCP EIA process for infrastructure

15.9 ANALYSIS OF THREAT ABATEMENT PLANS

15.9.1 INTRODUCTION

Under the EPBC Act, the impact assessment should address whether the actions under the Plan are inconsistent with any approved Threat Abatement Plans (TAPs).

TAPs have been developed under the EPBC Act to address listed KTPs and include actions to reduce their impact on threatened species and TECs.

There are seven TAPs which address KTPs that are potentially relevant to the Plan, which are discussed below.

15.9.2 THREAT ABATEMENT PLAN FOR COMPETITION AND LAND DEGRADATION BY UNMANAGED GOATS

The goal of this is TAP is to minimise the impact of competition and land degradation by unmanaged goats (*Capra hircus*) on biodiversity. Unmanaged goats are free-living and not owned, identified, restrained or managed. Unmanaged goats can affect threatened species and TECs by:

- Grazing on threatened native vegetation and therefore preventing regeneration
- Overgrazing and causing soil erosion
- Competing with threatened fauna species for food and shelter
- Introducing weeds through seeds carried in their dung
- Polluting watercourses (DEWHA, 2008i)

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out five objectives to achieve the goal, they are:

- Prevent unmanaged goats occupying new areas and eradicate them from high conservation-value 'islands'
- Promote the maintenance and recovery of native species and ecological communities that are affected by competition and land degradation by unmanaged goats
- Improve knowledge and understanding of unmanaged goat impacts and interactions with other species and ecological processes
- Improve the effectiveness, target specificity and humaneness of control options for unmanaged goats
- Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control unmanaged goats (DEWHA, 2008i)

A set of actions accompanies each objective to help achieve the goal of the TAP. There are four actions to prevent unmanaged goats occupying new areas. These relate to collating data on areas of high conservation value and developing and implementing management plans for these areas.

There are three actions to promote the maintenance and recovery of native species and ecological communities that are affected by this threat. These relate to identifying priority areas to control unmanaged goats and conducting and monitoring goat control.

There are four actions to improve knowledge and understanding of unmanaged goat impacts and interactions. These relate to developing methods for assessing and monitoring the impact of unmanaged goats and improving knowledge of interactions between unmanaged goats and other key species.

There are seven actions to improve the control options for unmanaged goats. These relate to investigating ways to improve control methods and programs including:

- Improving self-mustering trap systems
- Assessing goat toxins for undesirable side effects
- Testing exclusion fence designs
- Developing training programs to help land managers
- Promoting the adoption and adaptation of the model codes of practice

There are two actions to increase awareness of stakeholders of the objectives and actions of the TAP which relate to the promotion of the objectives and actions in the TAP.

RELEVANCE OF THE TAP TO THE PLAN

There is little information to suggest that unmanaged goats are a problem in the Strategic Assessment Area and there are no activities under the Plan which are likely to lead to the introduction of unmanaged goats in the area.

The Plan has the potential to exacerbate the threat of goats to some extent and includes a commitment to manage priority pest animals in strategic locations in the Cumberland Subregion to reduce threats to land within the SCAs.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that:

- The Plan will not prevent any of the actions of the TAP from being implemented
- The measures under the Plan are consistent with the intent behind the actions to deliver on Objective 2, to "promote the maintenance and recovery of native species and ecological communities that are affected by competition and land degradation by unmanaged goats"

15.9.3 THREAT ABATEMENT PLAN FOR COMPETITION AND LAND DEGRADATION BY RABBITS

The goal of this TAP is to minimise the impact of competition and land degradation by rabbits (*Oryctolagus cuniculus*) on biodiversity. Rabbits are abundant in Australia and cause damage to native flora and fauna, vegetation communities and crops. Rabbits can affect threatened species and TECs by:

- Grazing on threatened native vegetation and therefore preventing regeneration
- Competing with threatened fauna species for food and shelter
- Reversing the normal processes of plant succession
- Altering ecological communities and changing soil structure and nutrient cycling, leading to significant erosion
- Removal of critical habitat for arboreal mammals and birds, leading to increased predation
- Supporting elevated population densities of pest predators such as foxes and feral cats
- Promoting growth of introduced and unpalatable species such as weeds (DoEE, 2016a)

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to achieve the goal, they are:

- Strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas
- Improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes
- Improve the effectiveness of rabbit control programs
- Increase engagement of the community of the environmental impacts of rabbits and the need for integrated control

A set of actions have been identified to achieve the objectives of the TAP. There are five actions to support the strategic management of rabbits at a landscape scale. These relate to identifying priority areas for rabbit control on a regional scale, coordinating efforts across all land tenures such as private land and urban areas, and developing regular monitoring and reporting mechanisms to track progress.

There are three actions to improve knowledge and understanding of the impact of rabbits. These relate to further investigating the interaction of rabbits with other species and threats to improve rabbit control measures.

There are eight actions to improve the effectiveness of rabbit control programs through further research.

There are four actions to increase communication with stakeholders around the impacts caused by rabbits. These relate to developing training programs for land managers, promoting and seeking engagement from all people in the community and promoting adoption of model codes of practice for rabbit control (DoEE, 2016a).

RELEVANCE OF THE TAP TO THE PLAN

There is no likelihood of national rabbit eradication, so rabbit control is an ongoing issue across Australia. Current rabbit control programs focus on long-term management and suppression of rabbit populations.

The Plan has the potential to exacerbate the threat of rabbits to some extent and includes a commitment to manage priority pest animals in strategic locations in the Cumberland Subregion to reduce threats to land within the SCAs.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that:

- The Plan will not prevent any of the actions of the TAP from being implemented
- The measures under the Plan are consistent with the intent behind the actions to deliver on Objective 1, to "strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas"

15.9.4 THREAT ABATEMENT PLAN FOR DISEASE IN NATURAL ECOSYSTEMS CAUSED BY *PHYTOPHTHORA CINNAMOMI*

The goal of this TAP is to minimise the impacts of Phytophthora on EPBC-listed threatened species, TECs and MNES. The TAP applies to *Phytophthora cinnamomi,* however, other species of *Phytophthora* can also be found in Australia and may benefit from the same controls.

Phytophthora cinnamomi (Phytophthora) is a soil-borne plant pathogen, infection in plants can result in:

- Inability of infected plants to develop new shoots, flowers, fruit, and seed
- Extinction of populations of some flora species
- A dramatic modification of the native plant community's structure and composition
- A significant reduction in primary productivity and functionality
- Habitat loss and degradation of dependent flora and fauna
- Local extinction and a significant loss of genetic diversity
- Major declines in some animal species due to the loss of shelter and nesting sites or food (DoEE, 2018d)

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to achieve the goal, they are:

- Identify and prioritise for protection biodiversity assets that are, or may be, impacted by Phytophthora. Prioritised biodiversity assets may include:
    - Listed threatened species and ecological communities
    - Areas where there is potential for Phytophthora to cause unlisted native species or ecological communities to become eligible for listing under the EPBC Act (in any category other than conservation dependent)
- Reduce the spread and mitigate the impacts of Phytophthora to protect:
    - Priority biodiversity assets
    - Areas where there is potential for Phytophthora to cause native species or ecological communities not yet listed to become eligible for listing under the EPBC Act (in any category other than conservation dependent)
- Inform and engage the community by promoting information about Phytophthora, its impacts on biodiversity and actions to mitigate these impacts
- Encourage research on Phytophthora species and options to manage infestations and protect biodiversity assets

A set of actions have been identified to achieve the objectives of the TAP. There are five actions to identify and prioritise for protection biodiversity assets that are, or may be, impacted by Phytophthora which relate to developing a list of flora, fauna and communities that are at risk and areas at risk of infection spatially to inform threat management.

There are seven actions to reduce the spread and mitigate the impacts of Phytophthora which relate to safeguarding priority biodiversity assets through adherence to hygiene protocols, integrating management of Phytophthora dieback

with other natural resource management systems (in particular fire management), and including management actions in National Recovery Plans for EPBC-listed threatened species and TECs.

There are six actions to inform and engage the community about the impacts of Phytophthora which relate to developing communication and training strategies for relevant stakeholder groups and ensuring the currency and accessibility of the relevant mapping, guidelines and signage.

There are nine actions to encourage research on Phytophthora species which relate to:

- Learning more about the Phytophthora genus
- Developing new and effective treatments for the disease
- Developing resistance and resilience in vulnerable species and communities
- Developing improved techniques for rapid diagnosis of Phytophthora infestation
- Developing restoration methods for priority sites that are degraded by Phytophthora dieback

RELEVANCE OF THE TAP TO THE PLAN

There is no effective mechanism to remove the Phytophthora pathogen from an area, and therefore the TAP aims to minimise the spread of the disease, especially when undertaking high-risk activities, such as:

- Land development
- Road construction
- Construction and maintenance of recreational tracks and walking trails
- Construction of straight-line infrastructure (for example power lines and telecommunication structures)
- Soil and gravel extraction
- Fencing
- Installation of drainage (DoEE, 2018a)

The activities above will be undertaken as part of the Plan and could exacerbate the threat of Phytophthora.

While there is a risk of the spread of Phytophthora as a result of the activities proposed in the Plan, there are commitments to manage the risk of indirect impacts due to the development under the Plan, including managing the risk of spread of Phytophthora at construction sites, and to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that:

- The Plan will not prevent any of the actions of the TAP from being implemented
- The measures under the Plan are consistent with the intent behind the actions to deliver on Objective 2, to "protect priority biodiversity asses through reducing the spread and mitigating the impacts of *Phytophthora cinnamomi*"

15.9.5 THREAT ABATEMENT PLAN FOR INFECTION OF AMPHIBIANS WITH CHYTRID FUNGUS RESULTING IN CHYTRIDIOMYCOSIS

The goal of this TAP is to minimise the impacts of amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) on affected native species and ecological communities.

Chytrid fungus causes chytridiomycosis in amphibians which is a highly infectious disease that can be found in all areas in Australia except the Northern Territory. The fungus invades the surface layers of the skin and disrupts its normal function which results in electrolyte depletion and osmotic imbalance. This can affect the nervous system of some animals and paralysis, and ultimately death, occurs. Susceptibility to the disease varies between populations but the reasons for this are unknown (DoEE, 2016b).

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to help achieve the goal, they are:

- Improve understanding of the extent and impact of infection by amphibian chytrid fungus and reduce its spread to uninfected areas and populations
- Identify and prioritise key threatened amphibian species, populations and geographical areas and improve their level of protection by implementing coordinated, cost-effective on-ground management strategies
- Facilitate collaborative applied research that can be used to inform and support improved management of amphibian chytrid fungus
- Build scientific capacity and promote communication among stakeholders

A set of actions have been identified to achieve the objectives of the TAP. There are four actions to improve the understanding of infection by chytrid fungus and reduce its spread which relate to monitoring at-risk species, mapping the distribution of chytridiomycosis (and chytrid fungus), including control measures in amphibian translocation strategies, and ensuring appropriate hygiene protocols are implemented in chytrid-free areas.

There are six actions to support the identification and prioritisation of key threatened species, populations and geographical areas and the implementation of management strategies, which relate to completing risk assessments for high-priority species, implementing biosecurity measures around high-priority areas, and coordinating conservation efforts.

There are seven actions to facilitate research to improve management of chytrid fungus which include obtaining knowledge on:

- Assisted colonisation strategies
- The mechanisms for resistance
- The severity of chytrid fungus
- The best treatment protocols

There are three actions to build scientific capacity and promote communication among stakeholders which relate to developing an effective communication strategy, supporting a central information storage site, and encouraging participation in the National Chytrid Working Group.

RELEVANCE OF THE TAP TO THE PLAN

Most of populations susceptible to chytrid fungus that occur adjacent to or within proximity to proposed development, such as the Green and Golden Bell Frog, already exist within a highly built up and urbanised environment. Development under the Plan is unlikely to change the current level of risk in these areas in relation to chytrid fungus.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that:

- The Plan will not prevent any of the actions of the TAP from being implemented
- The measures under the Plan are consistent with the intent behind the actions to deliver on Objective 2, to "identify and prioritise key threatened amphibian species, populations and geographical areas and improve their level of protection by implementing coordinated, cost-effective, on-ground management strategies"

15.9.6 THREAT ABATEMENT PLAN FOR PREDATION BY EUROPEAN RED FOX

The goal of this TAP is to minimise the impact of the European red fox (*Vulpes Vulpes*) on biodiversity in Australia.

The European red fox can be found all over the Australian mainland, apart from in the far North. Fox predation is a threat to many threatened fauna species, in particular terrestrial mammals and ground-nesting birds.

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to achieve the goal, they are:

- Prevent foxes occupying new areas in Australia and eradicate foxes from high-conservation-value 'islands'
- Promote the maintenance and recovery of native species and ecological communities that are affected by fox predation
- Improve knowledge and understanding of fox impacts and interactions with other species and other ecological processes
- Improve the effectiveness, target specificity, integration, and humaneness of control options for foxes
- Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control and manage foxes

A set of actions have been identified to help achieve the objectives of the TAP. There are four actions to prevent foxes occupying new areas in Australia which relate to collating data on areas with high conservation values, developing and implementing management plans, and eradicating populations of foxes from lands adjacent to priority areas.

There are three actions to promote the recovery of native species and ecological communities that are affected by fox predation which relate to identifying priority areas for fox control and undertaking and monitoring fox control at these locations.

There are five actions to improve the knowledge and understanding of fox impacts which relate to developing methods for monitoring foxes, exploring the interactions between foxes, feral cats, wild dogs, and rabbits, and estimating the costs of impacts from foxes.

There are seven actions to improve the control options for foxes which relate to investigating existing and new control techniques, developing training programs for land managers, and promoting best practice standards.

There is one action to increase awareness of the need to control and manage foxes which relates to ensuring that the actions in the TAP are better communicated.

RELEVANCE OF THE TAP TO THE PLAN

The Plan has the potential to exacerbate the threat of foxes to some extent and includes a commitment to manage priority pest animals in strategic locations in the Cumberland Subregion to reduce threats to land within the SCAs.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that:

- The Plan will not prevent any of the actions of the TAP from being implemented
- The measures under the Plan are consistent with the intent behind the actions to deliver on Objective 2, to "promote the maintenance and recovery of native species and ecological communities that are affected by fox predation"

15.9.7 THREAT ABATEMENT PLAN FOR PREDATION BY FERAL CATS

The goal of this TAP is to minimise predation of native species by feral cats (*Felis catus*).

Feral cats are found throughout all habitats in mainland Australia and Tasmania and on some offshore islands. They are known to have a devastating effect on native fauna, predominantly from predation but also through competition and disease transmission (DoE, 2015e).

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out four objectives to achieve the goal, they are:

- Effectively control feral cats in different landscapes
- Improve effectiveness of existing control options for feral cats
- Develop or maintain alternative strategies for threatened species recovery
- Increase public support for feral cat management and promote responsible cat ownership

A set of actions have been identified to help achieve the objectives of the TAP. There are nine actions to improve the control of feral cats in different landscapes which relate to further research and development of current and new feral cat control options, improving understanding of the interactions between feral cats and other predators, and development of Code of Practice and/or Standard Operating Procedures for new tools.

There are four actions to improve the effectiveness of existing feral cat control options which relate to understanding how best to encourage land managers to include cat management programs within their activities, providing information regarding best practice methods and standard operating procedures, and implementing a consistent regulatory approach across all state and territory governments.

There are five actions to support the investigation of alternative strategies for threatened species recovery which include eradicating or controlling cats in priority areas, implementing, or improving biosecurity measures in cat-free areas, and creating fenced reserves to support the recovery of threatened species.

There are four actions to increase public support for cat management which relate to increasing awareness and understanding about:

- The threat to biodiversity posed by cats
- The need for responsible cat ownership
- The containment of cats where their roaming may impact priority areas

RELEVANCE OF THE TAP TO THE PLAN

Total eradication of feral cats is not currently feasible and cat control is an ongoing issue across Australia. Current control programs focus on long-term management and suppression of feral cat populations.

Existing land use within the nominated areas and surrounding region includes residential areas and farming, which means cats are unlikely to pose a novel threat to native fauna in the area. However, the extent of proposed new urban development under the Plan means the threat is likely to be exacerbated. The main areas of concern relate to new urban development in Wilton and the southern section of GMAC, where the current density of houses is low.

The Plan includes a commitment to manage indirect impacts due to development under the Plan, including to ensure that:

- Domestic animals are appropriately contained at urban/bushland interfaces
- Property boundaries should have appropriate fencing to contain domestic animals within the landholders' property

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that:

- The Plan will not prevent any of the actions of the TAP from being implemented
- The measures under the Plan are consistent with the intent behind the actions to deliver on Objective 4, to "increase public support for feral cat management and promote responsible cat ownership"

15.9.8 THREAT ABATEMENT PLAN FOR PREDATION, HABITAT DEGRADATION, COMPETITION AND DISEASE TRANSMISSION BY FERAL PIGS (*SUS SCROFA*)

The goal of this TAP is to prevent further species and ecological communities from becoming threatened or extinct due to the impacts of feral pigs.

Feral pigs are widespread throughout Australia and can affect threatened species and ecological communities by:

- Consuming threatened fauna species
- Destroying threatened flora species
- Altering ecological parameters such as plant species composition and succession, nutrient and water cycles, and water quality
- Changing the composition of threatened plant communities
- Altering soil structure
- Increasing the spread of weeds

- Spreading animal diseases such as leptospirosis, brucellosis, and plant pathogens such as *Phytophthora cinnamomi*

OBJECTIVES AND ACTIONS UNDER THE TAP

The TAP sets out six objectives to achieve the goal, they are:

- Prioritise key species, ecological communities, ecosystems, and locations across Australia for strategic feral pig management
- Encourage the integration of feral pig management into land management activities at regional, state and territory, and national levels
- Encourage further scientific research into feral pig impacts on nationally threatened species and ecological communities, and feral pig ecology and control
- Record and monitor feral pig control programs, so their effectiveness can be evaluated
- Build capacity for feral pig management and raise feral pig awareness amongst landholders and land managers
- Improve public awareness about feral pigs and the environmental damage and problems they cause, and the need for the feral pig control

A set of actions have been identified to help achieve the objectives of the TAP. There are two actions to support strategic feral pig management which include identifying priority species, ecological communities, ecosystems, and locations for priority protection, and implementing control measures in these areas.

There is one action to support the integration of feral pig management into land management activities which relates to encouraging government departments and agencies, and regional groups, to integrate feral pig management into their land management activities.

There are four actions to encourage further scientific research into feral pig impacts which include undertaking more research into:

- Feral pig impacts
- Feral pig population dynamics and ecology
- Special and temporal use of landscapes by feral pigs
- The effectiveness of feral pig control methods

There are three actions to evaluate the effectiveness of feral pig control programs which relate to developing better monitoring techniques and encouraging centralised recording of feral pig control actions.

There are two actions to raise feral pig awareness amongst landholders and land managers which relate to increased delivery of training programs to build feral pig management skills and improve the understanding of special impediments to feral pig control.

There are two actions to improve public awareness about feral pigs which include developing a public education program about feral pigs and the environmental damage and problems they could cause.

RELEVANCE OF THE TAP TO THE PLAN

Feral pigs are widely established in Australia and it is not currently possible to completely eradicate them (DoEE, 2017).

The Plan has the potential to exacerbate the threat of feral pigs to some extent and includes a commitment to manage priority pest animals in strategic locations in the Cumberland Subregion to reduce threats to land within the SCAs.

CONSISTENCY WITH THE TAP

The Plan is not inconsistent with the TAP on the basis that:

- The Plan will not prevent any of the actions of the TAP from being implemented
- The measures under the Plan are consistent with the intent behind the actions to deliver on Objective 2, to "encourage the integration of feral pig management into land management activities at regional, state and territory, and national levels"

16 Adaptive management for addressing uncertainty

This Chapter:

- Discusses what is adaptive management and why it is important
- Sets out the regulatory requirements for adaptive management under the BAM and ToR
- Identifies key uncertainties and risks in implementation
- Describes the Plan's approach to adaptive management
- Assesses the adequacy of the Plan's approach to adaptive management

The analysis in this Chapter is supported by the detailed evaluation of the Plan in Part 7.

16.1 WHAT IS ADAPTIVE MANAGEMENT AND WHY IS IT IMPORTANT

Adaptive management is a process for improving management practices through learning from the outcomes of previous management (DSEWPC, 2011). It is based on information derived from monitoring and can be applied anywhere uncertainty in management exists. Adaptive management typically involves the following steps:

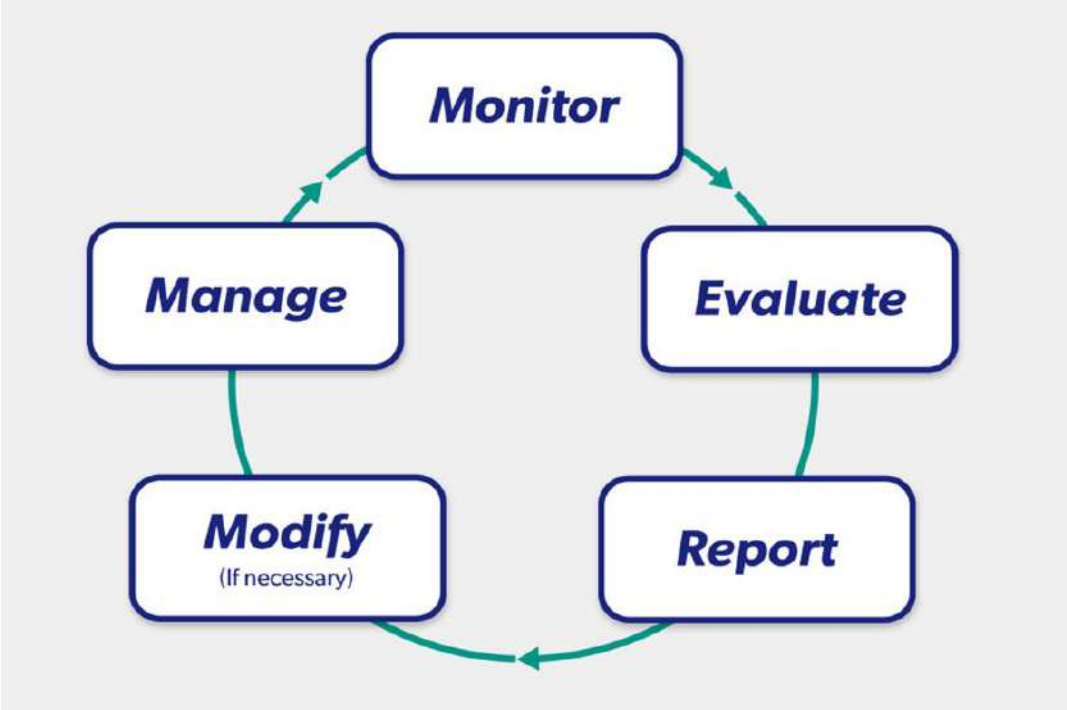


Figure 16-1: Adaptive management steps (taken from Sub-Plan B)

Adaptive management is an essential part of the implementation framework for strategic assessments. It is important because:

- The scale and complexity of strategic assessments means that there may be uncertainty relating to some impacts during the assessment process that need to be addressed during implementation
- The timeframes for strategic assessments are long and implementing agreed outcomes will be subject to a range of uncertainties over the life of the Plan
- Factors relating to the environment are likely to change over the life of a strategic assessment and an adaptive approach to management will be important for achieving the Plan's outcomes
- Changes to State and Commonwealth legislation, policies, plans and advice will occur over the life of the Plan

Providing a process to address uncertainty and deal with changing circumstances during the life of the Plan is therefore critical.

16.2 REGULATORY REQUIREMENTS

The BAM and ToR both require the Assessment Report to demonstrate how uncertainty will be addressed through adaptive management during implementation.

The BAM applies a narrower focus around just dealing with uncertain impacts, while the ToR has a broader focus on addressing uncertainty across all elements of implementation (including conservation commitments and actions).

16.2.1 BC ACT REQUIREMENTS

BAM

Section 9.4 of the BAM requires the BCAR to outline the adaptive management strategy proposed for minimising impacts that are uncertain. The BAM identifies the following impacts on biodiversity that are uncertain:

- Impacts related to damage to karst, caves, crevices, cliffs, and other geological features of significance
- Impacts related to subsidence and upsidence resulting from underground mining
- Impacts related to wind turbine strikes
- Impacts related to vehicle strikes

Impacts related to vehicle strikes is the only relevant consideration for development within the nominated areas. Mining and the construction of wind turbines are not within the scope of the project and are not considered further.

Chapter 24 (Prescribed Biodiversity Impacts) examines the potential for impacts related to karst, caves, crevices, cliffs, and other geological features of significance. It concludes that impacts to these features will not occur within the nominated areas, and it is therefore not considered further in this chapter.

GUIDELINES

In addition to the BAM, the draft *Guidelines for planning authorities for proposing conservation measures in strategic applications for biodiversity certification* (version 6) provide a set of guiding principles for demonstrating that commitments and actions proposed for a strategic biodiversity certification adequately address impacts on biodiversity values.

The last principle relates to certainty of implementation and requires that:

> *"Principle 8 – The delivery of conservation measures is timely and certain"*

16.2.2 EPBC ACT REQUIREMENTS

Section 6 of the ToR requires the SAR to identify key uncertainties and risks associated with implementing the Plan and describe and assess the adequacy of the procedures proposed in the Plan to ensure an adaptive approach to implementation of the Plan.

The relevant ToR are:

> *6.1 The Report must identify key uncertainties and risks associated with implementing the Plan, responses to these and proposed adaptations to changing circumstances. Key uncertainties may include:*
>
> - *Knowledge gaps in scientific understanding and responding to new knowledge.*
> - *Assumptions made in assessing potential impacts and benefits.*
> - *How changes to State and Commonwealth legislation, policies, plans, and advice is to be accounted for in the management of the areas impacted by the Plan.*
> - *Effectiveness or capacity to ensure the Plan is implemented.*
>
> *6.2 The Report must describe and assess the adequacy of the procedures proposed in the Plan to ensure an adaptive approach to implementation of the Plan. This must include:*
>
> 1. *How the results of monitoring will be used to understand the effectiveness of conservation outcomes for protected matters and improve implementation.*

2. *How new information relating to protected matters and biodiversity, including legislative changes, may be assessed and accounted for in implementation of the Plan.*

16.3 KEY UNCERTAINTIES AND RISKS IN IMPLEMENTATION

The ToR (Clause 6.1) provide a framework for identifying the key uncertainties and risks in implementation. This framework includes BAM requirements around uncertain impacts and is addressed below.

16.3.1 KNOWLEDGE GAPS IN SCIENTIFIC UNDERSTANDING AND RESPONDING TO NEW KNOWLEDGE

KNOWLEDGE GAPS IN SCIENTIFIC UNDERSTANDING

There are two key types of gaps in scientific understanding relevant to the assessment:

- Data gaps
- Gaps in understanding of ecological processes

Data gaps

Data gaps for this assessment can be defined as a lack of information about a particular element of the environment. For example, presence or absence information for a threatened species at a particular site may not be available at the time required.

Given the large spatial scale of the Plan, it is not possible to have perfect information about the environment and some level of uncertainty in data is inherent in the project. However, the requirements of the BAM and the ToR define what is an acceptable level of data to understand the environment and to conduct the assessment. As outlined in Part 3, a comprehensive data set has been collected for the assessment which addresses the BAM and ToR.

The data that has been used in the assessment and any limitations are discussed in detail in:

- Chapter 13: Data and limitations
- Individual assessment chapters for protected matters

Understanding of ecological processes

Sufficient understanding of ecological processes is a key challenge for all environmental impact assessments. There is commonly a lack of information about issues such as:

- Species distribution
- Species habitat requirements
- Species population numbers and dynamics
- The effects of key threatening processes (e.g. climate change)
- The best approaches for minimising and mitigating potential impacts

The assessment addresses these uncertainties through:

- Gathering the best available information from scientific literature, expert knowledge, on-ground surveys
- Applying a precautionary approach to understanding and evaluating potential impacts. An analysis of the application of the precautionary principle is provided in Part 7

The Plan addresses uncertainty through its monitoring, evaluation, and reporting (MER) framework combined with ongoing adaptive management.

RESPONDING TO NEW KNOWLEDGE

Given the long timeframe of the Plan, new knowledge about environmental issues will become available through:

- New scientific research
- Monitoring as part of implementation of the Plan

It will be critical that the Plan can consider this information and respond appropriately. The Plan's approach to this is discussed below in Section 16.4.

16.3.2 ASSUMPTIONS MADE IN ASSESSING POTENTIAL IMPACTS AND BENEFITS

One of the key risks in environmental impact assessment is making incorrect assumptions about the nature of potential impacts and benefits of a project. In particular, it is important that the consequences of potential impacts are not understated, and the benefits of conservation measures are not overstated.

To address this risk, the assessment report takes a precautionary approach to identifying and analysing impacts and benefits. For example, the habitat mapping for threatened species generally overestimates the amount of habitat in the Plan Area which means the impacts that are assessed are likely to be larger than what will ultimately occur on the ground.

The assumptions made in assessing potential impacts and benefits are:

- Outlined in Part 3 – Assessment Approach which describes the methods used in the assessment
- Set out in relation to each protected matter in the individual assessment chapters

The application of the precautionary principle to the assessment is evaluated in Part 7.

16.3.3 HOW CHANGES TO STATE AND COMMONWEALTH LEGISLATION, POLICIES, PLANS AND ADVICE IS TO BE ACCOUNTED FOR IN THE MANAGEMENT OF THE AREAS IMPACTED BY THE PLAN

Given the long timeframes of the Plan, changes to legislation, policies, plans, and advice are inevitable. These changes may lead to risks around:

- Implementation processes. For example, changes to State planning policies may affect the approaches to addressing indirect impacts
- Conservation priorities for threatened species and ecological communities. For example, changes to a Conservation Advice may provide new information about the key threats to a species and the recommended mitigation strategies
- Compliance. For example, changes to legislation may have implications for compliance under what would then be an approval under outdated legislation

The Plan addresses these risks through:

- Clearly establishing outcomes and commitments that will be delivered despite any changes to legislation, policies, plans and advice
- Its approach to MERI and adaptive management (discussed in Section 9.5 and in Section 16.4 below) which will provide a way of responding to any changes to legislation, policies, plans and advice

16.3.4 EFFECTIVENESS OR CAPACITY TO ENSURE THE PLAN IS IMPLEMENTED

Effective implementation is particularly important for strategic assessments because of the size and complexity of the programs, the long timeframes over which they are implemented, the number of stakeholders and the diversity of their interests, the amount of money the programs cost, and the complexity of the legal frameworks they operate within.

Lessons learnt from other strategic assessments around Australia suggest that effective implementation requires:

- Clear and feasible outcomes that the Plan will deliver
- Clarity about the delivery framework and mechanisms to implement the Plan
- Appropriate flexibility within the Plan to ensure it remains relevant over time
- Clear governance arrangements, including certain funding
- Comprehensive processes to monitor and report on implementation, and adapt implementation as needed

The Plan has been designed to address these issues. A detailed evaluation of the implementability of the Plan is provided in Chapter 41.

16.4 THE PLAN'S APPROACH TO ADAPTIVE MANAGEMENT

The Plan includes a commitment (Commitment 25) to "implement an evaluation program for the Plan that sets out requirements for monitoring, evaluation, reporting and adaptive management". The approach to adaptive management is set out in Sub-Plan A. The approach is designed around:

- Clearly defining outcomes through program logic
- Undertaking regular data collection/monitoring to track progress
- Completing regular evaluations to investigate cause and effect, efficiency and effectiveness, and test assumptions
- Establishing programs of research to test and improve management interventions

Adaptive management will be applied across the entire conservation program. It will use the data sourced through monitoring and the findings of program evaluation to determine if actions need to be revised to more-effectively deliver the Plan's commitments (and consequently the Plan's outcomes). Evaluations will consider any new information that becomes available over the life of the Plan (in addition to monitoring data). Information about the Plan's approach to MERI is provided in Part 2 and evaluated in Part 7.

Where evaluation suggests a commitment is not tracking as planned, it will trigger a review and potential modification to the required action or delivery of action. This process will include delivery partners as appropriate.

Changes to actions may be made in the case that:

- Targets are not being met
- The program logic does not adequately translate into the desired outcomes (i.e. the commitments are not leading to the outcomes as anticipated)
- External factors arise that affect the assumptions, logic, or delivery of the Plan. This may relate to large-scale changes (e.g. unpredicted climate variation) or smaller scale changes (e.g. local events such as fires, floods or disease)

One particularly important part of the adaptive management process will be a series of adaptive management steps that will be triggered in the case that biodiversity offsets are not secured in line with development impacts. Where the total amount of secured offsets is less than 80 per cent of the offset liability at a point in time, the following adaptive management steps will be implemented:

- Property acquisition by agreement
- Compulsory acquisition of property
- Land use planning responses to development

These steps will not be implemented within the first 5 years to allow time for the Plan to be implemented and offsets established unless the executive implementation committee decides to initiate them. After 5 years, the steps will be triggered as outlined above.

16.5 ADEQUACY OF THE PLAN'S APPROACH TO ADAPTIVE MANAGEMENT

Adaptive management under the Plan will use data from monitoring and the findings of program evaluations to determine whether actions need to be revised to achieve the commitments and outcomes more effectively.

Where an evaluation indicates a commitment or outcome is not being effectively and efficiently delivered or achieved, the Plan specifies that this will trigger a detailed review of implementation. This will be carried out by the relevant delivery agency for that particular project or program, in partnership with the Department.

The Plan specifies that adaptive responses may be triggered where:

- Offset targets are not being met
- External factors arise that affect the assumptions, logic, or delivery of the Plan

The Plan's approach to adaptive management is considered appropriate because:

- There is a clear commitment in the Plan to take an adaptive approach to ensure the outcomes and commitments are delivered
- The approach addresses the key uncertainties and risks in implementation of the Plan
- The approach is supported by:
    - Clear processes and steps as part of the MERI framework
    - The broader governance arrangements of the Plan which identify roles and responsibility for implementation
    - Commitments to fund implementation of the Plan

Further evaluation of the adequacy of the plan's approach to adaptive management is provided in Chapter 7.

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CUMBERLAND PLAIN ASSESSMENT REPORT

PART 4: ATTACHMENT

ATTACHMENT A - INDIRECT IMPACTS RELEVANT TO EACH SPECIES AND TEC

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	N/A
CONTENT:	Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines)
REVIEWED BY:	
OPEN LINES:	Tom Holden (Open Lines) Darren James (DAJ Environmental)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor – BAAS18134
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VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 4 Attachment Contents

Part 4 Attachment List of Tables

A. Indirect impacts relevant to each species and TEC

Identification of indirect impacts relevant to each matter is presented in:

- Table A-1 – NSW-listed threatened fauna
- Table A-2 – NSW-listed threatened flora
- Table A-3 – NSW-listed TECs

Table A-1: Potential indirect impacts which may affect threatened fauna

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance	Fauna mortality / barriers to movement	Fauna disturbance due to noise, dust or light	Inadvertent impacts on adjacent habitat
BIRDS														
Anthochaera phrygia	Regent Honeyeater	CE	CE	ECS SCS				✓		✓	✓			✓
Artamus cyanopterus cyanopterus	Dusky Wood-swallow	N/A	V	ECS				✓						
Botaurus poiciloptilus	Australasian Bittern	E	E	ECS	✓			✓	✓	✓				
Callocephalon fimbriatum	Gang-gang Cockatoo	N/A	V	ECS SCS				✓						
Calyptorhynchus lathami	Glossy Black-cockatoo	N/A	V	ECS SCS				✓		✓				✓
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	V Mig.	V	ECS SCS	As discussed in the Migratory Species Impact Assessment – Chapter 32, there are no important habitat areas for the species which are at risk of indirect impacts from development under the Plan									

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance	Fauna mortality / barriers to movement	Fauna disturbance due to noise, dust or light	Inadvertent impacts on adjacent habitat
Chthonicola sagittata	Speckled Warbler	N/A	V	ECS				✓	✓					
Circus assimilis	Spotted Harrier	N/A	V	ECS								✓		✓
Climacteris picumnus victoriae	Brown Treecreeper	N/A	V	ECS				✓						✓
Daphoenositta chrysoptera	Varied Sittella	N/A	V	ECS				✓		✓				
Ephippiorhyn-chus asiaticus	Black-necked Stork	N/A	E	ECS	✓									
Epthianura albifrons	White-Fronted Chat	N/A	V	ECS	No relevant threats to bioregional persistence identified. The species is wide-ranging and habitat is away from areas that could be impacted									
Glossopsitta pusilla	Little Lorikeet	N/A	V	ECS				✓		✓				✓
Grantiella picta	Painted Honeyeater	V	V	ECS										
Haliaeetus leucogaster	White-bellied Sea-Eagle	N/A	V	ECS SCS							✓	✓		✓
Hieraaetus morphnoides	Little Eagle	N/A	V	ECS SCS								✓		✓
Irediparra gallinacea	Comb-crested Jacana	N/A	V	ECS	✓				✓					

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance	Fauna mortality / barriers to movement	Fauna disturbance due to noise, dust or light	Inadvertent impacts on adjacent habitat
Ixobrychus flavicollis	Black Bittern	N/A	V	ECS					✓					✓
Lathamus discolor	Swift Parrot	CE	E	ECS SCS					✓	✓		✓		
Limicola falcinellus	Broad-billed Sandpiper	N/A	V	ECS	No relevant threats to bioregional persistence identified. There are no records in the subregion and habitat is away from areas that could be impacted									
Limosa limosa	Black-tailed Godwit	Mig.	V	ECS	As discussed in the Migratory Species Impact Assessment – Chapter 32, there are no important habitat areas for the species which are at risk of indirect impacts from development under the Plan									
Lophoictinia isura	Square-tailed kite	N/A	V	ECS SCS								✓		✓
Melanodryas cucullata cucullata	Hooded Robin	N/A	V	ECS				✓		✓				
Melithreptus gularis gularis	Black-chinned Honeyeater	N/A	V	ECS				✓		✓				✓
Neophema pulchella	Turquoise Parrot	N/A	V	ECS				✓	✓	✓				✓
Ninox connivens	Barking Owl	N/A	V	ECS SCS										✓
Ninox strenua	Powerful Owl	N/A	V	ECS SCS					✓	✓				✓
Pandion cristatus	Eastern Osprey	N/A	V	ECS	No relevant threats to bioregional persistence identified. The species prefers coastal areas and habitat is away from areas that could be impacted									

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance	Fauna mortality / barriers to movement	Fauna disturbance due to noise, dust or light	Inadvertent impacts on adjacent habitat
Petroica boodang	Scarlet Robin	N/A	V	ECS				✓	✓					
Petroica phoenicea	Flame Robin	N/A	V	ECS				✓						
Rostratula australis	Australian Painted Snipe	E	E	ECS	✓			✓	✓	✓				
Stagonopleura guttata	Diamond Firetail	N/A	V	ECS				✓						
Stictonetta naevosa	Freckled Duck	N/A	V	ECS	✓									
Tyto novaehollandiae	Masked Owl	N/A	V	ECS SCS										✓
MAMMALS														
Cercartetus nanus	Eastern Pygmy-possum	N/A	V	SCS					✓	✓		✓		
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	SCS					✓	✓	✓			
Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll	E	V	ECS					✓	✓		✓		
Falsistrellus tasmaniensis	Eastern False Pipistrelle	N/A	V	ECS										✓

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance	Fauna mortality / barriers to movement	Fauna disturbance due to noise, dust or light	Inadvertent impacts on adjacent habitat
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	N/A	V	ECS						✓		✓	✓	✓
Miniopterus australis	Little Bent-winged Bat	N/A	V	ECS SCS					✓	✓	✓	✓		✓
Miniopterus orianae oceanensis	Large Bent-winged Bat	N/A	V	ECS SCS					✓	✓	✓	✓		✓
Myotis macropus	Southern Myotis	N/A	V	SCS	✓						✓			
Petaurus australis	Yellow-Bellied Glider	N/A	V	ECS										✓
Petaurus norfolcensis	Squirrel Glider	N/A	V	SCS						✓		✓		✓
Phascolarctos cinereus	Koala*	V	V	ECS SCS			✓		✓	✓	✓	✓		
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	ECS SCS							✓			✓
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	N/A	V	ECS							✓			✓
Scoteanax rueppellii	Greater Broad-nosed Bat	N/A	V	ECS							✓			✓

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance	Fauna mortality / barriers to movement	Fauna disturbance due to noise, dust or light	Inadvertent impacts on adjacent habitat
REPTILES														
Hoplocephalus bungaroides	Broad-headed Snake	V	E	ECS SCS					✓	✓	✓	✓		✓
Varanus rosenbergi	Rosenberg's Monitor	N/A	V	ECS					✓					✓
AMPHIBIANS														
Heleioporus australiacus	Giant Burrowing Frog	V	V	SCS	✓		✓		✓	✓		✓		
Litoria aurea	Green and Golden Bell Frog	V	E	SCS	✓		✓		✓	✓	✓	✓		
Pseudophryne australis	Red-crowned Toadlet	N/A	V	SCS	✓					✓	✓			✓
INVERTEBRATES														
Meridolum corneovirens	Cumberland Plain Land Snail	N/A	E	SCS		✓		✓		✓	✓			✓
Pommerhelix duralensis	Dural Land Snail	E	E	SCS				✓		✓				

* The Koala is assessed in further detail in Chapter 30

Table A-2: Potential indirect impacts which may affect threatened flora

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	V	E	SCS				✓		✓	✓
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	V	V	SCS				✓		✓	✓
Allocasuarina glareicola		E	E	SCS				✓		✓	✓
Commersonia prostrata	Dwarf Kerrawang	E	E	SCS	No relevant threats to bioregional persistence identified. Areas of mapped habitat occur away from the urban capable land and transport corridors						
Cynanchum elegans	White-flowered Wax Plant	E	E	SCS	✓			✓		✓	
Deyeuxia appressa		E	E	SCS	No relevant threats to bioregional persistence identified. Areas of mapped habitat occur away from the urban capable land and transport corridors						
Dillwynia tenuifolia		N/A	V	SCS				✓		✓	✓
Epacris purpurascens var. *purpurascens*		N/A	V	SCS	✓			✓		✓	✓
Eucalyptus benthamii	Camden White Gum, Nepean River Gum	V	V	SCS	✓	✓	✓	✓		✓	
Genoplesium baueri	Yellow Gnat-orchid	E	E	SCS							✓

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	N/A	V	SCS			✓	✓		✓	✓
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	ECS				✓		✓	✓
Hibbertia fumana		N/A	CE	SCS				✓		✓	✓
Hibbertia puberula		N/A	E	SCS				✓			✓
Leucopogon exolasius	Woronora Beard-heath	V	V	SCS				✓		✓	
Marsdenia viridiflora subsp. *viridiflora*		N/A	E	SCS						✓	✓
Maundia triglochinoides		N/A	V	SCS	✓			✓			✓
Melaleuca deanei	Deane's Melaleuca	V	V	SCS				✓		✓	✓
Micromyrtus minutiflora		V	E	SCS				✓		✓	✓
Persicaria elatior	Tall Knotweed	V	V	SCS	✓			✓			✓

Scientific name	Common name	Cth status	NSW status	BAM species type	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance
Persoonia bargoensis	Bargo Geebung	V	E	SCS			✓			✓	✓
Persoonia glaucescens	Mittagong Geebung	V	E	SCS	No relevant threats to bioregional persistence identified. Areas of mapped habitat occur away from the urban capable land and transport corridors						
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	E	E	SCS	✓		✓	✓		✓	✓
Persoonia nutans	Nodding Geebung	E	E	SCS			✓	✓		✓	✓
Pimelea curviflora var. *curviflora*		V	V	SCS				✓		✓	✓
Pimelea spicata	Spiked Rice-flower	E	E	SCS	✓	✓		✓		✓	✓
Pomaderris brunnea	Rufous Pomaderris	V	E	SCS	✓	✓		✓		✓	✓
Pterostylis saxicola	Sydney Plains Greenhood	E	E	SCS				✓		✓	✓
Pultenaea parviflora		V	E	SCS				✓		✓	✓
Pultenaea pedunculata	Matted Bush-pea	N/A	E	SCS				✓		✓	✓

Table A-3: Potential indirect impacts which may affect TECs

Threatened Ecological Community name	Cth status	NSW status	Hydrology / soil disturbance	Ground subsidence	Spread of infection / disease	Spread of weeds	Pest / domestic animals	Altered fire regimes	Increased public access / disturbance
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	N/A	V			✓	✓	✓	✓	✓
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	N/A	E	✓		✓	✓	✓	✓	✓
Cumberland Plain Woodland in the Sydney Basin Bioregion	N/A	CE	✓	✓	✓	✓	✓	✓	✓
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	N/A	E	✓			✓	✓		✓
Moist Shale Woodland in the Sydney Basin Bioregion	N/A	E	✓			✓	✓	✓	✓
River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	N/A	E	✓	✓	✓	✓	✓	✓	✓
Shale Gravel Transition Forest in the Sydney Basin Bioregion	N/A	E			✓	✓	✓	✓	✓
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	N/A	CE	✓			✓	✓	✓	✓
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	N/A	E	✓		✓	✓	✓	✓	✓

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2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 5A: BCAR STAGE 1 (BIODIVERSITY ASSESSMENT)

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	James Shepherd, Callan Wharfe, Rebecca Dwyer (Biosis)
CONTENT:	Callan Wharfe, Rebecca Dwyer, Matthew Hyde (Biosis) Darren James (DAJ Environmental) Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines)
REVIEWED BY:	
OPEN LINES:	Darren James (DAJ Environmental) Tom Holden, Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor – BAAS18134
VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 5A Contents

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17 Introduction

This Part describes the existing biodiversity values within the nominated areas for matters listed under the *Biodiversity Conservation Act 2016* (BC Act) in accordance with the Biodiversity Assessment Method 2017 (BAM), including:

- Landscape features and site context
- Native vegetation, including native vegetation extent, type and condition
- NSW listed Threatened Ecological Communities (TECs)
- NSW listed threatened species and habitat

The BAM uses the term Subject Land to mean land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land, including land within urban capable land or proposed for biodiversity certification. In this Assessment Report, the terms 'nominated areas' and 'urban capable land' are used instead of the term Subject Land.

18 Landscape features and site context

This Chapter provides an assessment of the landscape features and site context of the nominated areas in accordance with section 4 of the BAM, including:

- Interim Biogeographic Regionalisation of Australia (IBRA) bioregions and subregions
- Native vegetation extent – buffer area
- NSW (Mitchell) Landscapes
- Rivers and streams
- Wetlands
- Habitat connectivity and fragmentation
- Areas of geological significance and soil hazards
- Areas of outstanding biodiversity value
- Site context

These landscape features are shown in the site and location maps for each nominated area:

- Wilton: Figure 18-1 (site map) and Map 18-1 (location map)
- GMAC: Figure 18-2 (site map) and Map 18-2 (location map)
- WSA: Figure 18-3 (site map) and Map 18-3 (location map)
- GPEC: Figure 18-4 (site map) and Map 18-4 (location map)

18.1 IBRA BIOREGIONS AND SUBREGIONS

The nominated areas occur within the Sydney Basin IBRA bioregion (version 7) and the Cumberland and Cataract subregions. The percentages of each subregion within each nominated area are shown in Table 18-1.

Table 18-1: Percent of nominated areas representing each subregion

Nominated area	Subregion	Per cent of nominated area within each subregion
Wilton Growth Area (Wilton)	Cumberland	98.46
	Sydney Cataract	1.54
Greater Macarthur Growth Area (GMAC)	Cumberland	96.45
	Sydney Cataract	3.55
Western Sydney Aerotropolis (WSA)	Cumberland	100.00

Nominated area	Subregion	Per cent of nominated area within each subregion
Greater Penrith to Eastern Creek Growth Area (GPEC)	Cumberland	100.00

The Sydney Basin bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares. It occupies about 4.53 per cent of NSW and is one of three bioregions contained wholly within the State.

The Sydney Basin bioregion extends from just north of Batemans Bay to Nelson Bay on the lower North Coast, and west to Merriwa. It is bordered to the north mostly by the NSW North Coast and Brigalow Belt South bioregions, to the south by the South East Corner bioregion and to the west by the South Eastern Highlands and NSW South Western Slopes bioregions. The bioregion is one of the most species-diverse in Australia (OEH, 2016).

The Cumberland subregion geology is dominated by Triassic age Wianamatta Group shales and lithic sandstones. Quaternary alluvium occurs along the main streams and a large plume of Tertiary-era sandy and gravelly alluvium occurs in the northern end between Wianamatta (South Creek) and the Nepean/Hawkesbury River. The characteristic landform is low rolling hills and wide valleys within a rain shadow area between the Blue Mountains and the coast. There are also swamps and lagoons on the floodplain of the Nepean and Hawkesbury Rivers and major creeks including Wianamatta (South Creek).

Typical soils of the Cumberland subregion are red and yellow texture contrast soils on slopes, becoming harsher and sometimes affected by dryland salinity in tributary valley floors. There is uniform red to brown clays and poor uniform stony soils, often with texture contrast profiles on older gravels with high quality loams on modern floodplain alluvium (DPIE, 2019).

Characteristic landforms of the Cumberland subregion include low rolling hills and wide valleys in a rain shadow area below the Blue Mountains. At least three terrace levels are evident in the gravel splays which occur within the subregion. Swamps and lagoons occur on the floodplain of the Nepean River. Typical vegetation of the Cumberland subregion includes Grey Box, Forest Red Gum, Narrow-Leaved Ironbark woodland to open forest with some Spotted Gum on the shale hills. Hard-leaved Scribbly Gum, Narrow-leaved Apple and Old Man Banksia occur on alluvial sands and gravels. Broad-Leaved Apple, Cabbage Gum and Forest Red Gum with abundant Swamp Oak occur on low-lying flats. Tall Spike Rush, and *Juncus* sp. with Swamp Oak occur in lagoons and swamps (OEH, 2016).

The Sydney Cataract subregion occurring to the south-east of Wilton and the east of GMAC is Triassic era geology with Hawkesbury Sandstone on the coastal edge of the Sydney Basin above the Illawarra escarpment. The characteristic landform is a sandstone plateau with shallow creeks flowing through hanging swamps in the highest parts, ramping down to low hills in the Georges River and Botany Bay. There are coastal cliffs north of the Illawarra and a large barrier system with beach, dunes, swamps, and estuary at the westernmost edge of Kurnell.

Typical soils of the Sydney Cataract subregion are deep sands and clayey sands with peat in hanging swamps, yellow earths on better drained sandstone ridges. Siliceous sands occur in younger dunes and well-developed podzols occur in older dunes.

Characteristic landforms of the Sydney Cataract include a sandstone plateau with shallow creeks flowing through hanging swamps in the highest part of the subregion, ramping down to low hills in the Georges River and Botany Bay areas. Coastal cliffs occur to the north of the Illawarra and a large barriers system with dunes, swamps and estuary occurs at Kurnell. Vegetation of the Sydney Cataract subregion is typically Red Bloodwood and Silvertop Ash Woodland with abundant shrubs on sandstone and extensive *Gahnia* and *Banksia* in hanging swamps. There is a coastal dune sequence of Tea-Tree, Coast Wattle, Smooth-Barked Apple, Blackbutt and Swamp Mahogany on the barrier system (OEH, 2016).

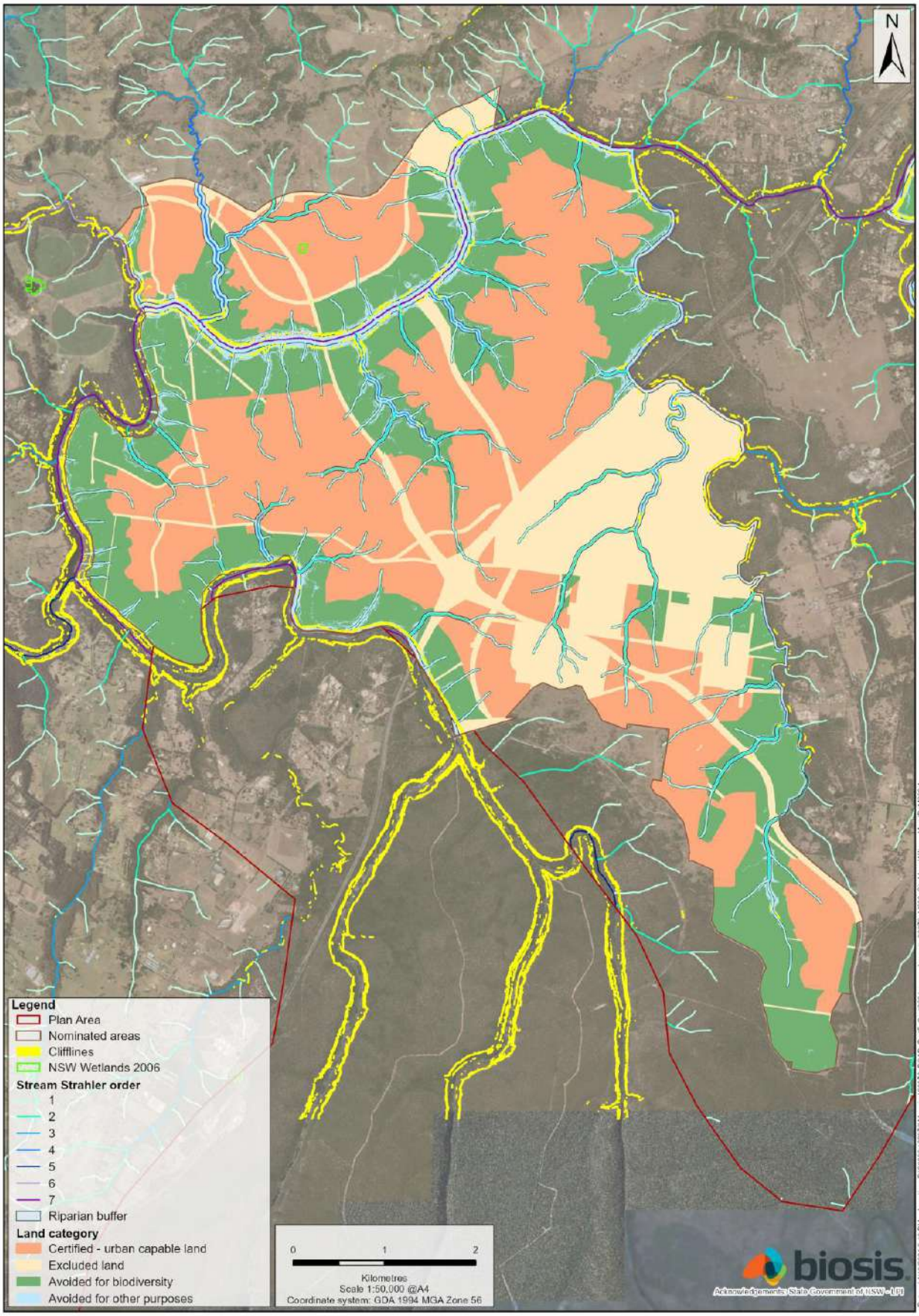

Figure 18-1: Site map – Wilton

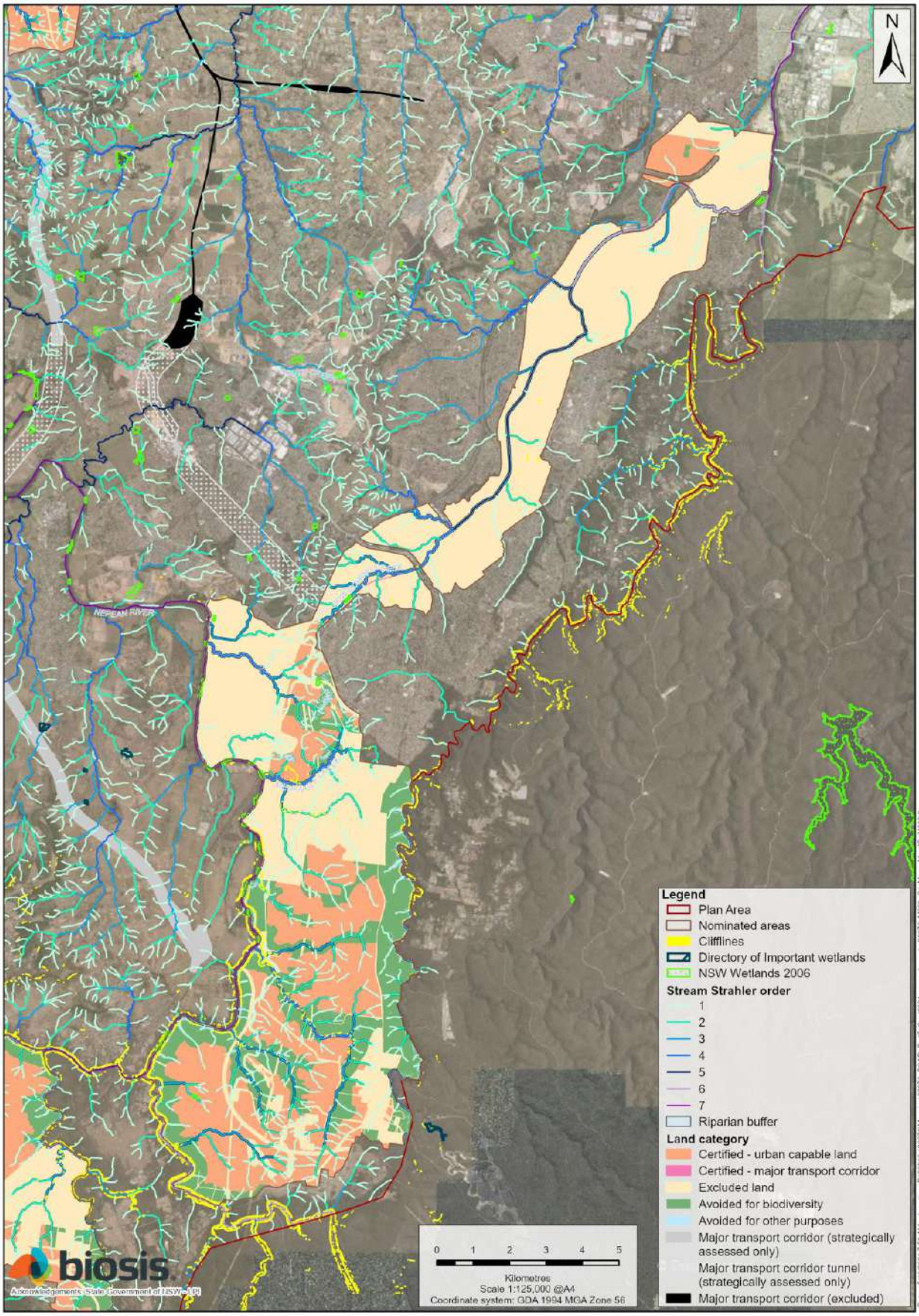

Figure 18-2: Site map – GMAC

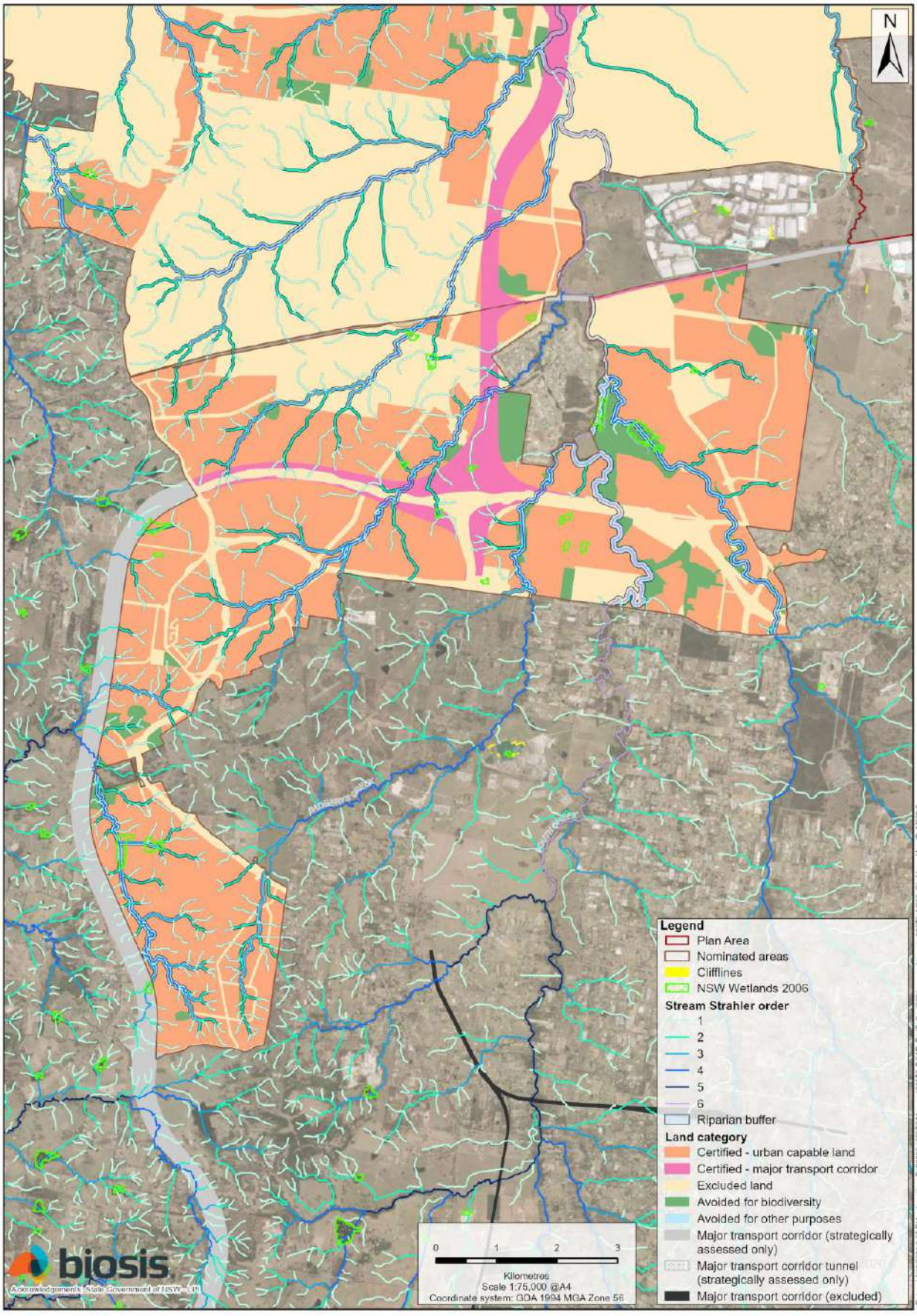

Figure 18-3: Site map – WSA

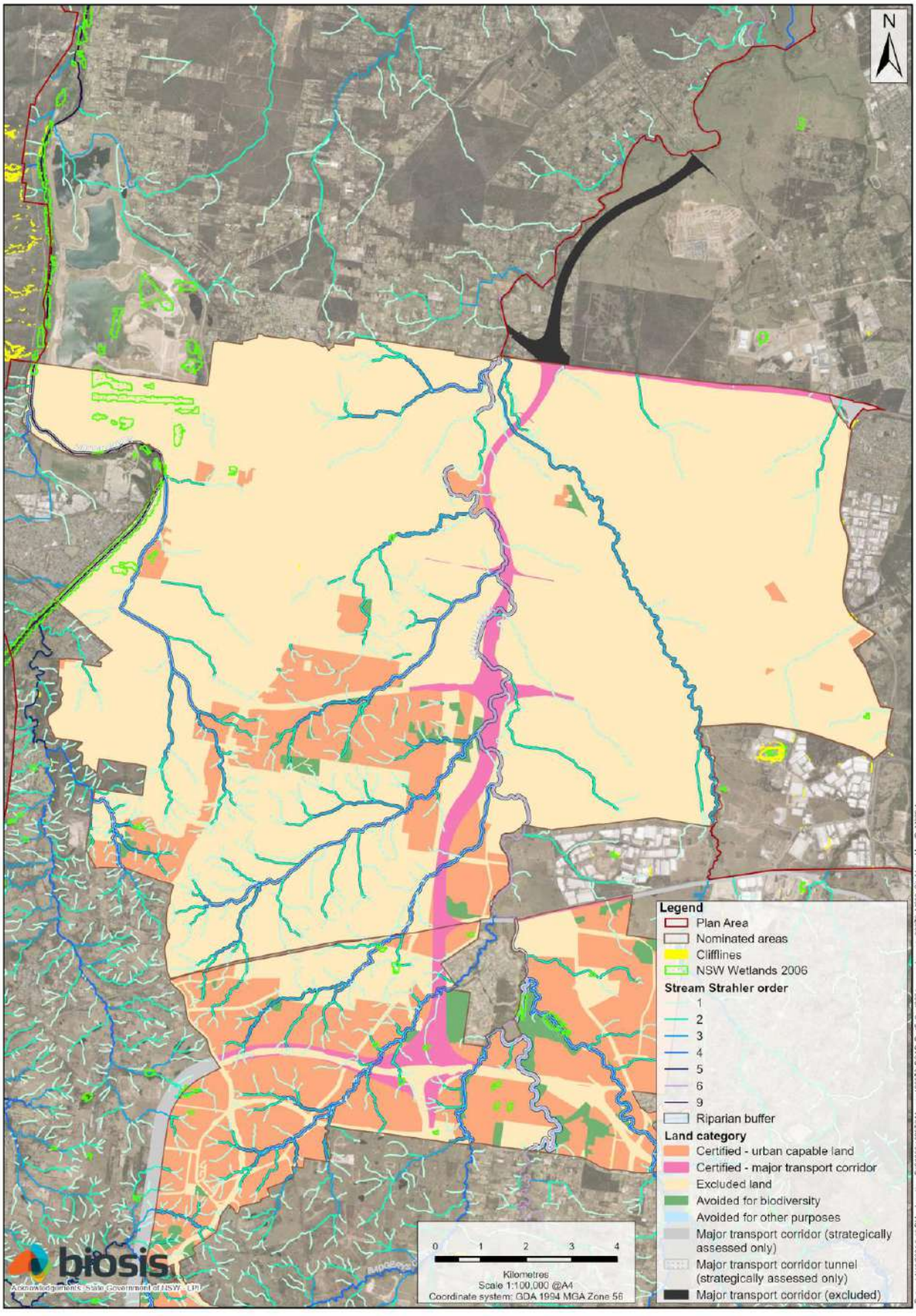

Figure 18-4: Site map – GPEC

18.2 NATIVE VEGETATION EXTENT – BUFFER AREA

Table 18-2 provides the percentage cover of native woody and derived grassland vegetation within the urban capable land of each nominated area, and the 1,500 m buffer. The vegetation mapping within the 1,500 m buffer was undertaken using existing vegetation mapping only, therefore the native vegetation extent for derived grasslands is likely to be under-represented.

Table 18-2: Native vegetation cover

Nominated area	Native vegetation extent (ha) (%)	Native vegetation extent (%) within urban capable land*		Native vegetation extent (%) within 1,500 m buffer*		
		Woody	Derived grasslands	Woody	Derived grasslands	Cover Class
Wilton	2,347 (58%)	9	28	46	6	>30-70%
GMAC	3,254 (30%)	9	3	33	1	>30-70%
WSA	876 (14%)	8	1	21	<1	>10-30%
GPEC	3,254 (17%)	8	2	20	<1	>10-30%

* Percentages rounded to whole numbers

18.3 NSW (MITCHELL) LANDSCAPES

NSW landscapes (also known as Mitchell Landscapes (Mitchell, 2002)) that occur within the nominated areas are described in Table 18-3. The landscape entered into the BAM calculator for each nominated area is the landscape in which most of the likely impacts within a nominated area occur and is marked with an asterisk in the table.

Table 18-3: NSW (Mitchell) landscapes

NSW (Mitchell) landscape	Subregion	Nominated area	Area of landscape in nominated area (ha)	Description
Upper Nepean Gorges	Cataract	Wilton	1,463	The Upper Nepean Gorges landscape is characterised by steep-sided benched slopes of the Nepean River tributaries on Triassic age quartz sandstones, with elevation of 250 to 350 m and local relief of 80 m. The landscape has shallow, well-drained sands with limited development of yellow texture-contrast soils on benches underlain by clayey sandstone of thin shale units
		GMAC	1,433	
Picton-Razorback Hills	Cumberland and Cataract	Wilton	2,499*	The Picton-Razorback Hills landscape is a plateau ridge with steep slopes on horizontal upper Triassic shale, carbonaceous claystone, and lithic sandstone, subject to extensive earthflows on slopes above 120 m. General elevation is 180 to 300 m with local relief of 90 m. Soils are harsh, red, brown, or yellow texture-contrast soils with reactive clay subsoils
		GMAC	3,127	
Cumberland Plain	Cumberland and Cataract	Wilton	109	The Cumberland Plain landscape is characterised by low, rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline. It is partly covered by Tertiary river gravels and sands (Hawkesbury-Nepean Terrace Gravels landscape). Quaternary alluvium occurs along the mains streams. General elevation is 30 to 120 m, with local relief of 50 m. The landscape is sometimes affected by dryland salinity in tributary valley floors. Soils are pedal uniform red to brown clays on volcanic hills, and red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys
		GMAC	3,751*	
		WSA	5,285*	
		GPEC	14,522*	
Hawkesbury - Nepean Channels and Floodplains	Cumberland	GMAC	450	The Hawkesbury –Nepean Channels and Floodplains landscape is a meandering channel and moderately wide floodplain of the Hawkesbury and Nepean rivers on Quaternary sand and gravel. Sand is dominant upstream of the Warragamba River junction with general elevation 0 to 20 m and local relief of less than 10 m. Soils are characterised as undifferentiated alluvial sand to poorly structured gradation profiles of sandy loam or clay loam
		WSA	871	
		GPEC	3,347	
Woronora Plateau	Cataract and Cumberland	GMAC	354	The Woronora Plateau landscape is an extensive plateau developed on Triassic quartz sandstone with benched, low angle slopes and a marked break to steep sided, deep valleys controlled by joint patterns. General elevation is 400 to 500 m with local relief of 100 m. There are small areas of nodular ironstone on ridge crests, with deep uniform sands or texture-contrast soils on slopes and deep, uniform, grey or white organic sands on swampy valley floors. Rock outcrop is common on ridgelines and in creeks, and absent from most slopes

NSW (Mitchell) landscape	Subregion	Nominated area	Area of landscape in nominated area (ha)	Description
Ashfield Plains	Cumberland	GMAC	724	The Ashfield Plains landscape is a coastal extension of the Cumberland Plain landscape and is characterised by undulating hills and valleys on horizontal Triassic shale and siltstone, and occasional quartz sandstones, especially near the margin of the Port Jackson landscape. General elevation is 0 to 45 m with local relief of less than 20 m. Soils are red and brown texture-contrast on crests, grading to yellow harsh texture-contrast soils in valleys
Georges River Alluvial Plain	Cumberland	GMAC	1,107	Georges River Alluvial Plain comprises channel, floodplain, and terraces of the Georges River on Quaternary and Tertiary alluvial sediments. Mostly clayey sand and sand with limited gravel on the highest terrace, general elevation 0 to 30 m, local relief 10 m. Massive uniform or gradational profiles on yellow brown to orange clayey sand. Podzols with well-developed double pans on limited areas of deep quartz sand, stony, harsh, yellow, texture-contrast soils on higher terraces
Sydney Basin Diatremes	Cumberland	GMAC	12	Sydney Basin Diatremes are widely distributed across the Sydney Basin and distinguished as a landscape because they always contain locally different landform, soil, and vegetation. Diatremes are circular volcanic vents filled with layered, brecciated country rock cemented by a fine-grained basaltic matrix. Some contain a core of basalt. In sandstone country the volcanic breccia weathers and erodes more rapidly than the sandstone and the landform is circular with the appearance of a crater. Soils in the crater are dominated by sandstone detritus from the surrounding slopes but the subsoils are a fertile well, structured clay derived from the breccia and these protected sites carry more mesic variants of the local vegetation. In shale country the breccia is more resistant than the shale and the diatremes form a low rounded hill with red-brown gradational profiles of clay loam and structured clay with moderate to high fertility. General elevation varies considerably across the basin
		WSA	5	
		GPEC	28	
Hawkesbury - Nepean Terrace Gravels	Cumberland	GPEC	718	Hawkesbury - Nepean Terrace Gravels comprise three levels of river terrace dating into the Tertiary. General elevation is 20 to 45 m, local relief 10 m. Planar, poorly drained terraces with harsh texture-contrast soils and heavy clays in swamps and cut-off meanders
Kurrajong Fault Scarp	Cumberland	GPEC	3	Kurrajong Fault Scarp dissected and broken slopes on Triassic Quartz sandstone and shale across the Lapstone monocline and Kurrajong fault scarp. Local dips on the sedimentary rocks up to 300, general elevation 100 to 250 m, local relief 100 m. Abundant rock outcrop with pockets of yellow-brown sand and occasional yellow texture-contrast soils

*NSW (Mitchell) Landscape entered into the BAM calculator for each nominated area

18.4 RIVERS AND STREAMS

The nominated areas are located within two catchments (OEH, 2010):

- Hawkesbury
- Port Jackson/Georges River

Within the nominated areas, the watercourses and creeks provide riparian connectivity, and connections to the major watercourses of the Georges River (to the east) and the Hawkesbury-Nepean River (to the west).

Major watercourses of each nominated area are described in Table 18-4. Unnamed and minor tributaries are numerous throughout the nominated areas and are not listed in the tables.

Table 18-4: Watercourses of the nominated areas

Nominated areas	General Information	Major watercourses	Watercourse Strahler order*
Wilton	Wilton is located at the southern end of the Cumberland subregion. Four major watercourses run through the area, which generally have a south to north flow regime. There are several creeks that junction into the major watercourses	Nepean River, flowing west then north of Wilton	The Strahler order of the watercourses across Wilton is as follows: • One seventh-order watercourse • Three fourth-order watercourses • Six third-order watercourses • 26 second-order watercourses • 110 first order watercourses
		Allen's Creek, starting just south-east of Wilton, flowing north into the Nepean River	
		Other smaller creeks include Sand Gully Creek, a second-order tributary as well as Clements Creek, a third order tributary	
		Stringybark Creek, a third-order tributary situated downstream of Clements Creek	
GMAC	GMAC stretches from Glenfield to Appin. There are three major watercourses that have a south to north flow regime	Bow Bowing Creek, a major watercourse that runs north-east through northern GMAC The creek has several lower-order tributaries associated with it including Smith's Creek, McBarron Creek, Leumeah Creek, Fishers Ghost Creek, Birunji Creek, and Keanes Creek Georges River is generally east of GMAC	The Strahler order of the watercourses across GMAC is as follows: • Three seventh-order watercourses • Four sixth-order watercourses • One fifth-order watercourse • 11 fourth-order watercourses • 16 third-order watercourses • 68 second-order watercourses • 245 first-order watercourses
		Nepean River borders the south-west portion of GMAC, it is the major watercourse flowing south to north There are four creeks that converge into the Nepean River that run through the southern portion of GMAC: • Menangle Creek, a fourth-order tributary, flowing west • Leafs Gully Creek, a second-order tributary, flowing north-west	

Nominated areas	General Information	Major watercourses	Watercourse Strahler order*
		• Ousedale Creek, a fourth-order tributary flowing north west • Simpsons Creek, a third-order tributary, flowing north-west into the Nepean River	
		The Cataract River forms the southern border of GMAC Rocky Ponds Creek, a third-order tributary, converges into Cataract River	
WSA	The WSA contains five major watercourses. All watercourses have several tributaries	Ropes Creek forms the eastern border of WSA, it is a perennial creek, flowing northwards. Wianamatta (South Creek) which also flows northwards has four high-order tributaries (some listed below) and two third-order creeks that junction into it. Badgerys Creek is a fourth-order watercourse that has several unnamed tributaries	The Strahler order of the watercourses across the WSA is as follows: • One sixth-order watercourse • Four fourth-order water courses • 15 third-order watercourses. • 59 second-order watercourses • 208 first-order watercourses
		Kemps Creek, flows in a north-west direction, it is a perennial creek that converges into Wianamatta (South Creek). Kemps Creek has three unnamed tributaries that come from an easterly direction	
		Cosgroves Creek flows through WSA in a north-east direction. It has several creeks and tributaries that converge with it, including Oaky Creek	
		Duncans Creek drains the south-west corner of WSA and junctions into the Nepean River in the west	
GPEC	The GPEC has three major watercourses. There are several creeks that junction into these major watercourses	Nepean River forms the western border for GPEC, flowing from south to north Four creeks flow into the Nepean River: • Boundary Creek, a second-order tributary with a westerly flow • Peach Tree Creek, a fourth-order tributary with a northern flow • Surveyors Creek, which junctions just north of the western motorway School House Creek is the most southern creek to junction into the Nepean River	The Strahler order of the watercourses across GPEC is as follows: • One ninth-order watercourse • Two sixth-order watercourses • Seven fourth-order water courses • 15 third-order watercourses • 53 second-order watercourses

Nominated areas	General Information	Major watercourses	Watercourse Strahler order*
		Ropes Creek, runs through GPEC and is a major watercourse	• 193 first-order watercourses
		Wianamatta (South Creek) flows south to north through the middle of GPEC. It has several smaller tributaries that feed into the large watercourse including: • Werrington Creek • Claremont Creek • Blaxland Creek • Byrnes Creek	
		Kemps Creek, flows in a north-west direction, it is a perennial creek that converges into Wianamatta (South Creek). Kemps Creek has three unnamed tributaries that come from an easterly direction	
		Cosgroves Creek flows through WSA in a north-east direction. It has several creeks and tributaries that converge with it, including Oaky Creek	
		Duncans Creek drains the south-west corner of WSA and junctions into the Nepean River in the west	

* This stream order system was originally developed by Strahler (1964). It functions by adding two streams of equal order at their confluence to form a higher order stream. As stream order increases, so does the likelihood that it would be a perennial source of water

18.5 WETLANDS

There are no wetlands protected under the Coastal Management State Environmental Planning Policy (SEPP) within the nominated areas. These wetlands were previously listed as SEPP 14 – Coastal Wetlands.

Locally occurring wetlands that provide wetland habitats include areas of floodplain wetland along the Nepean River, Wianamatta (South Creek) and Werrington Creek, farm dams and reservoirs. There are more than 60 of these types of wetland habitats mapped across the nominated areas (OEH, 2011a).

There are no nationally important wetlands or Ramsar-listed wetlands within the nominated areas. The closest nationally important wetlands to the nominated areas are (DoEE, 2018):

- Towra Point (Ramsar site) 25 kilometres east of Glenfield
- Lake Illawarra, 30 kilometres to the south-east of Wilton
- Bicentennial Park, Newington Wetlands, Silverwater Nature Reserve, 17 kilometres east of Prospect Reservoir
- Pitt Town Lagoon, Pitt Town
- Longneck Lagoon, Pitt Town

The closest Ramsar wetland is located at the Towra Point Nature Reserve, in Botany Bay.

18.6 HABITAT CONNECTIVITY AND FRAGMENTATION

The soils of the Cumberland subregion are relatively fertile, particularly when compared to the surrounding Hawkesbury Sandstone landscapes. This fertility has resulted in extensive clearing of native vegetation for agriculture, market gardens and orchards. More recently, clearing has occurred for urban development.

Only approximately 13 per cent of the pre-1970 extent of native vegetation in the Cumberland subregion remains intact and in good condition, with an additional 12 per cent occurring as scattered trees in disturbed areas (DECCW, 2011).

Remaining native vegetation is often highly fragmented. In 2010, an estimated 2,446 individual native vegetation remnants remained in the subregion, ranging from less than 1 hectare to 3,598 hectares in area (DECCW, 2010). Eighty one of the largest patches (those greater than 50 hectares) represent 51 per cent of the remaining native vegetation (DECCW, 2011).

Fragmentation of habitats across and between the nominated areas mirrors this general pattern of clearing and development in the Cumberland subregion, with significant areas of native vegetation community restricted to reserves, major riparian corridors, sandstone geologies and areas not suited to agriculture, such as steep slopes and escarpments.

The impacts of the development on habitat connectivity are assessed in Chapter 24.

18.6.1 WILTON

Connectivity of intact vegetation within Wilton is generally in the hilly, gorge and riparian corridors on the fringes of the nominated area. There is intact vegetation creating connectivity along Allens Creek from the west of the nominated area towards the areas of more intact vegetation south of the nominated area. Habitat for native species within the central parts of the nominated area (predominantly on shale soils) is restricted to scattered trees and derived grasslands or small native remnants of less than 5 hectares, which are under pressure from weed invasion, edge impacts and ongoing agricultural practices.

Map 24-3 shows habitat connectivity within Wilton.

18.6.2 GMAC

Fragmentation of habitat within GMAC is also typical of that seen in the Cumberland subregion, with clearing of vegetation from the fertile crests, and the low-lying and alluvial soils. However, due to the presence of riparian corridors and sandstone geologies there is some connectivity of intact habitats along a number of east-west corridors in the southern portion of GMAC. These connections reach from the Nepean River riparian corridor on the western boundary, to near the eastern boundary, where the habitats of the Georges River riparian corridor are located.

Habitat connectivity within the highly developed northern portion of the nominated area is restricted to small local connections such as largely cleared riparian corridors and urban bushland parks. Scattered trees and urban native vegetation are also present in this area, providing some connectivity for highly mobile species.

Map 24-3 shows habitat connectivity within GMAC.

18.6.3 WSA

WSA is characterised predominantly by an agricultural landscape with limited small acreage subdivision in the far south and larger acreage and small residential subdivisions in the centre and northern parts. Some small acreage subdivisions contain native vegetation, providing local connections for native fauna and flora species.

Other native vegetation habitats are present along the many riparian corridors that cross WSA, including Wianamatta (South Creek), Duncans Creek and Badgerys Creek corridors and tributaries. There are remnant patches of vegetation located between Willowdene Avenue and the Northern Road in the central part of the nominated area around Duncans Creek, providing some limited connectivity east-west. There are also many waterbodies within WSA that provide habitat connectivity for species dependent on these environments for dispersal and reproduction.

Map 24-3 shows habitat connectivity within WSA.

18.6.4 GPEC

GPEC has been extensively developed for housing. Intact native vegetation and habitats are restricted to the far north of the nominated area around the Wianamatta Regional Park, and the Orchard Hills Defence Establishment in the far south of the nominated area. These two areas of remnant habitats are connected via the riparian corridors of Wianamatta (South Creek). The Ropes Creek corridor reaches from the Wianamatta Regional Park through to the south-east of the nominated area. Both of these major riparian corridors have been subject to varying levels of clearing and disturbance. However, they provide the only vegetated link within the local and regional landscape for native flora and fauna species.

Map 24-3 shows habitat connectivity within GPEC.

18.7 AREAS OF GEOLOGICAL SIGNIFICANCE AND SOIL HAZARDS

Areas of geological significance occur outside urban capable land on the edges of some of the nominated areas, including rocky escarpments associated with surrounding sandstone landscapes. These areas may be important for species that have specific habitat constraints and associations. Areas of potential soil hazard within the nominated areas include:

- Acid Sulfate Soils
- Sodic soils
- Salinity
- Land contamination
- Soil compaction
- Unstable soils

The impacts of the development on karst, caves, crevices and cliffs are assessed in Chapter 24.

18.7.1 ACID SULFATE SOILS

Table 18-5 provides a description of the soil hazard map units identified in the Atlas of Australian Acid Sulfate Soils (Fitzpatrick, Powell et al., 2011).

Areas of high probability Acid Sulfate Soils within the nominated areas are shown in Map 18-5.

Table 18-5: Acid Sulfate Soils within the nominated areas

Map Units	Probability of occurrence	Map unit	Subscript	Confidence	Nominated area
Bn(p4)	B - Low (6-70%)	n - Inland landscapes in wet/riparian corridors associated with sodosols, chromosols and dermosols. Acid Sulfate Soils generally within upper 1 m of wet / riparian corridors	p - Potential acid sulfate soil (PASS) = sulfidic material	4- Classification is provisional	GMAC GPEC
Cq(p4)	C- Extremely low (1-5%)	q - Inland landscapes in wet/riparian corridors associated with kandosols, tenosols and rudosols. Acid Sulfate Soils generally within 1 m	p - Potential acid sulfate soil (PASS) = sulfidic material	4- Classification is provisional	Wilton GMAC WSA GPEC

Map Units	Probability of occurrence	Map unit	Subscript	Confidence	Nominated area
		of wet/riparian corridor			
Cu(--)	C- Extremely low (1-5%)	u - unclassified Not Acid Sulfate Soils	Not Acid Sulfate Soils	Not Acid Sulfate Soils	GMAC GPEC
An(p4)	A - High (>70%)	n - Inland landscapes in wet/riparian corridors associated with sodosols, chromosols and dermosols. Acid Sulfate Soils generally within upper 1 m of wet / riparian corridors	p - Potential Acid Sulfate Soil (PASS) = sulfidic material	4- Classification is provisional	WSA GPEC
Aq(p4)	A - High (>70%)	q - Inland landscapes in wet/riparian corridors associated with kandosols, tenosols and rudosols. Acid Sulfate Soils generally within 1 m of wet/riparian corridor	p - Potential acid sulfate soil (PASS) = sulfidic material	4- Classification is provisional	WSA GPEC
Cn(p4)	C- Extremely low (1-5%)	n - Inland landscapes in wet/riparian corridors associated with sodosols, chromosols and dermosols. Acid Sulfate Soils generally within upper 1 m of wet / riparian corridors	p - Potential Acid Sulfate Soil (PASS) = sulfidic material	4- Classification is provisional	WSA GPEC

18.7.2 SODIC SOILS

Sodicity refers to the proportion of exchangeable sodium cations held on the surface of clay particles. The greater the proportion of sodium in the total exchangeable cations, the greater the sodicity of the soil.

Sodic soils cause clay dispersion, an undesirable condition.

Sodic soils could occur within the nominated areas, most likely in riparian corridors and near dams. A site assessment would be necessary to determine extent at specific locations.

18.7.3 SALINITY

Salinity refers to the amount of dissolved salt in the soil. A large concentration of salt gives high salinity and increasing salinity makes it difficult for plant roots to absorb water.

The Western Sydney Hydrogeological Landscape maps show the majority of Western Sydney as having high land salinity. Wilton is mapped as having low to moderate land salinity, while parts of the assessment area north of Wilton are predominantly high land salinity areas (OEH, 2011b).

Site assessments would be required to determine the salinity of individual sites.

18.7.4 LAND CONTAMINATION

Land contamination can threaten human health and the environment, limit land use potential or increase development costs. Contaminated sites are typically found in areas that have been used for heavy industry or agriculture, chemical storage areas and service stations and dry cleaning sites (NSW EPA, 2019).

Declarations of significantly contaminated lands have been made for various sites across each of the nominated areas, primarily relating to industrial sites. The list of current declarations for each Local Government Area (LGA) within the nominated areas is available through the NSW Environment Protection Authority website.

18.7.5 SOIL COMPACTION

Compaction of soils can occur through movement of stock, machinery, or vehicles. When soil becomes compacted, air and water movement through the soil are restricted, limiting their use.

Compacted soils within the nominated areas are most likely to be found in areas used for grazing or agriculture. Areas of susceptibility are likely to occur on the alluvial plains and the Cumberland Plain Mitchell Landscape.

Site assessments would be required to determine soil compaction levels at individual sites.

18.7.6 UNSTABLE SOILS

Unstable soils are referred to as 'dispersible soils' and are often associated with high levels of salt. They are vulnerable to compaction, surface sealing and erosion. Areas of potential high land salinity within the nominated areas are more likely to exhibit unstable soils. Potential areas of instability and potential for gully erosion within the nominated areas are most likely to occur in areas of high slope, salinity, and reduced vegetation ground cover.

Within the nominated areas, the Wianamatta (South Creek) soil landscape has high to extreme potential for erosion, and stream bank and gully erosion in this landscape can result from concentrated water flows. The Luddenham Soil Landscape has a moderate to very high potential for erosion, with minor gully erosion and sheet erosion in disturbed areas.

18.8 AREAS OF OUTSTANDING BIODIVERSITY VALUE

No areas identified as Areas of Outstanding Biodiversity Value occur within the nominated areas (OEH, 2020).

18.9 SITE CONTEXT

This section describes the site context, in accordance with section 4.3 of the BAM, for each of the nominated areas.

18.9.1 PER CENT NATIVE VEGETATION COVER

Per cent native vegetation cover is shown in Table 18-6 for the:

- Nominated areas
- Urban capable land
- 1,500 m buffer areas

Table 18-6: Native vegetation cover

Nominated area	Native vegetation cover (%)	Cover Class	Native vegetation cover (%) – urban capable land*	Cover Class	Native vegetation cover (%) – 1,500 m buffer*	Cover Class
Wilton	58	>30-70%	37	>30-70%	52	>30-70%
GMAC	30	>10-30%	12	>10-30%	34	>30-70%
WSA	14	>10-30%	9	0-10%	21	>10-30%
GPEC	17	>10-30%	10	0-10%	20	>10-30%
Average	30	>10-30%	17	>10-30%	32	>30-70%

* Percentages rounded to whole numbers

18.9.2 CHANGES TO THE MAPPED NATIVE VEGETATION EXTENT

Several areas of native vegetation shown on the existing native vegetation maps (OEH, 2013, 2016) have been cleared since the maps were prepared and no longer exist. These areas were discernible on Nearmap aerial imagery (Nearmap, 2018) and were excluded from the updated vegetation maps. Areas of urban vegetation such as roadside plantings were also excluded. These areas were ground-truthed during surveys where possible to positively identify them as being non-native vegetation or native vegetation with a cultivated origin.

18.9.3 PATCH SIZE

Patch size for BAM credit calculations was defined as greater than 100 hectares for all vegetation zones in the nominated areas. This served to not limit the potential threatened species that could be recorded or identified in the assessment for consideration.

19 Native vegetation

This Chapter describes the native vegetation communities in the nominated areas, including vegetation extent, PCTs and vegetation condition (native vegetation integrity).

The method for identifying and mapping native vegetation within the nominated areas is provided in Chapter 11.

19.1 NATIVE VEGETATION EXTENT

The total extent of vegetation within the nominated areas is 11,764 hectares (see Table 19-3). This includes:

- 9,730 ha of native vegetation, including areas with native dominated ground cover and canopy area of trees
- 2,034 ha of 'Urban Native/Exotic' vegetation, which comprises areas of exotic vegetation or with few native species, as well as planted vegetation, landscaped areas, gardens, and other areas that are not considered representative of 'native vegetation' and/or a PCT

Map 19-1 shows the extent of native vegetation within the nominated areas, including the extent of the 'Urban Native/Exotic' vegetation.

19.2 PLANT COMMUNITY TYPES

A total of 15 different PCTs occur within the nominated areas. In addition to these 15 PCTs, a category of vegetation called 'Urban Native/Exotic' vegetation also occurs (see Table 19-1).

A description of the PCTs that occur within the nominated areas, including the percentage of each PCT that has been cleared (up to 2018) (OEH, 2018) is provided in Table 19-1.

Table 19-2 provides a justification for the identification of each PCT in accordance with section 5.2.1.12 of the BAM which included:

- Qualitative analysis of BAM plot data (including photographs) against BioNet (PCT ID tools) using filters such as the; Sydney Basin IBRA, Sydney Cataract and Cumberland IBRA Subregions, vegetation class and formation, vegetation description followed by analysis of upper, mid and ground stratum floristics, identified dominant strata species followed
- Matching the outputs of the quantitative analysis of the BAM plot survey data to PCTs followed by cross referencing of the identified PCT against available vegetation mapping for the region to verify and confirm
- Quality checking of PCT analysis through entering all BAM plot data into 'Tozer tool' floristic assessment worksheets to confirm PCT suitably based on the presence of positive diagnostic species for Tozer et al (2010) map units, to the 95% confidence interval, where sufficient data existed
- Final mapping of the PCTs

Table 19-3 provides the amount (hectares) of each PCT within the nominated areas.

The five most extensive PCTs (including the Urban Native/Exotic category of vegetation) within the nominated areas are:

- 1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest – 3,357 ha
- 849 Grey Box - Forest Red Gum grassy woodland on flats – 2,890 ha
- Urban Native/Exotic – 2,034 ha
- 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats – 1,187 ha
- 1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes – 774 ha

Map 19-2, Map 19-3, Map 19-4 and Map 19-5 show the distribution of PCTs within the nominated areas.

Table 19-1: PCTs within the nominated areas

PCT	Name	Vegetation formation	Vegetation class	Description*	Per cent cleared value (BioNet)
724	Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Dry Sclerophyll Forest	Cumberland Dry Sclerophyll Forest	This community is associated with shale-influenced sandy soils that support a component of ironstone gravels. The vegetation typically consists of an open eucalypt forest with an understorey that varies between dense shrubs and a low sparse shrub cover with an abundant ground cover of grasses. The canopy typically includes Broad-leaved Ironbark *Eucalyptus fibrosa* along with a wide variety of other eucalypts depending on location. White Feather Honeymyrtle *Melaleuca decora* is sometimes present above a lower open shrub layer of Blackthorn *Bursaria spinosa* and Gorse Bitter Pea *Daviesia ulicifolia*. The ground cover is a mix of grasses, sedges, and herbs. On the basis of floristic composition alone, Castlereagh Shale-Gravel Transition Forest is closely related to Castlereagh Ironbark Forest	75%
725	Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Dry Sclerophyll Forest (Shrub/grass sub-formation)	Cumberland Dry Sclerophyll Forest	This community is associated with clay soils derived from Tertiary alluvial deposits (Tozer 2003). It is one of two closely related ironbark shrub-grass forests found in western Sydney. The structure ranges from a moderately tall open eucalypt forest or woodland to a low dense thicket of paperbarks with low emergent eucalypts. Human-induced changes to the original forest structure have resulted in the presence of varying structures of the community Benson and Howell (1994a). Broad-leaved Ironbark is the most commonly recorded eucalypt although at some sites it may be absent Woollybutt *Eucalyptus longifolia* is also common although sites often have a diverse canopy composition which reflects subtle grades between substrates sourced from Tertiary sand, sandstone bedrock, shale, and ironstone gravels. For this reason, there are localised occurrences of Hard-leaved Scribbly Gum *Eucalyptus sclerophylla*, Smooth-barked Apple *Angophora costata* and Narrow-leaved Apple *Angophora bakeri*, species more typically associated with siliceous soils of sand deposits and the sandstone plateau. A prominent small tree layer of White Feather Honeymyrtle features above a dense cover of shrubs that include *Melaleuca nodosa*, Blackthorn and Peach Heath *Lissanthe strigosa* The ground layer is a sparse cover of grasses and forbs. These may be very depauperate in locations where dense shrub layers exclude light	95%

PCT	Name	Vegetation formation	Vegetation class	Description*	Per cent cleared value (BioNet)
781	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands	Coastal Freshwater Lagoons	This community is associated with freshwater lagoons and swamps on alluvial flats and sand depressions across the NSW east coast. Lagoons have fluctuating levels of standing water that gives rise to a varied assemblage of species. They include a range of sedges, rushes and aquatic herbs with woody shrubs and small trees found only on the margins of the wetlands in low abundance. Tall reedlands (reaching over 3 m in height) may dominate individual wetlands. Cumbungi *Typha orientalis* is typically dominant in urban wetlands and may be joined by Common Reed *Phragmites australis*. Other tall reeds include *Eleocharis sphacelata* and tall sedges such as Twig-rushes *Baumea* spp. The margins of open water carry a range of aquatic herbs such as *Isachne gibbosa* and *Persicaria decipiens*. Less frequently inundated wetlands support only a few species of sedges or rushes such as *Carex appressa* and *Baumea* spp. which do not reach the height of the taller reedlands found elsewhere	74%
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	This community occurs on protected aspects on steeper shale hills and rises of the southern half of the Cumberland Plain. It differs from the grassy woodlands found in Western Sydney by the prevalence of waxy-leaved shrubs and small trees in the understorey and a ground cover of herbs, fleshy twiners and grasses. Some of these species, such as Hairy Clerodendrum *Clerodendrum tomentosum* and Slender Grape *Cayratia clematidea*, are features of the Hinterland Dry Rainforest, a community that occasionally occurs in more protected situations nearby. Across its range in Western Sydney the canopy is mostly dominated by Forest Red Gum *Eucalyptus tereticornis* and Grey Box *Eucalyptus moluccana*. Much of this habitat has been extensively cleared, with remaining stands commonly choked by dense thickets of African Olive *Olea europaea* subsp. *cuspidata* and Lantana *Lantana camara*. This reduces species diversity and in chronic situations it may be difficult to correctly diagnose the community due to low numbers of native species	75%

PCT	Name	Vegetation formation	Vegetation class	Description*	Per cent cleared value (BioNet)
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	This community is located on broad alluvial flats of the Hawkesbury and Nepean river systems. It also forms narrower ribbons alongside streams and creeks that drain the Cumberland Plain. The canopy typically includes one of either Rough-barked Apple *Angophora floribunda* or Broad-leaved Apple *Angophora subvelutina* and one or both of Forest Red Gum and Cabbage Gum *Eucalyptus amplifolia*. However, eucalypt species will vary between localities, including Blue Box *Eucalyptus baueriana*, Sydney Blue Gum *Eucalyptus saligna* and Blackbutt *Eucalyptus pilularis*. The understorey within this community is characterised by an occasional sparse to open small tree stratum of Paper Bark *Melaleuca* spp. and Wattles *Acacia* spp. A sparse lower shrub layer features Blackthorn *Bursaria spinosa* at most sites. The ground layer is characterised by an abundant cover of grasses with herbs and ferns	93%
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	This community is one of two grassy woodlands that comprise Cumberland Plain Woodland listed under the BC Act. The community includes an open grassy woodland dominated by Grey Box, Forest Red Gum and Narrow-leaved Ironbark and Broad-leaved Ironbark. Like the related community Cumberland Shale Hills Woodland, it is typified by a sparse to moderate cover of shrubs and a high cover of grasses and forbs	93%
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	This community is one of two grassy woodlands that comprise the Cumberland Plain Woodland listed under the BC Act. The community is an open woodland of Grey Box and Forest Red Gum with Narrow-leaved Ironbark also common. Hickory Wattle *Acacia implexa* occurs amongst the small tree layer, often amongst regrowth stands. This species is one of the more distinctive floristic attributes that helps distinguish between the two components of the EEC. Other features are similar in that the two woodland units are characterised by an open shrub layer and a grassy ground cover. Fire history can have an important influence on the abundance of shrubs (Watson et al. 2009), with density of Blackthorn *Bursaria spinosa* increasing with time since fire	88%

PCT	Name	Vegetation formation	Vegetation class	Description*	Per cent cleared value (BioNet)
877	Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion	Rainforests	Dry Rainforests	This community occurs on very sheltered clay-rich soils of the undulating hills and ranges of western Sydney and the southern Blue Mountains. Grey myrtle *Backhousia myrtifolia* is the most common and abundant rainforest species. Other locally prominent species include fig *Ficus rubiginosa*, wild quince *Alectryon subcinereus* and whalebone tree *Streblus brunonianus*. The rainforest canopy may include eucalypts (in the study area spotted gum *Corymbia maculata* is common), wattles and paperbarks. The former is more commonly an emergent layer and the latter prevalent in hillside drainage lines. Several mesic shrubs consistently occur including hairy clerodendrum *Clerodendrum tomentosum* and large mock olive *Notelaea longifolia*. The ground cover is a sparse cover of herbs and ferns.	25%
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Sand Flats Dry Sclerophyll Forests	This community is one of several unique dry shrub woodland communities found on poorly consolidated sand deposits on hinterland plains and valleys of the Sydney region. The woodland comprises an open, low-growing eucalypt cover dominated by Hard-leaved Scribbly Gum *Eucalyptus sclerophylla*, Narrow-leaved Apple and Drooping Red Gum *Eucalyptus parramattensis* subsp. *parramattensis*. A sparse cover of White Feather Honeymyrtle is often present. Banksias, hakeas, wattles, tea-trees and paperbarks provide a well-developed shrub layer. The ground cover is usually a diverse mix of species typically including a high cover of grasses and sedges	50%
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Hinterland Dry Sclerophyll Forests	This community is equivalent to DSF 146 identified by Tindall et al. (2004) and is a eucalypt woodland with an open understorey of sclerophyll shrubs, sedges, forbs and grasses. This transition woodland encircles the Cumberland Plain rainshadow, on loamy soils typically derived from sediments belonging to the Hawkesbury or Mittagong formations. 40 per cent of this community's original distribution has been cleared and clearing continues in localised areas of suburban expansion. However, considerable areas are represented within conservation reserves	40%

PCT	Name	Vegetation formation	Vegetation class	Description*	Per cent cleared value (BioNet)
1105	River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion	Forested Wetlands	Eastern Riverine Forests	Open *Casuarina* forest, 10-40 m tall, with a variable non-sclerophyll shrub stratum and patchy groundcover of sedges and herbs, interspersed with leaf litter, cobbles and open sand. Restricted to narrow bands along rivers of the coast and tablelands north from Bega continuing into central Queensland	40%
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	This community is equivalent to DSF 142 identified by Tindall et al. (2004) and is an open eucalypt forest with an abundant sclerophyll shrub stratum and a groundcover dominated by sedges. This community grades from Hinterland Sandstone Gully Forest into Sandstone Riparian Scrub immediately adjacent to creeklines and is replaced by Coastal Sandstone Ridgetop Woodland or Wingecarribee-Burragorang Sandstone Forest on upper slopes and exposed positions. Dominant trees include; Smooth-barked Apple, Red Bloodwood *Corymbia gummifera*, Sydney Peppermint *Eucalyptus piperita*. As rainfall increases toward the coast, it is replaced by Coastal Sandstone Gully Forest. Much of this community's original distribution has been cleared. Large areas remain, including examples in conservation reserves, though edge effects such as weed invasion and high fire frequency are evident in some locations	20%

PCT	Name	Vegetation formation	Vegetation class	Description*	Per cent cleared value (BioNet)
1292	Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion	Forested Wetlands	Eastern Riverine Forests	This low scrub comprises a mix of hardy shrubs growing on rocky creek lines or shallow alluvial soils at the base of deep sandstone gully systems. The vegetation cover is highly variable as it is interspersed by rock pools, rock pavements and open sandy banks. It is a zone of occasional flooding and plants must survive fast-moving waters to persist. Water gums *Tristaniopsis laurina* and *Tristania neriifolia* are invariably present, often in combination with wattles, hakeas, grevilleas, tea-trees and casuarinas. Two shrub species, River Lomatia *Lomatia myricoides* and Blunt-leaved Wattle *Acacia obtusifolia*, are particularly common in this community; both are easily distinguished by their long leaves. Small moisture-loving ferns and sedges may form dense clumps on or near stream banks. A sparse cover of overhanging eucalypts may also be present, though these are often rooted in the adjoining slopes rather than the creek line itself	10%
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	This community is found on the fringes of the Cumberland Plain. It is one of a suite of forests that are associated with the subtle intergrade between clay-rich shale soil and the coarse sandy substrates of the sandstone plateau. It is a moderately tall eucalypt forest with a mixed understorey of sclerophyll shrubs and grasses (Tozer et al. 2010). Sites invariably have one of two species of Ironbark, Narrow-leaved Ironbark and Broad-leaved Ironbark, present in the canopy along with Grey Gum *Eucalyptus punctata* and Red Bloodwood. A sparse cover of tall Casuarinas *Allocasuarina littoralis*/*Allocasuarina torulosa* is common. The understorey supports a mix of shrubs that are common on shale substrates such as Blackthorn *Bursaria spinosa* and those more commonly associated with sandstone soils such as Geebungs (*Persoonia* spp). Beneath this diverse mix of shrubs is a high cover of grass and forbs. The grass layer includes a wide range of species, most of which occur more extensively on the Cumberland Plain	80%
1800	Swamp Oak open forest on river flats of the Cumberland Plain and Hunter valley	Forested Wetlands	Coastal Floodplain Wetlands	This community is found on the river flats of the Cumberland Plain in western Sydney. The distinguishing feature is the prominent stands of Swamp Oak *Casuarina glauca* found along or near streams. Often these are relatively young trees, swarming amongst a mix of old and young eucalypts such as Rough-barked Apple *Angophora floribunda*, Forest Red Gum and Grey Box. This community features an open grassy and herbaceous understorey, as is typical of river flat forests	60%

PCT	Name	Vegetation formation	Vegetation class	Description*	Per cent cleared value (BioNet)
	Urban Native/Exotic			Vegetation that is not consistent with floristic composition and landscape positions for native plant community types as defined by the NSW BioNet Vegetation Classification system; most commonly communities comprise of very few native species or consist of an assorted mix of planted natives	

*Adapted from the BioNet Vegetation Information System (VIS) database

Table 19-2: Justification for the identification of PCTs

PCT	Name	Diagnostic species present in BAM plot data (as aligned with BioNet PCT descriptions)	Additional justification of evidence to identify the PCT (Source: BioNet and BAM plot data)
724	Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	*E. fibrosa, M. decora, Lissanthe strigosa, Microlaena stipoides* var. *stipoides, Cheilanthes sieberi, Lobelia purpurascens, Wahlenbergia gracilis, Aristida vagans, Lomandra multiflora*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion, Dry Sclerophyll Forests (Shrub/grass sub-formation) and match with BAM plot upper, mid, and ground strata diagnostic species Associated with shale-gravelly soils. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as an open eucalypt forest with an understorey that may vary between dense shrubs and a low sparse shrub cover with an abundant ground cover of grasses, sedges, and herbs, consistent with the species assemblage for this PCT
725	Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	*E. fibrosa, M. decora, M. nodosa, Bursaria spinosa, Daviesia ulicifolia, Lobelia purpurascens, Microlaena stipoides* var. *stipoides, Pomax umbellata, Ozothamnus diosmifolius, Lepidosperma laterale, Laxmannia gracilis*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion, Dry Sclerophyll Forests (Shrub/grass sub-formation) and match with BAM plot upper, mid, and ground strata diagnostic species Associated with clay soils derived from Tertiary alluvial deposits and laterized deeply weathered shale. This PCT was found in varying degrees of condition and species composition. In intact condition, the structure ranges from a moderately tall open eucalypt forest or woodland to a low dense thicket of paperbarks with low emergent eucalypts, consistent with the species assemblage for this PCT
781	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	*Typha orientalis, Phragmites australis, Eleocharis sphacelata, Carex appressa, Baumea juncea, Baumea* spp. and *Persicaria strigosa*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion, Freshwater Wetlands and match with BAM plot upper, mid and ground strata diagnostic species Associated with freshwater lagoons and swamps on alluvial flats, found generally at low elevations less than 20 m above sea level, and up to 50 m above sea level. This PCT was found in varying degrees of condition and species composition. In intact condition, the lagoons consist of a range of sedges, rushes and aquatic herbs

PCT	Name	Diagnostic species present in BAM plot data (as aligned with BioNet PCT descriptions)	Additional justification of evidence to identify the PCT (Source: BioNet and BAM plot data)
			with woody shrubs and small trees, consistent with the species assemblage for this PCT
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*E. tereticornis, E. moluccana, Clerodendrum tomentosum, Solanum prinophyllum, Microlaena stipoides* var. *stipoides*	Sydney Basin IBRA, Cumberland Subregion, Grassy Woodlands and match with BAM plot upper, mid and ground strata diagnostic species Associated with protected aspects on steeper shale hills and rises of the southern half of the Cumberland Plain. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as an open grassy woodland with prevalence of waxy-leaved shrubs and small trees in the understorey and a ground cover of herbs, fleshy twiners, and grasses, consistent with the species assemblage for this PCT
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	*E. tereticornis, Angophora floribunda, E. amplifolia* subsp. *amplifolia, Acacia parramattensis, Bursaria spinosa* subsp. *spinosa, Microlaena stipoides* var. *stipoides, Dichondra repens, Solanum prinophyllum, Commelina cyanea, Lobelia purpurascens, Veronica plebeia*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Forested Wetlands and match with BAM plot upper, mid, and ground strata diagnostic species Associated with broad alluvial flats, streams, and creeks at altitudes between one and 160 m above sea level. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as an open eucalypt forest, with occasional sparse to open small tree stratum and a sparse lower shrub layer, with an abundant cover of grasses, small herbs, and ferns, consistent with the species assemblage for this PCT
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	*E. moluccana, E. tereticornis, Bursaria spinosa* subsp. *Spinosa, Cheilanthes sieberi* subsp. *Sieberi, Aristida vagans, Aristida ramosa, Euchiton sphaericus, Microlaena stipoides* var. *stipoides, Lomandra filiformis, Goodenia hederacea, Dichelachne micrantha, Themeda triandra*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Grassy Woodlands and match with BAM plot upper, mid, and ground strata diagnostic species Associated with gentle topography generally at less than 150 m above sea level and can occur over 300 m above sea level in some locations. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as an open grassy eucalypt woodland with a sparse to moderate cover of shrubs and a high cover of grasses and forbs, consistent with the species assemblage for this PCT
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	*E. moluccana, E. tereticornis, Bursaria spinosa* subsp. *spinosa, Dichondra repens, Microlaena stipoides* var. *stipoides, Carex*	Sydney Basin IBRA, Cumberland Subregion Grassy Woodlands and match with BAM plot upper, mid, and ground strata diagnostic species Associated with elevations between 50 m and 350 m above sea level in more rugged landforms separating this from gentler landforms occupied by PCT 849.

PCT	Name	Diagnostic species present in BAM plot data (as aligned with BioNet PCT descriptions)	Additional justification of evidence to identify the PCT (Source: BioNet and BAM plot data)
		inversa, Asperula conferta, Oxalis perennans, Wahlenbergia gracilis	This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as an open woodland with an open shrub layer and a grassy ground cover, consistent with the species assemblage for this PCT
877	Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion	No BAM plot data, PCT not impacted	Sydney Basin IBRA, Cumberland Subregion Rainforests and match with BAM plot upper, mid, and ground strata diagnostic species This PCT typically occurs as a simple, low closed forest with a sparse groundcover. It is widely distributed as small patches throughout the dry gorge country of the southern Blue Mountains (Coxs, Kowmung and Wollondilly gorges), the margins of the Cumberland Plain, and the Shoalhaven and Ettrema Gorges. It usually occupies the steep lower slopes of gorges below 600m ASL with an annual rainfall from 750 - 900mm, where pre-Permian rocks underlying those of the Sydney Basin are exposed (Tozer et al 2010) Within the nominated areas it occurs at one location in Greater Macarthur where it was confirmed as present during public submission and mapping received as prepared by a BAM Accredited ecological consultant. Access to the vegetation was not possible during the project's field campaign and as such no detailed vegetation community assessment was undertaken or plot data was collected.
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	*E. sclerophylla, M. decora, M nodosa, Grevillea mucronulata, Cyathochaeta diandra, Lomandra multiflora, Cheilanthes sieberi; Dianella revoluta*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Dry Sclerophyll Forests (Shrubby sub-formation) and match with BAM plot upper, mid, and ground strata diagnostic species Associated with soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium, with sandy deposits. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as a shrubby woodland with an open, low-growing eucalypt cover, well developed shrub layer, and a diverse mix of species typically including a high cover of grasses and sedges, consistent with the species assemblage for this PCT
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	*E. punctata, Entolasia stricta, Persoonia linearis, Leptospermum trinervium, Acacia ulicifolia, Lambertia formosa, Dianella revoluta* var. *revoluta*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Dry Sclerophyll Forests (Shrubby sub-formation) and match with BAM plot upper, mid, and ground strata diagnostic species This community is present on loamy soils on dry ridges in the rainshadow zone surrounding the Cumberland Plain. It occurs at elevations below 400 m above sea level. This PCT was predominantly found in moderate condition, with an intact

PCT	Name	Diagnostic species present in BAM plot data (as aligned with BioNet PCT descriptions)	Additional justification of evidence to identify the PCT (Source: BioNet and BAM plot data)
			native canopy over ground and midstorey layers subject to weed incurrence. The species composition was consistent with the species assemblage for this PCT and Proteaceae (particularly banksias) are often present
1105	River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion	*Casuarina cunninghamiana, Acacia floribunda, Lomandra longifolia, Microlaena stipoides* var. *stipoides*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Forested Wetlands and match with BAM plot upper, mid, and ground strata diagnostic species Associated with sand or gravel alluvium along rivers and streams between 1 m and 600 m. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as an open or tall open forest with an open shrub layer and a dense or patchy groundcover of grasses and forbs, consistent with the species assemblage for this PCT
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	*Corymbia gummifera, E. pilularis, Banksia spinulosa, Allocasuarina littoralis, Dianella caerulea, Lomandra longifolia, Pomax umbellata, Xanthorrhoea arborea, Entolasia stricta, Phyllanthus hirtellus*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Dry Sclerophyll Forests (Shrubby sub-formation) and match with BAM plot upper, mid, and ground strata diagnostic species Associated with lower slopes of dry sandstone gullies up to 600 m above sea level. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as an open eucalypt forest with an abundant sclerophyll shrub stratum and a groundcover dominated by sedges, consistent with the species assemblage for this PCT
1292	Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion	Only 1 BAM plot undertaken, community not being impacted. *Backhousia myrtifolia, Morinda jasminoides, Pittosporum undulatum, Wahlenbergia gracilis*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Forested Wetlands The BAM plot floristics are not a great match, however the landscape position i.e. proximity to the Nepean River, and broader community structure aligned PCT 1292 as the best fit throughout the nominated areas This community is present on sandy banks and sandstone beds of streams draining sandstone plateaux below 450 m elevation. It was mainly present in good condition within the Plan Area, with a species composition and structure that aligns with the descriptive characteristics for the PCT
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	*E. crebra, Allocasuarina littoralis, E. fibrosa, E. punctata, Bursaria spinosa* subsp. *spinosa, Entolasia stricta, Dichondra repens, Microlaena*	Sydney Basin IBRA, Sydney Cataract and Cumberland Subregion Grassy Woodlands and match with BAM plot upper, mid and ground strata diagnostic species

PCT	Name	Diagnostic species present in BAM plot data (as aligned with BioNet PCT descriptions)	Additional justification of evidence to identify the PCT (Source: BioNet and BAM plot data)
		stipoides var. *stipoides, Cheilanthes sieberi, Themeda australis*	Associated with clay-rich shale soil and the coarse sandy substrates of sandstone plateaus. This PCT was found in varying degrees of condition and species composition. In intact condition, it occurs as a moderately tall eucalypt forest with a mixed understorey of sclerophyll shrubs and grasses, consistent with the species assemblage for this PCT. Generally with few to no Proteaceae present, which distinguishes the community from PCT 1081
1800	Swamp Oak open forest on river flats of the Cumberland Plain and Hunter valley	*Casuarina glauca, E. tereticornis* and *E. moluccana, M. styphelioides, Bursaria spinosa, Casuarina glauca, Acacia decurrens, Dichondra repens, Commelina cyanea, Lobelia purpurascens*	Sydney Basin IBRA, Cumberland Subregion Forested Wetlands and match with BAM plot upper, mid and ground strata diagnostic species Associated with grey-black clay-loams and sandy loams, on drainage lines, lake margins and estuarine fringes associated with coastal floodplains, generally below 20 m elevation but up to 60 m ASL in the upper Wianamatta (South Creek) reaches. This PCT was found in varying degrees of condition and species composition. In intact condition it occurs as an open grassy and herbaceous understorey, consistent with the species assemblage for this PCT
	Urban Native/Exotic	Exotic species	This PCT is associated with exotic species, and the species assemblage was not associated with a PCT

*All plot data were entered into the BioNet PCT ID tool and the Tozer vegetation identification tool and then reviewed by ecologists with experience in the vegetation of the Cumberland Plain

Table 19-3: Amount (ha) of each PCT within the nominated areas*

PCT	Name	Nominated areas				
		Wilton	GMAC	WSA	GPEC	Total
724	Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion.	0.0	0.0	110.4	185.7	**296.1**
725	Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion.	0.0	0.0	38.8	127.5	**166.3**
781	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion.	0.0	0.0	4.4	65.4	**69.8**
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion.	0.0	18.5	0.0	2.8	**21.3**
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion.	0.0	188.1	172.6	826.2	**1,186.8**
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.	286.5	420.7	437.5	1,745.0	**2,889.7**
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion.	164.5	215.5	7.7	80.8	**468.5**
877	Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion	0.0	13.8	0.0	0.0	**13.8**
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion.	0.0	0.9	0.0	6.5	**7.4**
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion.	66.8	7.5	0.0	0.0	**74.3**
1105	River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion.	0.0	44.4	0.0	94.1	**138.6**

PCT	Name	Nominated areas				
		Wilton	GMAC	WSA	GPEC	Total
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion.	365.3	408.4	0.0	0.0	**773.7**
1292	Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion.	39.1	0.8	0.0	0.0	**39.9**
1395	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion.	1,424.5	1,930.8	0.0	2.0	**3,357.3**
1800	Swamp Oak open forest on river flats of the Cumberland Plain and Hunter valley.	0.0	4.1	104.9	118.0	**227.0**
	Urban Native/Exotic.	105.5	613.9	136.4	1,178.4	**2,034**
Total (including urban native/exotic)		**2,452.1**	**3,867.4**	**1,012.6**	**4,432.2**	**11,764**
Total (excluding urban native/exotic)		**2,346.7**	**3,253.6**	**876.2**	**3,253.8**	**9,730.2**

*Areas of NOG are not included in this table

19.3 NATIVE VEGETATION CONDITION

Vegetation zones have been identified within the nominated areas in accordance with the method described in Chapter 11. A vegetation zone is an area of native vegetation that is the same PCT and has a similar condition state.

There is a total of 44 vegetation zones within the nominated areas.

Table 19-4 identifies the area of each native vegetation zone within each nominated area. A description of the vegetation condition categories shown in Table 10 is provided in Chapter 11.Table 19-5 identifies the area of Non-Offsettable Grassland (NOG) in the nominated areas.

The current vegetation integrity score (a measure of vegetation condition) of each vegetation zone within the nominated areas is provided in Table 19-6. The vegetation integrity score has not been calculated for each nominated area separately as the nominated areas comprise a single biodiversity certification area over which all plots were collected.

Map 19-6, Map 19-7, Map 19-8, and Map 19-9 show the vegetation zones within each nominated area.

Table 19-4: Vegetation condition and amount (ha) of each PCT and condition type within the nominated areas

Vegetation zone ID	Vegetation zone		Area (ha) in nominated areas				
	PCT	Condition	Wilton	GMAC	WSA	GPEC	Total
724_Intact	724	Intact	0.0	0.0	3.3	69.2	**72.5**
724_Thinned	724	Thinned	0.0	0.0	103.3	79.8	**183.1**
724_Scattered_trees	724	Scattered Trees	0.0	0.0	3.7	36.7	**40.4**
725_Intact	725	Intact	0.0	0.0	19.9	87.4	**107.3**
725_Thinned	725	Thinned	0.0	0.0	15.7	33.9	**49.6**
725_Scattered_trees	725	Scattered Trees	0.0	0.0	3.2	6.2	**9.5**
781_Thinned	781	Thinned	0.0	0.0	4.4	65.4	**69.8**
830_Intact	830	Intact	0.0	2.2	0.0	2.8	**5.0**
830_Thinned	830	Thinned	0.0	16.2	0.0	0.0	**16.2**
830_DNG	830	DNG	0.0	0.2	0.0	0.0	**0.2**
835_Intact	835	Intact	0.0	59.2	13.4	321.8	**394.4**
835_Thinned	835	Thinned	0.0	120.4	120.7	496.0	**737.1**
835_Scattered_trees	835	Scattered Trees	0.0	8.5	38.4	8.3	**55.3**

Vegetation zone ID	Vegetation zone		Area (ha) in nominated areas				
	PCT	Condition	Wilton	GMAC	WSA	GPEC	Total
835_DNG	835	DNG	0.0	0.0	0.1	0.0	**0.1**
849_Intact	849	Intact	4.2	75.0	29.1	430.5	**538.9**
849_Thinned	849	Thinned	66.5	184.0	275.8	1,178.7	**1,704.9**
849_Scattered_trees	849	Scattered Trees	39.5	64.8	83.8	125.9	**314.0**
849_DNG	849	DNG	176.4	96.9	48.8	9.9	**331.9**
850_Intact	850	Intact	0.0	74.3	0.0	0.3	**74.6**
850_Thinned	850	Thinned	0.0	106.1	5.8	52.9	**164.8**
850_Scattered_trees	850	Scattered Trees	1.1	14.2	1.7	4.1	**21.1**
850_DNG	850	DNG	163.4	20.9	0.2	23.5	**208.0**
877_Intact	877	Intact	0.0	5.6	0.0	0.0	**5.6**
877_Thinned	877	Thinned	0.0	8.2	0.0	0.0	**8.2**
883_Intact	883	Intact	0.0	0.0	0.0	6.4	**6.4**
883_Thinned	883	Thinned	0.0	0.9	0.0	0.1	**1.0**

Vegetation zone ID	Vegetation zone		Area (ha) in nominated areas				
	PCT	Condition	Wilton	GMAC	WSA	GPEC	Total
1081_Intact	1081	Intact	44.8	7.5	0.0	0.0	**52.3**
1081_Thinned	1081	Thinned	22.0	0.0	0.0	0.0	**22.0**
1105_Intact	1105	Intact	0.0	13.6	0.0	0.0	**13.6**
1105_Thinned	1105	Thinned	0.0	30.9	0.0	94.1	**125.0**
1181_Intact	1181	Intact	363.2	407.7	0.0	0.0	**770.9**
1181_Thinned	1181	Thinned	2.1	0.7	0.0	0.0	**2.8**
1292_Intact	1292	Intact	39.1	0.8	0.0	0.0	**39.9**
1395_Intact	1395	Intact	542.7	1,298.8	0.0	0.0	**1,841.5**
1395_Thinned	1395	Thinned	528.0	456.8	0.0	2.0	**986.8**
1395_Scattered_trees	1395	Scattered Trees	49.2	76.2	0.0	0.0	**125.3**
1395_DNG	1395	DNG	304.6	99.1	0.0	0.0	**403.7**
1800_Intact	1800	Intact	0.0	0.0	14.6	6.3	**20.9**
1800_Thinned	1800	Thinned	0.0	4.1	86.2	111.0	**201.3**

Vegetation zone ID	Vegetation zone		Area (ha) in nominated areas				
	PCT	Condition	Wilton	GMAC	WSA	GPEC	Total
1800_Scattered_trees	1800	Scattered Trees	0.0	0.0	4.1	0.7	**4.8**
Total			**2,346.7**	**3,253.6**	**876.2**	**3,253.8**	**9,730.2**

Table 19-5: NOG (Non-Offsettable Grassland) within the nominated areas

Vegetation zone			Area (ha) impacted				
Vegetation zone ID	PCT	Condition	Wilton	GMAC	WSA	GPEC	Total
835_NOG	835	NOG	0.0	777.7	1,099.2	1,758.4	**3,635.4**
849_NOG	849	NOG	858.3	2,674.5	3,322.3	5,986.1	**12,841.2**
850_NOG	850	NOG	12.6	841.7	11.0	469.6	**1335.0**
1395_NOG	1395	NOG	532.9	1,077.4	0.0	3.5	**1,613.8**

Table 19-6: Current vegetation integrity score for each vegetation zone within urban capable lands of the nominated areas*

Vegetation zone			Composition score	Structure score	Function score	Current vegetation integrity score
Vegetation zone ID	PCT	Condition				
724_Intact	724	Intact	75.1	44.2	70.8	61.7
724_Thinned	724	Thinned	24.2	46.8	41.9	36.2
724_Scattered_trees	724	Scattered trees	8.4	22.9	45	20.5
725_Intact	725	Intact	83.7	30.6	46.7	49.2
725_Thinned	725	Thinned	57.1	27.1	52.4	43.3
725_Scattered_trees	725	Scattered trees	13.3	11.9	47.4	19.6
781_Thinned	781	Thinned	66.4	58.9	-	62.5
830_Intact	830	Intact	19.6	66.5	88.1	48.3
830_Thinned	830	Thinned	14.8	9.6	57.3	20.1
835_Intact	835	Intact	85.1	54.3	97.5	76.6
835_Thinned	835	Thinned	64.4	30.5	94.8	57.1
835_Scattered_trees	835	Scattered trees	54.1	66.4	90.4	68.7
835_NOG	835	NOG	6.0	16.9	5.0	8.0

Vegetation zone			Composition score	Structure score	Function score	Current vegetation integrity score
Vegetation zone ID	PCT	Condition				
849_Intact	849	Intact	39.3	65.4	60.9	53.9
849_Thinned	849	Thinned	32.9	33.9	68.0	42.3
849_Scattered_trees	849	Scattered trees	11.1	10.8	51.2	18.3
849_DNG	849	DNG	25.9	35.0	15.4	24.1
849_NOG	849	NOG	10.5	8.3	11.8	10.1
850_Intact	850	Intact	61.1	35.6	90.2	58.1
850_Thinned	850	Thinned	37.2	38.6	51.2	41.9
850_Scattered_trees	850	Scattered trees	35.8	27.0	57.4	38.1
850_DNG	850	DNG	30.6	39.1	14.1	25.7
850_NOG	850	NOG	10.6	15.8	11.1	12.3
1395_Intact	1395	Intact	75.0	63.1	82.0	72.9
1395_Thinned	1395	Thinned	56.4	68.1	67.9	63.9
1395_Scattered_trees	1395	Scattered trees	31.5	34.5	24.9	30.0
1395_DNG	1395	DNG	33.5	44.1	15.4	28.4

Vegetation zone			Composition score	Structure score	Function score	Current vegetation integrity score
Vegetation zone ID	**PCT**	**Condition**				
1395_NOG	1395	NOG	19.0	2.8	3.0	5.4
1800_Intact	1800	Intact	35.2	35.3	64.7	43.2
1800_Thinned	1800	Thinned	37.5	31.7	85.2	46.6
1800_Scattered_trees	1800	Scattered trees	29.3	61.6	38.9	41.2

*Vegetation integrity scores are only calculated for zones impacted by the proposed development. Of the 44 zones in the nominated areas, 31 are impacted

20 Threatened ecological communities

A total of nine NSW-listed TECs occur within the nominated areas.

The method to determine the TECs that occur within the nominated areas is explained in Chapter 11.

Identification of the NSW-listed TECs that occur within the nominated areas, as well as the extent of each TEC within each nominated area, is provided in Table 20-1.

Table 20-1 also indicates whether a PCT is notionally associated with a Commonwealth-listed TEC. It is important to note that Commonwealth-listed TECs often do not align exactly to a PCT and are usually defined differently to NSW-listed TECs. Commonwealth-listed TECs are described and assessed in Chapter 31.

The five most extensive NSW TECs within the nominated areas are:

- Cumberland Plain Woodland – 3,358 ha (this comprises 2,890 ha of PCT 849, and 468 ha of PCT 850)
- Shale Sandstone Transition Forest – 3,357 ha
- River-flat Eucalypt Forest on Coastal Floodplains – 1,187 ha
- Shale Gravel Transition Forest – 296 ha
- Swamp Oak Floodplain Forest – 227 ha

Map 20-1, Map 20-2, Map 20-3, and Map 20-4 show the distribution of TECs within each nominated area.

Table 20-1: TECs and amount (ha) of each TEC within the nominated areas

PCT	NSW TEC name	NSW status^	Area (ha)					Commonwealth TEC name	Cth status^
			Wilton	GMAC	WSA	GPEC	Total		
724	*Shale Gravel Transition Forest in the Sydney Basin Bioregion*	E	0.0	0.0	110.4	185.7	**296.1**	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*	CE
725	*Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	E	0.0	0.0	38.8	127.5	**166.3**	*Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	CE
781	*Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	E	0.0	0.0	4.4	65.4	**69.8**	N/A	N/A
830	*Moist Shale Woodland in the Sydney Basin Bioregion*	E	0.0	18.5	0.0	2.8	**21.3**	*Western Sydney Dry Rainforest and Moist Woodland on Shale*	CE
835	*River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	E	0.0	188.1	172.6	826.2	**1,186.8**	N/A Note the Cth status of this TEC is currently being assessed by the Cth Threatened Species Scientific Committee	N/A
849	*Cumberland Plain Woodland in the Sydney Basin Bioregion*	CE	286.5	420.7	437.5	1,745.0	**2,889.7**	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*	CE
850	*Cumberland Plain Woodland in the Sydney Basin Bioregion*	CE	164.5	215.5	7.7	80.8	**468.5**	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*	CE
883	*Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion*	V	0.0	0.9	0.0	6.5	**7.4**	*Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion*	E
1395	*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*	CE	1,424.5	1,930.8	0.0	2.0	**3,357.3**	*Shale Sandstone Transition Forest of the Sydney Basin Bioregion*	CE

PCT	NSW TEC name	NSW status^	Area (ha)					Commonwealth TEC name	Cth status^
			Wilton	GMAC	WSA	GPEC	Total		
1800	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	E	0.0	4.1	104.9	118.0	**227.0**	*Coastal Swamp Oak Casuarina glauca Forest of New South Wales and South East Queensland ecological community*	E

^CE = critically endangered; E = endangered; V = vulnerable

21 Threatened species and habitat

This Chapter identifies the NSW-listed ecosystem credit species (ECS) and candidate species credit species (SCS) predicted to occur within the nominated areas and provides maps of the locations of the habitat for candidate SCS.

The method to predict the ECS and SCS within the nominated areas is explained in Chapter 9.

21.1 ECOSYSTEM CREDIT SPECIES

The ECS predicted to occur within the nominated areas are provided in Table 21-1.

The method to predict the ECS within the nominated areas is explained in Chapter 11.

A total of 46 ECS are predicted to occur within the nominated areas.

For this assessment, it was assumed that all ECS predicted to occur within the nominated areas are present, and no ECS were excluded from the assessment as allowed under section 6.4 of the BAM.

Table 21-1: Ecosystem credit species predicted to occur within the nominated areas

Scientific name	Common Name	NSW status^	Cth status^	Habitat constraints	Sensitivity to gain class	Predicted location			
						Wilton	GMAC	WSA	GPEC
*Anthochaera phrygia**	Regent Honeyeater	CE	CE	N/A	High	Yes	Yes	Yes	Yes
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Botaurus poiciloptilus	Australasian Bittern	E	E	Waterbodies; brackish or freshwater wetlands.	Moderate	No	Yes	Yes	Yes
*Calidris ferruginea**	Curlew Sandpiper	E	CE	N/A	High	No	No	Yes	No
*Callocephalon fimbriatum**	Gang-Gang Cockatoo	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
*Calyptorhynchus lathami**	Glossy Black Cockatoo	V	N/A	N/A	High	Yes	Yes	Yes	Yes
Chthonicola sagittata	Speckled Warbler	V	N/A	N/A	High	Yes	Yes	Yes	Yes
Circus assimilis	Spotted Harrier	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Climacteris picumnus victoriae	Brown Treecreeper	V	N/A	N/A	High	Yes	Yes	Yes	Yes
Daphoenositta chrysoptera	Varied Sittella	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Dasyurus maculatus	Spotted-tailed Quoll	V	E	N/A	High	Yes	Yes	Yes	Yes

Scientific name	Common Name	NSW status^	Cth status^	Habitat constraints	Sensitivity to gain class	Predicted location			
						Wilton	GMAC	WSA	GPEC
Ephippiorhynchus asiaticus	Black-Necked Stork	E	N/A	Swamps and shallow, open freshwater or saline wetlands or shallow edges of deeper wetlands within 300 m of these swamps; waterbodies and shallow lakes, lake margins and estuaries within 300 m of these waterbodies.	Moderate	No	No	Yes	No
Epthianura albifrons	White-Fronted Chat	V	N/A	N/A	Moderate	No	No	Yes	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	N/A	N/A	High	Yes	Yes	No	No
Glossopsitta pusilla	Little Lorikeet	V	N/A	N/A	High	Yes	Yes	Yes	Yes
Grantiella picta	Painted Honeyeater	V	V	Mistletoes present at a density of greater than five mistletoes per ha.	Moderate	Yes	Yes	Yes	Yes
*Haliaeetus leucogaster**	White-Bellied Sea-Eagle	V	N/A	Within 1 km of rivers, lakes, large dams or creeks, wetlands, and coastlines	High	Yes	Yes	Yes	Yes
*Hieraaetus morphnoides**	Little Eagle	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Hirundapus caudacutus	White-throated Needletail	N/A	V	N/A	High	Yes	Yes	Yes	Yes
Irediparra gallinacea	Comb-Crested Jacana	V	N/A	Waterbodies; freshwater wetlands with a good surface cover of floating aquatic vegetation.	Moderate	No	No	Yes	No
Ixobrychus flavicollis	Black Bittern	V	N/A	Waterbodies; land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation.	Moderate	No	Yes	Yes	Yes

Scientific name	Common Name	NSW status^	Cth status^	Habitat constraints	Sensitivity to gain class	Predicted location			
						Wilton	GMAC	WSA	GPEC
*Lathamus discolor**	Swift Parrot	E	CE	N/A	Moderate	Yes	Yes	Yes	Yes
*Limicola falcinellus**	Broad-Billed Sandpiper	V	N/A	N/A	High	No	No	Yes	No
*Limosa limosa**	Black-Tailed Godwit	V	N/A	N/A	High	No	No	Yes	No
*Lophoictinia isura**	Square-Tailed Kite	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Melanodryas cucullata cucullata	Hooded Robin (South-Eastern Form)	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Melithreptus gularis gularis	Black-Chinned Honeyeater (Eastern subsp.)	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	N/A	N/A	High	Yes	Yes	Yes	Yes
*Miniopterus australis**	Little Bent-wing Bat	V	N/A	N/A	High	Yes	Yes	Yes	Yes
*Miniopterus orianae oceanensis**	Large Bent-winged Bat	V	N/A	N/A	High	Yes	Yes	Yes	Yes
Neophema pulchella	Turquoise Parrot	V	N/A	N/A	High	Yes	Yes	Yes	Yes
*Ninox connivens**	Barking Owl	V	N/A	N/A	High	Yes	Yes	Yes	Yes
*Ninox strenua**	Powerful Owl	V	N/A	N/A	High	Yes	Yes	Yes	Yes
*Pandion cristatus**	Eastern Osprey	V	N/A	N/A	Moderate	No	Yes	Yes	Yes

Scientific name	Common Name	NSW status^	Cth status^	Habitat constraints	Sensitivity to gain class	Predicted location			
						Wilton	GMAC	WSA	GPEC
Petaurus australis	Yellow-Bellied Glider	V	N/A	Hollow-bearing trees; hollows > 25 cm diameter.	High	Yes	Yes	No	No
Petroica boodang	Scarlet Robin	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Petroica phoenicea	Flame Robin	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
*Phascolarctos cinereus**	Koala	V	V	N/A	High	Yes	Yes	Yes	Yes
*Pteropus poliocephalus**	Grey-Headed Flying-fox	V	V	N/A	High	Yes	Yes	Yes	Yes
Rostratula australis	Australian Painted-Snipe	E	E	N/A	Moderate	No	No	Yes	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail-Bat	V	N/A	N/A	High	Yes	Yes	Yes	Yes
Scoteanax rueppellii	Greater Broad-Nosed Bat	V	N/A	N/A	High	Yes	Yes	No	No
Stagonopleura guttata	Diamond Firetail	V	N/A	N/A	Moderate	Yes	Yes	Yes	Yes
Stictonetta naevosa	Freckled Duck	V	N/A	N/A	Moderate	No	No	Yes	No
*Tyto novaehollandiae**	Masked Owl	V	N/A	N/A	High	Yes	Yes	Yes	Yes
Varanus rosenbergi	Rosenberg's Monitor	V	N/A	N/A	High	Yes	Yes	No	Yes

^CE = critically endangered; E = endangered; V = vulnerable; E.pop. = endangered population

*These species are ECS in relation to foraging habitat only

21.1.1 SPECIES CREDIT SPECIES

Section 6.4 of the BAM sets out a process for determining the SCS that need to be assessed in the Assessment Report. The method to predict the candidate SCS within the nominated areas is explained in Chapter 11.

Table 21-2 identifies the list of SCS predicted to occur according to the BAM calculator, and:

- The nominated area that the SCS is predicted to occur within (marked with a tick or cross)
- Whether the SCS has been removed from needing further assessment within a nominated area (marked with an 'R')
- The remaining list of candidate SCS
- The method used to determine the presence of each candidate SCS

Attachment A in Chapter 11 provides a justification for each SCS removed from needing further assessment and identifies the relevant section of the BAM under which a SCS was removed. Section 6.1.1.2 of the BAM was the primary basis used for removing a SCS from needing further assessment.

A total of 83 SCS were predicted to occur within the nominated areas.

Of these, 41 SCS were determined to be candidate SCS needing further assessment, and 42 were removed.

Table 21-3 identifies the amount of habitat for each candidate SCS in the nominated areas.

The following maps show the distribution of habitat within the nominated areas for each candidate SCS:

- Map 21-1– *Acacia bynoeana*
- Map 21-2– *Acacia pubescens*
- Map 21-3– *Allocasuarina glareicola*
- Map 21-4– *Callocephalon fimbriatum*
- Map 21-5– *Calyptorhynchus lathami*
- Map 21-6– *Cercartetus nanus*
- Map 21-7– *Chalinolobus dwyeri*
- Map 21-8– *Dillwynia tenuifolia*
- Map 21-9– *Epacris purpurascens* var. *purpurascens*
- Map 21-10– *Eucalyptus benthamii*
- Map 21-11– *Grevillea juniperina* subsp. *juniperina*
- Map 21-12– *Grevillea parviflora* subsp. *parviflora*
- Map 21-13– *Haliaeetus leucogaster*
- Map 21-14– *Heleioporus australiacus*
- Map 21-15– *Hibbertia fumana*
- Map 21-16– *Hibbertia puberula*
- Map 21-17– *Hieraaetus morphnoides*
- Map 21-18- *Lathamus discolour*
- Map 21-19– *Litoria aurea*
- Map 21-20– *Lophoictinia isura*
- Map 21-21– *Marsdenia viridiflora* subsp. *viridiflora*
- Map 21-22– *Maundia triglochinoides*
- Map 21-23– *Melaleuca deanei*
- Map 21-24– *Meridolum corneovirens*
- Map 21-25– *Micromyrtus minutiflora*
- Map 21-26– *Myotis macropus*
- Map 21-27– *Ninox connivens*
- Map 21-28– *Ninox strenua*

- Map 21-29– *Persicaria elatior*
- Map 21-30– *Persoonia bargoensis*
- Map 21-31– *Persoonia nutans*
- Map 21-32– *Petaurus norfolcensis*
- Map 21-33- *Phascolarctos cinereus*
- Map 21-34– *Pimelea curviflora* subsp. *curviflora*
- Map 21-35– *Pimelea spicata*
- Map 21-36– *Pomaderris brunnea*
- Map 21-37– *Pseudophryne australis*
- Map 21-38– *Pterostylis saxicola*
- Map 21-39– *Pultenaea parviflora*
- Map 21-40– *Pultenaea pedunculata*
- Map 21-41– *Tyto novaehollandiae*

Table 21-2: Species credit species predicted to occur within the nominated areas and candidate species requiring further assessment

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Acacia bynoeana	Bynoe's Wattle	E	V			2	High	✓	✓	✓	✓	Yes	Expert report
Acacia gordonii	Gordon's Wattle	E	E			2	High	R	X	X	X	No	N/A
Acacia prominens	Gosford Wattle	E. pop.	N/A			2	Moderate	R	X	R	R	No	N/A
Acacia pubescens	Downy Wattle	V	V			2	High	✓	✓	✓	✓	Yes	Expert report
Allocasuarina glareicola		E	E			3	High	X	X	R	✓	Yes	KBM
*Anthochaera phrygia**	Regent Honeyeater	CE	CE			3	High	R	R	R	R	No	N/A
Burhinus grallarius	Bush Stone-curlew	E	N/A		Fallen/standing dead timber, including logs	2	High	R	R	R	R	No	N/A
Caladenia tessellata	Thick Lip Spider Orchid	E	V			3	Moderate	R	R	R	R	No	N/A
*Calidris ferruginea**	Curlew Sandpiper	E	CE			3	High	X	X	R	X	No	N/A

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Callistemon linearifolius	Netted Bottle Brush	V	N/A			1.5	Moderate	R	R	R	R	No	N/A
*Callocephalon fimbriatum**	Gang-gang Cockatoo	V	N/A			2	High	✓	✓	R	✓	Yes	KBM
*Callocephalon fimbriatum**	Gang-gang Cockatoo	E Pop.	N/A	Hornsby and Ku-ring-gai Local Government Areas		2	High	R	R	X	X	No	N/A
*Calyptorhynchus lathami**	Glossy Black Cockatoo	V	N/A			2	High	✓	✓	R	✓	Yes	KBM
Cercartetus nanus	Eastern Pygmy-possum	V	N/A			2	High	✓	✓	✓	✓	Yes	KBM

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Chalinolobus dwyeri	Large-eared Pied Bat	V	V		Cliffs; within two km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two km of old mines/tunnels	3	Very High	✓	✓	R	✓	Yes	KBM
Cynanchum elegans	White-flowered Wax Plant	E	E			2	High	R	R	R	R	No	N/A
Darwinia biflora		V	V			2	High	R	X	X	X	No	N/A
Darwinia peduncularis		V	N/A			3	Moderate	R	X	X	X	No	N/A
Deyeuxia appressa		E	E			3	High	R	X	R	X	No	N/A
Dillwynia tenuifolia		V	N/A			2	Moderate	R	R	✓	✓	Yes	Expert report

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Dillwynia tenuifolia		E. pop.	N/A	The area bounded by western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area		2	High	X	X	R	X	No	N/A
Epacris purpurascens var. *purpurascens*		V	N/A			1.5	Moderate	✓	✓	R	R	Yes	KBM
Eucalyptus benthamii	Camden White Gum	V	V			2	High	✓	✓	R	R	Yes	KBM
Eucalyptus sp. *Cattai*		CE	CE			3	Very High	R	X	X	X	No	N/A

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Grammitis stenophylla	Narrow-leaf Finger Fern	E	N/A			2	Moderate	R	X	X	X	No	N/A
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V	N/A			1.5	Moderate	R	R	✓	✓	Yes	Expert report
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V			2	High	✓	✓	✓	✓	Yes	KBM
Grevillea parviflora subsp. *supplicans*		E	N/A			2	High	R	R	X	R	No	N/A
Gyrostemon thesioides		E	N/A			3	High	R	R	R	R	No	N/A
*Haliaeetus leucogaster**	White-bellied Sea-Eagle	V	N/A			2	High	✓	✓	✓	✓	Yes	KBM

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Haloragis exalata subsp. *exalata*	Square Raspwort	V	V		Waterbodies; edges of coastal lakes after flooding has removed other vegetation; creek banks within flood zone; areas close to these features subject to human disturbance, including road verges and power line easements or within 100 m of these features	1.5	Moderate	X	X	R	X	No	N/A
Haloragodendron lucasii		E	E			3	Very High	R	X	X	X	No	N/A
Heleioporus australiacus	Giant Burrowing Frog	V	V			1.5	Moderate	✓	✓	X	✓	Yes	KBM

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Hibbertia fumana		CE	N/A			3	Very High	✓	✓	✓	✓	Yes	Expert report
Hibbertia puberula		E	N/A			2	High	✓	✓	✓	✓	Yes	Expert report
Hibbertia sp. *Bankstown*		CE	CE			3	High	X	R	R	R	No	N/A
Hibbertia spanantha	Julian's Hibbertia	CE	CE			3	High	R	R	X	R	No	N/A
Hibbertia superans		E	N/A		Ridgetops	2	High	R	R	X	R	No	N/A
*Hieraaetus morphnoides**	Little Eagle	V	N/A		Nest trees - live (sometimes dead) large old trees in vegetation.	1.5	Moderate	✓	✓	✓	✓	Yes	Expert report / KBM
*Hoplocephalus bungaroides**	Broad-headed Snake	E	V			3	High	R	R	X	X	No	N/A
Lasiopetalum joyceae		V	V		Rocky areas; lateritic to shaly ridgetops.	1.5	High	R	X	X	X	No	N/A

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
*Lathamus discolor**	Swift Parrot	E	CE			3	Moderate	R	R	R	✓	Yes	EES important habitat mapping
Leucopogon exolasius		V	V			2	High	R	X	R	R	No	N/A
Leucopogon fletcheri subsp. *fletcheri*		E	N/A			2	High	R	R	X	R	No	N/A
*Limicola falcinellus**	Broad-billed Sandpiper	V	N/A			2	High	X	X	R	X	No	N/A
*Limosa limosa**	Black-tailed Godwit	V	N/A			2	High	X	X	R	X	No	N/A

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Litoria aurea	Green and Golden Bell Frog	E	V		Semi-permanent/ ephemeral wet areas; within 1 km of wet areas; swamps; within 1 km of swamps; waterbodies; within 1 km of waterbodies.	2	High	✓	✓	✓	✓	Yes	Expert report
*Lophoictinia isura**	Square-tailed Kite	V	N/A			1.5	Moderate	✓	✓	✓	✓	Yes	Expert report / KBM
Marsdenia viridiflora subsp. *viridiflora*		E. pop.	N/A	Those LGAs named in the population's listing		2	Moderate	X	✓	✓	✓	Yes	KBM
Maundia triglochinoides		V	N/A		Swamps; swamps or shallow fresh water on clay.	2	High	X	X	✓	✓	Yes	KBM
Melaleuca deanei	Deane's Paperbark	V	V			2	High	✓	✓	X	R	Yes	Expert report

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Meridolum corneovirens	Cumberland Plain Land Snail	E	N/A			2	High	✓	✓	✓	✓	Yes	Expert report
Micromyrtus minutiflora		E	V			2	High	X	X	✓	✓	Yes	KBM
*Miniopterus australis**	Little Bent-wing Bat	V	N/A			3	Very High	R	R	R	R	No	N/A
*Miniopterus orianae oceanensis**	Large Bent-winged Bat	V	N/A			3	Very High	R	R	R	R	No	N/A
Myotis macropus	Southern Myotis	V	N/A			2	High	✓	✓	✓	✓	Yes	KBM
*Ninox connivens**	Barking owl	V	N/A			2	High	✓	✓	R	✓	Yes	KBM
*Ninox strenua**	Powerful owl	V	N/A			2	High	✓	✓	✓	✓	Yes	KBM
*Pandion cristatus**	Eastern Osprey	V	N/A			1.5	Moderate	X	R	R	R	No	N/A
Persicaria elatior	Tall Knotweed	V	V			2	High	X	✓	✓	✓	Yes	KBM
Persoonia bargoensis	Bargo Geebung	E	V			2	High	✓	✓	R	R	Yes	KBM

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Persoonia glaucescens	Mittagong Geebung	E	V			2	High	R	X	X	X	No	N/A
Persoonia hirsuta	Hairy Geebung	E	E			3	High	R	R	R	R	No	N/A
Persoonia mollis subsp. *maxima*	Soft Geebung	E	E			2	High	R	X	X	X	No	N/A
Persoonia nutans	Nodding Geebung	E	E			2	Moderate	R	R	✓	✓	Yes	Expert report
Petaurus norfolcensis	Squirrel Glider	V	N/A			2	High	✓	✓	R	✓	Yes	KBM
*Phascolarctos cinereus**	Koala	V	V			2	High	✓	✓	R	R	Yes	KBM
Pilularia novae-hollandiae	Austral Pillwort	E	N/A			3	High	X	R	R	R	No	N/A
Pimelea curviflora var. *curviflora*		E	V			2	High	R	R	R	✓	Yes	KBM
Pimelea spicata	Spiked Rice-flower	E	E			2	High	✓	✓	✓	✓	Yes	Expert report
Pomaderris brunnea	Brown Pomaderris	E	V			2	High	✓	✓	R	R	Yes	KBM

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Pomaderris prunifolia		E. pop.	N/A			2	High	R	X	R	R	No	N/A
Pommerhelix duralensis	Dural Woodland Snail	E	E		Leaf litter and shed bark or within 50 m of litter or bark; rocky areas; rocks or within 50 m of rocks; fallen/standing dead timber; logs and bark or within 50 m.	2	High	R	R	R	R	No	N/A
Pseudophryne australis	Red-crowned Toadlet	V	N/A	Margin of Cumberland Plain where sandstone outcrops intersect		1.5	Moderate	✓	✓	X	✓	Yes	KBM
*Pteropus poliocephalus**	Grey-headed Flying-fox	V	V			2	High	R	R	R	R	No	N/A
Pterostylis saxicola	Sydney Plains Greenhood	E	E			2	Moderate	✓	✓	✓	✓	Yes	Expert report

Scientific name	Common name	NSW status^	Cth status^	Geographic limitations	Habitat constraints	Bio. risk weight	Sens. to gain class	Predicted location ✓ = predicted to occur X = not predicted to occur R = predicted to occur but removed from needing further assessment				Candidate species needing further assessment	Method to determine presence
								Wilton	GMAC	WSA	GPEC		
Pultenaea parviflora		E	V			2	Moderate	X	X	✓	✓	Yes	KBM
Pultenaea pedunculata	Matted Bush-pea	E	N/A			2	High	✓	✓	✓	✓	Yes	KBM
Tetratheca glandulosa		V	N/A			2	High	R	R	X	R	No	N/A
Thesium australe	Austral Toadflax	V	V			1.5	Moderate	R	R	R	R	No	N/A
Tyto novaehollandiae	Masked Owl	V	N/A			2	High	✓	✓	R	✓	Yes	KBM
Wahlenbergia multicaulis	Tadgell's Bluebell	E. pop.	N/A			2	High	R	R	R	R	No	N/A
Zannichellia palustris	Horned Pondweed	E	N/A		Waterbodies; land containing freshwater bodies.	2	High	X	X	R	X	No	N/A
Zieria involucrata		E	V			2	High	R	X	X	X	No	N/A

^CE = critically endangered; E = endangered; V = vulnerable; E.pop. = endangered population

*These species are SCS in relation to breeding/important habitat only

Table 21-3: Amount of habitat for each candidate species credit species within the nominated areas

Scientific name	Common name	NSW status^	Cth status^	Area of habitat (ha) within nominated areas					Species habitat directly impacted?
				Wilton	GMAC	WSA	GPEC	Total	
Acacia bynoeana	Bynoe's Wattle	E	V	1,462.0	1,761.0	38.8	130.5	**3,392.3**	Yes
Acacia pubescens	Downy Wattle	V	V	1,701.8	2,353.3	667.7	2,637.2	**7,360.1**	Yes
Allocasuarina glareicola		E	E	0.0	0.0	0.0	200.0	**200.0**	Yes
*Callocephalon fimbriatum**	Gang-gang Cockatoo	V	-	195.6	464.4	0.0	260.1	**920.1**	Yes
*Calyptorhynchus lathami**	Glossy Black Cockatoo	V	-	453.6	855.3	0.0	0.0	**1,309.0**	Yes
Cercartetus nanus	Eastern Pygmy-possum	V	-	979.6	1,908.3	42.2	759.1	**3689.1**	Yes
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	1,610.4	2,575.9	0.0	68.9	**4,255.1**	Yes
Dillwynia tenuifolia		V	-	0.0	0.0	165.2	607.6	**772.7**	Yes

Scientific name	Common name	NSW status^	Cth status^	Area of habitat (ha) within nominated areas					Species habitat directly impacted?
				Wilton	GMAC	WSA	GPEC	Total	
Epacris purpurascens var. *purpurascens*		V	-	1,259.7	1,899.2	0.0	0.0	**3,158.9**	Yes
Eucalyptus benthamii	Camden White Gum	V	V	0.0	73.3	0.0	0.2	**73.4**	No
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V	-	0.0	0.0	534.1	1,961.1	**2,495.2**	Yes
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	428.1	285.3	14.9	68.2	**796.5**	Yes
*Haliaeetus leucogaster**	White-bellied Sea-Eagle	V	-	697.5	1,248.7	34.3	452.3	**2,432.9**	Yes
Heleioporus australiacus	Giant Burrowing Frog	V	V	292.4	108.0	0.0	0.0	**400.4**	Yes
Hibbertia fumana		CE	-	785.8	739.5	52.2	138.9	**1,716.4**	Yes

Scientific name	Common name	NSW status^	Cth status^	Area of habitat (ha) within nominated areas					Species habitat directly impacted?
				Wilton	GMAC	WSA	GPEC	Total	
Hibbertia puberula		E	-	773.0	739.5	52.2	148.1	**1,712.7**	Yes
*Hieraaetus morphnoides**	Little Eagle	V	-	1,254.9	2,395.2	25.0	415.6	**4,090.7**	Yes
Lathamus discolor	Swift Parrot	E	CE	0.0	0.0	0.0	493.4	**493.4**	Yes
Litoria aurea	Green and Golden Bell Frog	E	V	0.0	232.9	0.0	1,421.6	**1,654.5**	Yes
*Lophoictinia isura**	Square-tailed Kite	V	-	1,288.0	2,415.5	34.3	460.9	**4,198.7**	Yes
Marsdenia viridiflora subsp. *viridiflora*		E. pop.	-	0.0	1,116.0	596.6	2,707.7	**4,420.3**	Yes
Maundia triglochinoides		V	-	0.0	0.0	96.5	153.5	**250.0**	Yes
Melaleuca deanei	Deane's Paperbark	V	V	905.2	1,416.2	0.0	0.0	**2,321.4**	Yes

Scientific name	Common name	NSW status^	Cth status^	Area of habitat (ha) within nominated areas					Species habitat directly impacted?
				Wilton	GMAC	WSA	GPEC	Total	
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	1,115.3	2,341.0	561.6	2,702.1	**6,720.1**	Yes
Micromyrtus minutiflora		E	V	0.0	0.9	50.3	206.1	**257.3**	Yes
Myotis macropus	Southern Myotis	V	-	814.3	1,232.9	641.2	1,006.7	**3,695.1**	Yes
*Ninox connivens**	Barking Owl	V	-	253.8	259.0	0.2	2.1	**515.1**	No
*Ninox strenua**	Powerful Owl	V	-	250.4	266.5	0.2	2.1	**519.3**	Yes
Persicaria elatior	Tall Knotweed	V	V	0.0	7.1	37.5	220.7	**265.3**	Yes
Persoonia bargoensis	Bargo Geebung	E	V	1,274.5	1,850.4	0.0	<0.1	**3,124.9**	Yes
Persoonia nutans	Nodding Geebung	E	E	0.0	27.7	149.2	315.3	**492.2**	Yes
Petaurus norfolcensis	Squirrel Glider	V	-	1,452.8	2,570.6	0.0	2,444.0	**6,467.4**	Yes
Phascolarctos cinereus^^*	Koala	V	V	1,621.0	2,424.9	0.0	0.0	**4,046.0**	Yes

Scientific name	Common name	NSW status^	Cth status^	Area of habitat (ha) within nominated areas					Species habitat directly impacted?
				Wilton	GMAC	WSA	GPEC	Total	
Pimelea curviflora var. *curviflora*		E	V	0.0	0.0	0.0	523.8	**523.8**	Yes
Pimelea spicata	Spiked Rice-flower	E	E	664.4	475.5	510.2	2,164.1	**3,814.3**	Yes
Pomaderris brunnea	Brown Pomaderris	E	V	528.1	757.3	0.0	<0.1	**1,285.5**	Yes
Pseudophryne australis	Red-crowned Toadlet	V	-	424.2	657.8	0.0	0.0	**1,082.0**	Yes
Pterostylis saxicola	Sydney Plains Greenhood	E	E	953.2	1,774.4	0.0	14.3	**2,741.9**	Yes
Pultenaea parviflora		E	V	0.0	0.9	132.0	262.9	**395.8**	Yes
Pultenaea pedunculata	Matted Bush-pea	E	-	227.5	619.6	204.7	921.1	**1,972.9**	Yes
*Tyto novaehollandiae**	Masked Owl	V	-	255.8	280.8	0.6	4.4	**541.5**	Yes

^CE = critically endangered; E = endangered; V = vulnerable; E.pop. = endangered population *These species are SCS in relation to breeding/important habitat only ^^Important habitat defined as Primary, Secondary and Tertiary Koala corridors

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2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 5B: BCAR STAGE 2 (IMPACT ASSESSMENT)

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	James Shepherd, Callan Wharfe, Rebecca Dwyer, Matthew Hyde (Biosis)
CONTENT:	Callan Wharfe, Rebecca Dwyer (Biosis) Darren James (DAJ Environmental) Tom Holden, Stephanie Binks, Natasha Buckingham, Heidi Birkby, Christa Shen, Peter Hemphill, Heather Tolley (Open Lines)
REVIEWED BY:	
OPEN LINES:	Darren James (DAJ Environmental) Tom Holden, Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor (BAAS18134)
VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 5B Contents

Part 5B List of Tables

22 Introduction

This Part provides an assessment of the impacts of the urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors under the Plan within the nominated areas for matters listed under the BC Act in accordance with the BAM, including:

- Direct impacts on Plant Community Types (PCTs), threatened ecological communities (TECs), and threatened species and habitat (Chapter 23)
- Prescribed impacts (Chapter 24)
- Serious and irreversible impacts (SAII) (Chapter 25)
- Impact summary, including the number of credits that would be required to be retired to offset the impacts (Chapter 26)

Direct impacts described in Chapter 23 are identified in terms of:

- Impacts of urban, industrial, infrastructure, and intensive plant agriculture development within each nominated area and total impacts across all nominated areas
- Total impacts of the transport development across all nominated areas
- Total impacts of the urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors across all nominated areas

Note that the only development types in Wilton Growth Area (Wilton) are urban, industrial and infrastructure development.

Avoidance and minimisation of impacts on biodiversity values is described in Chapter 14.

Indirect impacts on native vegetation and habitat are described in Chapter 15.

23 Direct impacts on native vegetation and habitat

23.1 APPROACH TO THE ASSESSMENT

The BAM defines in detail the method for addressing direct impacts. In summary, this involved:

- Assessing the direct impacts that will result from the clearing of native vegetation, TECs and threatened species habitat (Section 9.1.2 of the BAM)
- Calculating:
  - The change in vegetation integrity for each vegetation zone and species polygon (Section 9.1.3 of the BAM)
  - The required number of ecosystem credits for direct impacts (Section 11.2.3 of the BAM)
  - The required number of species credits for direct impacts (Section 11.2.4 of the BAM)
- Identifying the credit class for ecosystem credits and species credit (Section 11.3 of the BAM)

23.2 NATIVE VEGETATION

23.2.1 VEGETATION ZONES

Table 23-1 summarises the amount (hectares) of each vegetation zone that will be directly impacted within the nominated areas, including:

- Urban and industrial development, infrastructure, and intensive plant agriculture within urban capable land
- Major transport corridors
- Total impacts from development under the Plan

A total of 1,753.6 ha of native vegetation occurs within the urban capable land and major transport corridors and will be impacted by the development under the Plan. The five most impacted vegetation zones (excluding non-offsettable grassland) are:

- PCT 849_Thinned – 301.7 ha
- PCT 849_DNG – 227.4 ha
- PCT 1395_DNG – 227.5 ha
- PCT 850_DNG – 195.2 ha
- PCT 835_Thinned – 150.0 ha

Table 23-1: Direct impacts on vegetation zones within each nominated area

Vegetation zone			Area (ha) impacted						Hollow-bearing trees^
			Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total*	
Vegetation zone ID	PCT	Condition	Wilton	GMAC	WSA	GPEC			
724_Intact	724	Intact	0.0	0.0	0.0	0.2	7.0	**7.2**	Yes
724_Thinned	724	Thinned	0.0	0.0	17.0	13.0	45.4	**75.3**	Yes
724_Scattered_trees	724	Scattered trees	0.0	0.0	1.8	8.6	15.3	**25.8**	Yes
725_Intact	725	Intact	0.0	0.0	0.8	0.0	15.2	**16.0**	No
725_Thinned	725	Thinned	0.0	0.0	8.6	6.4	3.7	**18.7**	No
725_Scattered_trees	725	Scattered trees	0.0	0.0	2.9	0.0	0.0	**2.9**	Yes
781_Thinned	781	Thinned	0.0	0.0	1.0	2.3	0.9	**4.2**	No
830_Intact	830	Intact	0.0	<0.1	0.0	0.0	0.0	**<0.1**	Yes
830_Thinned	830	Thinned	0.0	<0.1	0.0	0.0	0.0	**<0.1**	No
835_Intact	835	Intact	0.0	1.1	0.2	0.8	11.8	**13.9**	Yes
835_Thinned	835	Thinned	0.0	6.4	16.8	16.5	110.3	**150.0**	Yes

Vegetation zone			Area (ha) impacted						Hollow-bearing trees^
			Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total*	
Vegetation zone ID	PCT	Condition	Wilton	GMAC	WSA	GPEC			
835_Scattered_trees	835	Scattered trees	0.0	0.1	15.9	0.9	5.2	**22.1**	Yes
849_Intact	849	Intact	1.6	10.8	6.1	0.1	9.0	**27.5**	Yes
849_Thinned	849	Thinned	23.4	37.4	154.4	56.7	29.9	**301.7**	Yes
849_Scattered_trees	849	Scattered trees	23.8	26.3	57.1	3.3	10.1	**120.7**	Yes
849_DNG	849	DNG	148.7	28.2	38.8	8.9	2.8	**227.4**	No
850_Intact	850	Intact	0.0	4.0	0.0	0.0	0.0	**4.0**	Yes
850_Thinned	850	Thinned	0.0	21.8	5.8	16.1	0.0	**43.6**	Yes
850_Scattered_trees	850	Scattered trees	0.9	6.9	1.6	2.2	0.0	**11.5**	Yes
850_DNG	850	DNG	159.6	12.4	0.2	23.0	0.0	**195.2**	No
1395_Intact	1395	Intact	11.0	34.8	0.0	0.0	0.0	**45.7**	Yes
1395_Thinned	1395	Thinned	70.8	74.7	0.0	0.0	0.0	**145.6**	Yes

Vegetation zone			Area (ha) impacted						Hollow-bearing trees^
			Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total*	
Vegetation zone ID	PCT	Condition	Wilton	GMAC	WSA	GPEC			
1395_Scattered_trees	1395	Scattered trees	17.9	23.1	0.0	0.0	0.0	**41.0**	No
1395_DNG	1395	DNG	171.2	56.3	0.0	0.0	0.0	**227.5**	No
1800_Intact	1800	Intact	0.0	0.0	0.7	0.0	0.0	**0.7**	Yes
1800_Thinned	1800	Thinned	0.0	0.0	11.6	3.0	9.4	**24.0**	Yes
1800_Scattered_trees	1800	Scattered trees	0.0	0.0	1.4	0.0	0.1	**1.6**	No
Total			**628.8**	**344.2**	**342.6**	**161.9**	**276.1**	**1,753.6**	

^ While hollow-bearing trees may not have been recorded within plots used to assess that vegetation zone, they may occur elsewhere within the vegetation zone

* Totals highlighted in blue are based on raw vegetation data outputs. Some rounding errors may occur between the impact areas quoted for each nominated area and the summed total for each vegetation zone.

23.2.2 NON-OFFSETTABLE GRASSLAND

Table 23-2 provides a summary of impacts to non-offsettable grassland vegetation types within the nominated areas.

Non-offsettable grassland comprises grassland vegetation zones with a vegetation integrity score of <15 and does not require offsetting for the associated PCT under the BAM. However, where non-offsettable grasslands support species credit species habitat, offsets may be required for those species.

Table 23-2: Direct impacts on non-offsettable grassland (NOG) within the nominated areas

Vegetation zone			Area (ha) impacted					
Vegetation zone ID	PCT	Condition	Wilton	GMAC	WSA	GPEC	Major transport corridors	Total*
835_NOG	835	NOG	0.0	21.1	648.9	313.4	217.8	**1,201.3**
849_NOG	849	NOG	676.5	1,341.1	2,380.2	622.1	323.2	**5,343.1**
850_NOG	850	NOG	12.3	454.2	10.0	228.4	0.0	**704.9**
1395_NOG	1395	NOG	322.3	471.2	0.0	0.0	0.0	**793.5**

* Totals highlighted in blue are based on raw vegetation data outputs. Some rounding errors may occur between the impact areas quoted for each nominated area and the summed total for each vegetation zone.

23.2.3 VEGETATION INTEGRITY

Table 23-3 shows the change in vegetation integrity as a result of the urban and industrial development, infrastructure, intensive plant agriculture and major transport corridors within the nominated areas. Change in vegetation integrity is a measure of the direct impact on native vegetation and species habitat.

It has been assumed that all vegetation will be removed within the urban capable land of each nominated area and within the major transport corridors and therefore the future vegetation integrity score will be zero.

In practice some native vegetation will likely be retained through Development Control Plans and other planning processes and mechanisms, including hollow-bearing trees (see Chapter 15).

Table 23-3: Change in vegetation integrity due to urban and industrial development, infrastructure, intensive plant agriculture and major transport corridors

Vegetation zone			Area (ha) impacted	Current vegetation integrity score before development	Future vegetation integrity score after development	Change in vegetation integrity score
Vegetation zone ID	PCT	Condition				
724_Intact	724	Intact	7.2	61.7	0.0	-61.7
724_Thinned	724	Thinned	75.3	36.2	0.0	-36.2
724_Scattered_trees	724	Scattered trees	25.8	20.5	0.0	-17.8
725_Intact	725	Intact	16.0	49.2	0.0	-49.2
725_Thinned	725	Thinned	18.7	43.3	0.0	-43.3
725_Scattered_trees	725	Scattered trees	2.9	19.6	0.0	-19.6
781_Thinned	781	Thinned	4.2	62.5	0.0	-62.5
830_Intact	830	Intact	<0.1	48.3	0.0	-48.3
830_Thinned	830	Thinned	<0.1	20.1	0.0	-20.1
835_Intact	835	Intact	13.9	76.6	0.0	-76.6
835_Thinned	835	Thinned	150.0	57.1	0.0	-57.1
835_Scattered_trees	835	Scattered trees	22.1	68.7	0.0	-68.7
835_NOG	835	NOG	1,201.3	8.0	0.0	-8.0

Vegetation zone			Area (ha) impacted	Current vegetation integrity score before development	Future vegetation integrity score after development	Change in vegetation integrity score
Vegetation zone ID	PCT	Condition				
849_Intact	849	Intact	27.5	53.9	0.0	-53.9
849_Thinned	849	Thinned	301.7	42.3	0.0	-42.3
849_Scattered_trees	849	Scattered trees	120.7	18.3	0.0	-18.3
849_DNG	849	DNG	227.4	24.1	0.0	-24.1
849_NOG	849	NOG	5,343.1	10.1	0.0	-10.1
850_Intact	850	Intact	4.0	58.1	0.0	-58.1
850_Thinned	850	Thinned	43.6	41.9	0.0	-41.9
850_Scattered_trees	850	Scattered trees	11.5	38.1	0.0	-38.1
850_DNG	850	DNG	195.2	25.7	0.0	-25.7
850_NOG	850	NOG	704.9	12.3	0.0	-12.3
1395_Intact	1395	Intact	45.7	72.9	0.0	-72.9
1395_Thinned	1395	Thinned	145.6	63.9	0.0	-63.9
1395_Scattered_trees	1395	Scattered trees	41.0	30.0	0.0	-30.0
1395_DNG	1395	DNG	227.5	28.4	0.0	-28.4

Vegetation zone			Area (ha) impacted	Current vegetation integrity score before development	Future vegetation integrity score after development	Change in vegetation integrity score
Vegetation zone ID	PCT	Condition				
1395_NOG	1395	NOG	793.5	5.4	0.0	-5.4
1800_Intact	1800	Intact	0.7	43.2	0.0	-43.2
1800_Thinned	1800	Thinned	24.0	46.6	0.0	-46.6
1800_Scattered_trees	1800	Scattered trees	1.6	41.2	0.0	-41.2

23.3 THREATENED ECOLOGICAL COMMUNITIES

Table 23-4 summarises the amount (hectares) of each TEC that will be directly impacted within the nominated areas, including:

- Urban and industrial development, infrastructure, and intensive plant agriculture within urban capable land
- Major transport corridors
- Total impacts from development under the Plan

A total of 1,753.6 ha of TECs occurs within the urban capable land and major transport corridors and will be impacted by the development under the Plan. The TEC mapping method used is generally conservative and is more likely to over-predict distribution of TECs. Limitations to the mapping are further discussed in Chapter 13.3.

The five most impacted TECs are:

- Cumberland Plain Woodland – 931.5 ha
- Shale Sandstone Transition Forest – 459.8 ha
- River-flat Eucalypt Forest on Coastal Floodplains – 185.9 ha
- Shale Gravel Transition Forest – 108.3 ha
- Cooks River/Castlereagh Ironbark Forest – 37.6 ha

Table 23-4: Direct impacts on TECs within the nominated areas

PCT	Condition	NSW status^	NSW TEC name	Area (ha) impacted						Cth TEC name	Cth status^
				Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total*		
				Wilton	GMAC	WSA	GPEC				
724	Intact	E	*Shale Gravel Transition Forest in the Sydney Basin Bioregion*	0.0	0.0	0.0	0.2	7.0	7.2	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (part)*	CE
724	Thinned			0.0	0.0	17.0	13.0	45.4	75.3		
724	Scattered Trees			0.0	0.0	1.8	8.6	15.3	25.8		
Total Shale Gravel Transition Forest									**108.3**		
725	Intact	E	*Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	0.0	0.0	0.8	0.0	15.2	16.0	*Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion*	CE
725	Thinned			0.0	0.0	8.6	6.4	3.7	18.7		
725	Scattered Trees			0.0	0.0	2.9	0.0	0.0	2.9		
Total Cooks River/Castlereagh Ironbark Forest									**37.6**		

PCT	Condition	NSW status^	NSW TEC name	Area (ha) impacted						Cth TEC name	Cth status^
				Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total*		
				Wilton	GMAC	WSA	GPEC				
781	Thinned	E	*Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	0.0	0.0	1.0	2.3	0.9	4.2	N/A	N/A
Total Freshwater Wetlands on Coastal Floodplains									**4.2**		
830	Intact	E	*Moist Shale Woodland in the Sydney Basin Bioregion*	0.0	<0.1	0.0	0.0	0.0	<0.1	*Western Sydney Dry Rainforest and Moist Woodland on Shale (part)*	CE
830	Thinned			0.0	<0.1	0.0	0.0	0.0	<0.1		
Total Moist Shale Woodland									**0.1**		
835	Intact	E	*River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	0.0	1.1	0.2	0.8	11.8	13.9	N/A Note the Commonwealth status of this TEC is currently being assessed by the Threatened Species Scientific Committee	N/A
835	Thinned			0.0	6.4	16.8	16.5	110.3	150.0		
835	Scattered Trees			0.0	0.1	16.0	0.9	5.2	22.1		

PCT	Condition	NSW status^	NSW TEC name	Area (ha) impacted						Cth TEC name	Cth status^
				Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total*		
				Wilton	GMAC	WSA	GPEC				
Total River-flat Eucalypt Forest on Coastal Floodplains									**185.9**		
849	Intact	CE	*Cumberland Plain Woodland in the Sydney Basin Bioregion*	1.6	10.8	6.1	0.1	9.0	27.5	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (part)*	CE
849	Thinned			23.4	37.4	154.4	56.7	29.9	301.7		
849	Scattered Trees			23.8	26.3	57.1	3.3	10.1	120.7		
849	DNG			148.7	28.2	38.8	8.9	2.8	227.4		
850	Intact	CE	*Cumberland Plain Woodland in the Sydney Basin Bioregion*	0.0	4.0	0.0	0.0	0.0	4.0	*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (part)*	CE
850	Thinned			0.0	21.8	5.8	16.1	0.0	43.6		
850	Scattered Trees			0.9	6.9	1.6	2.2	0.0	11.5		
850	DNG			159.6	12.4	0.2	23.0	0.0	195.2		
Total Cumberland Plain Woodland									**931.5**		

PCT	Condition	NSW status^	NSW TEC name	Area (ha) impacted						Cth TEC name	Cth status^
				Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total*		
				Wilton	GMAC	WSA	GPEC				
1395	Intact	CE	*Shale Sandstone Transition Forest in the Sydney Basin Bioregion*	11.0	34.8	0.0	0.0	0.0	45.7	*Shale Sandstone Transition Forest of the Sydney Basin Bioregion*	CE
1395	Thinned			70.8	74.7	0.0	0.0	0.0	145.6		
1395	Scattered Trees			17.9	23.1	0.0	0.0	0.0	41.0		
1395	DNG			171.2	56.3	0.0	0.0	0.0	227.5		
Total Shale Sandstone Transition Forest									**459.8**		
1800	Intact	E	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	0.0	0.0	0.7	0.0	0.0	0.7	*Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*	E
1800	Thinned			0.0	0.0	11.6	3.0	9.4	24.0		
1800	Scattered Trees			0.0	0.0	1.4	0.0	0.1	1.6		
Total Swamp Oak Floodplain Forest									**26.2**		

^CE = critically endangered; E = endangered; V = vulnerable

* Totals highlighted in blue are based on raw vegetation data outputs. Some rounding errors may occur between the impact areas quoted for each nominated area and the summed total for each TEC.

23.4 THREATENED SPECIES AND SPECIES HABITAT

Table 23-5 identifies the amount of habitat (in hectares) of each candidate species credit species (SCS) that will be directly impacted within the nominated areas, including:

- Urban and industrial development, infrastructure, and intensive plant agriculture within urban capable land
- Major transport corridors
- Total impacts from development under the Plan

The five SCS with the largest area of potential habitat impacted by development under the Plan are:

- *Acacia pubescens* – 1,321.4 ha
- *Pimelea spicata* – 870.4 ha
- *Myotis macropus* – 759.2 ha
- *Meridolum corneovirens* – 720.1 ha
- *Grevillea juniperina* subsp. *juniperina* – 467.5 ha

It is important to note that the knowledge-based method used to determine habitat for some species is based on assuming presence within areas of potential habitat. The method is therefore likely to greatly overestimate the amount of actual or known habitat for these species impacted by the development (see Chapter 11).

The BAM requires certain candidate SCS to be assessed by a count of the species individuals directly impacted, rather than the area of habitat. One candidate SCS, *Epacris purpurascens* var. *purpurascens* requires assessment by a count of individuals. As the KBM process is limited to modelling habitat based on area, a modelled count of individuals is not possible. To address this for *Epacris purpurascens* var. *purpurascens* the following process was used to derive a biodiversity credit requirement for impacts to the species:

- All BioNet records of the species that occur within 20 kms of modelled habitat were selected to allow for consideration of populations in the locality of the nominated areas. Records used were sourced from "As Held BioNet Data" (at May 2021). A total of 314 records were considered, once duplicates had been removed
- To group individual records into populations, and to provide an estimated area within which the record occurs, each BioNet record was buffered by 56.42 m (radius) to create 1 ha buffers surrounding each point
- Buffer areas were then combined (with overlapping areas dissolved) to ascertain an area value for each group of records. A total of 108 buffer areas (populations) were created, ranging in area from 1 ha to 6.7 ha
- BioNet records were interrogated to determine the number of individual plants each record represents. Where no counts were provided the number of individuals was assumed to be one. Numbers of individuals per BioNet record ranged from 1 to 25,000. When these were provided as a range, the mid-point of the range was used
- The total individuals present within each buffer area (based on all BioNet records within each buffer area) were then summed to determine the number of individuals per population. The total individuals per population was divided by the total area of the buffer to ascertain the individuals per hectare estimate
- Individuals per hectare values were ranked and the median value of 8 individuals per hectare was selected. The median value is considered to be more suitable than the mean to return the central tendency for a skewed number distribution such as this dataset. The data ranges from 1 individual per hectare to 27,500 individuals per hectare, with 94 of the 108 total entries returning less than 1,000 individuals per hectare

Note that Little Eagle and Square-tailed Kite are candidate SCS for breeding habitat only. Expert reports were prepared for these species that mapped areas of 'breeding and foraging habitat' (equating to potential breeding habitat) within Wilton and GMAC. An additional 1,322.98 ha of foraging habitat for Little Eagle and 510.84 ha of foraging habitat for Square-tailed Kite were mapped within the expert reports which have not been included in the candidate SCS calculations, as they are not considered to be impacts to the species as required by the BAM and include mainly grassed paddocks. Potential breeding habitat is generally restricted to heavily vegetated areas outside urban capable land, however there is considerable overlap between potential forage habitat and urban capable land. In addition, impacts of 0.80 ha to a buffer around a confirmed stick nest (species not known) in GPEC, associated with grassed paddocks commensurate with the habitat mapped as potential forage habitat by the expert in Wilton and GMAC, has also been excluded from the candidate SCS calculations.

Table 23-5: Direct impacts on candidate species credit species habitat within the nominated areas

Scientific name	Common name	NSW status^	Cth status^	Habitat area (ha) impacted					
				Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total~
				Wilton	GMAC	WSA	GPEC		
Acacia bynoeana	Bynoe's Wattle	E	V	240.3	158.9	12.3	3.9	18.9	**434.3**
Acacia pubescens	Downy Wattle	V	V	428.2	265.1	297.1	105.7	225.3	**1,321.4**
Allocasuarina glareicola		E	E	0.0	0.0	0.0	12.9	4.50	**17.4**
*Callocephalon fimbriatum**	Gang-gang Cockatoo	V	-	0.6	3.1	0.0	0.0	<0.1	**3.7**
*Calyptorhynchus lathami**	Glossy Black Cockatoo	V	-	1.4	7.5	0.0	0.0	0.0	**9.0**
Cercartetus nanus	Eastern Pygmy-possum	V	-	7.0	35.0	5.9	0.8	18.4	**67.1**
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	106.7	172.8	0.0	0.9	1.0	**281.5**
Dillwynia tenuifolia		V	-	0.0	0.0	66.2	31.9	75.8	**173.9**
Epacris purpurascens var. *purpurascens*		V	-	39.3	53.4	0.0	0.0	0.0	**92.8**
Eucalyptus benthamii	Camden White Gum	V	V	0.0	0.0	0.0	0.0	0.0	**0.00**
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V	-	0.0	0.0	240.0	86.0	141.4	**467.5**
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	2.5	2.3	7.1	0.1	3.9	**15.9**
*Haliaeetus leucogaster**	White-bellied Sea-Eagle	V	-	2.5	7.9	0.9	0.3	6.2	**17.7**
Heleioporus australiacus	Giant Burrowing Frog	V	V	0.3	0.3	0.0	0.0	0.0	**0.6**
Hibbertia fumana+++		CE	-	28.3	7.1	6.9	0.0	31.5	**73.7**
Hibbertia puberula+++		E	-	27.6	7.1	6.9	0.0	36.2	**77.8**

Scientific name	Common name	NSW status^	Cth status^	Habitat area (ha) impacted					
				Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total~
				Wilton	GMAC	WSA	GPEC		
*Hieraaetus morphnoides**	Little Eagle	V	-	4.8	18.9	0.7	0.6	3.3	**28.2**
Lathamus discolor++	Swift Parrot	E	CE	0.0	0.0	0.0	42.4	0.9	**43.3**
Litoria aurea+	Green and Golden Bell Frog	E	V	0.0	0.0	0.0	11.0	2.3	**13.3**
*Lophoictinia isura**	Square-tailed Kite	V	-	5.0	25.2	0.9	0.3	13.3	**44.6**
Marsdenia viridiflora subsp. *viridiflora*		E. pop.	-	0.0	31.9	179.3	92.4	121.7	**425.3**
Maundia triglochinoides		V	-	0.0	0.0	8.9	3.4	10.3	**22.7**
Melaleuca deanei	Deane's Paperbark	V	V	45.4	60.8	0.0	0.0	0.0	**106.2**
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	88.5	154.0	189.3	91.9	196.4	**720.1**
Micromyrtus minutiflora		E	V	0.0	0.0	8.3	10.6	12.9	**31.7**
Myotis macropus	Southern Myotis	V	-	83.0	134.2	271.4	95.1	175.4	**759.2**
*Ninox connivens**	Barking Owl	V	-	0.0	0.0	0.0	0.0	0.0	**0.00**
*Ninox strenua**	Powerful Owl	V	-	0.0	0.0	0.0	0.0	0.1	**0.1**
Persicaria elatior	Tall Knotweed	V	V	0.0	0.0	2.3	1.1	46.5	**49.9**
Persoonia bargoensis	Bargo Geebung	E	V	37.1	46.4	0.0	<0.1	0.0	**83.5**
Persoonia nutans	Nodding Geebung	E	E	0.0	0.0	31.1	24.6	86.3	**142.0**
Petaurus norfolcensis	Squirrel Glider	V	-	58.1	106.2	0.0	45.6	91.4	**301.3**
*Phascolarctos cinereus**	Koala	V	V	106.9	135.2	0.0	0.0	0.0	**242.1**

Scientific name	Common name	NSW status^	Cth status^	Habitat area (ha) impacted					
				Urban and industrial development, infrastructure and intensive plant agriculture				Major transport corridors	Total~
				Wilton	GMAC	WSA	GPEC		
Pimelea curviflora var. *curviflora*		E	-	0.0	0.0	0.0	15.9	36.5	**52.4**
Pimelea spicata#	Spiked Rice-flower	E	E	387.7	66.0	219.6	62.6	134.6	**870.4**
Pomaderris brunnea	Brown Pomaderris	E	V	17.0	21.1	0.0	0.0	0.9	**39.0**
Pseudophryne australis	Red-crowned Toadlet	V	-	2.3	7.0	0.0	0.0	0.0	**9.3**
Pterostylis saxicola	Sydney Plains Greenhood	E	E	11.2	35.0	0.0	0.9	0.0	**47.1**
Pultenaea parviflora		E	V	0.0	0.0	21.2	13.0	71.3	**105.5**
Pultenaea pedunculata	Matted Bush-pea	E	-	24.2	26.3	61.5	37.8	58.7	**208.5**
*Tyto novaehollandiae**	Masked Owl	V	-	<0.1	0.1	0.0	0.0	0.5	**0.6**
Total				**1,755.9**	**1,588.8**	**1,637.8**	**749.3**	**1,625.5**	**7,357.3**

^CE = critically endangered; E = endangered; V = vulnerable; E.pop. = endangered population

*These species are SCS in relation to breeding habitat or mapped "important habitat" only

+7.7 hectares of impact to Green and Golden Bell Frog is associated with vegetation removal and hence has been entered into the BAM Calculator to determine the resultant credit requirement. The remaining 5.6 hectares of impact is associated with man-made structures and has been assessed under Prescribed Impact in Section 16.3 of the BCAR

++ 26.0 hectares of impact to Swift Parrot important habitat is associated with vegetation removal and hence has been entered into the BAM Calculator to determine the resultant credit requirement. The remaining 17.3 hectares of impact is associated with waterbodies and Non-Native Vegetation and has been assessed under Prescribed Impact in Section 16.3 of the BCAR

+++72.9 hectares of impact to *Hibbertia fumana* and 76.9 hectares of impact to *Hibbertia puberula* is associated with vegetation removal and hence has been entered into the BAM Calculator to determine the resultant credit requirement. The remaining 1.1 hectare of impact (for each species) is associated with Non-Native Vegetation and has been assessed under Prescribed Impact in Section 16.3 of the BCAR

#862.36 hectares of impact to *Pimelea spicata* is associated with vegetation removal and hence has been entered into the BAM Calculator to determine the resultant credit requirement. The remaining 8.1 hectares of impact is associated with Non-Native Vegetation and has been assessed under Prescribed Impact in Section 16.3 of the BCAR

~ Totals highlighted in blue are based on raw habitat data outputs. Some rounding errors may occur between the impact areas quoted for each nominated area and the summed total for each species

24 Prescribed biodiversity impacts

24.1 INTRODUCTION

The BAM requires prescribed impacts to be identified and assessed.

This Chapter sets out:

- Definition of prescribed impacts
- Approach taken to assessing prescribed impacts
- Identification of relevant prescribed impacts
- Presence and abundance of species and TECs associated with each prescribed impact type
- Assessment of the impacts of the urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors within the nominated areas under the Plan in relation to each relevant prescribed impact

24.2 DEFINITION OF PRESCRIBED IMPACTS

Prescribed impacts can be defined generally as impacts on biodiversity values that do not comprise direct clearing of native vegetation that are assessed through credits. Prescribed impacts comprise impacts on (Clause 6.1, BC Regulation):

- Habitat features for threatened species or TECs:
  - Karst, caves, crevices, cliffs, and other geological features of significance
  - Rocks
  - Human-made structures
  - Non-native vegetation
- Connectivity of habitat of threatened species that facilitates the movement of those species across their range
- Movement of threatened species that maintains their lifecycle
- Water quality, water bodies and hydrological processes that sustain threatened species and TECs
- Wind turbine strikes on protected fauna
- Vehicle strikes on threatened fauna or fauna that is part of a TEC

This assessment considered prescribed impacts to include two types:

- Prescribed impacts that are direct impacts. This includes, for example, direct removal of species habitat that is not native vegetation, such as rocks, water bodies or non-native vegetation
- Prescribed impacts that are indirect impacts. This includes, for example, indirect impacts on species habitat that is a water body through urban run-off, or indirect impacts to species through the severing of a habitat corridor

The assessment in this Chapter is considered in terms of both direct and indirect prescribed impacts.

24.3 APPROACH TO THE ASSESSMENT

The BAM requires the BCAR to identify and assess prescribed impacts within the nominated areas.

Section 6.7 of the BAM requires the BCAR to:

- Identify occurrences of habitats associated with prescribed impacts
- List the candidate SCS or ecosystem credit species (ECS) or TECs associated with those habitats
- Undertake targeted surveys for any relevant candidate SCS

Section 9.1.1.2 and 9. 2 of the BAM requires the BCAR to:

- Describe the nature, extent, frequency, duration, and timing of prescribed impacts relevant to the proposed development, including impacts during construction and operation

- Evaluate the consequences of prescribed impacts

The steps taken to assess prescribed impacts involved:

Step 1: Identify the relevant species and TECs (including ECS and candidate SCS) associated with each prescribed impact type within the nominated areas. This was done by drawing on ecological and life history information in BioNet profiles, as well as species records, habitat maps, and surveys undertaken for this assessment.

The following was described for each species or TEC:

- Likely presence/abundance of species/TEC in the nominated areas
- Use and importance of the prescribed impact type for the TEC/species

Step 2: Map the occurrence of each prescribed impact type within the nominated areas where possible. Where mapping was not possible (human-made structures, vehicle strikes) or not necessary (rock outcrops – see Section 24.7), the occurrence of the prescribed impact type in each nominated area was described and assessed qualitatively.

Mapping was undertaken for:

- Karst, caves, crevices, cliffs, and other geological features of significance
- Non-native vegetation
- Habitat connectivity and movement
- Water bodies and hydrological processes

The mapping of each prescribed impact type was overlayed on the urban capable land within each nominated area to provide impact data and other information on the nature, extent, and duration of impacts

Step 3: Describe the nature, extent, and duration of each prescribed impact type:

- Nature of impacts – qualitatively describe any direct impacts (e.g. removal or destruction of habitat) or indirect impacts (e.g. reduction in habitat connectivity, human use/disturbance, urban run-off)
- Extent of impacts – quantify the direct impacts where possible (e.g. the amount of habitat removed or destroyed (ha)) or the general location and extent of indirect impacts
- Duration – identify whether the impacts are permanent or temporary

Step 4: Describe the general mitigation measures and processes that will be implemented to mitigate prescribed impacts

Step 5: Assess the potential prescribed impacts on each TEC and species and identify any potential residual impacts. This was done taking into account:

- Likely presence/abundance of species/TEC and importance of the location at a local and regional scale
- Life history traits and susceptibility of the species/TEC to the prescribed impact
- Location of the species/TEC relative to the likely extent of the prescribed impact
- Amount and quality of unimpacted habitat remaining
- Levels of existing protection
- The effectiveness of the general mitigation measures and processes described through step 4

Step 6: Describe any additional specific mitigation measures needed to address potential residual prescribed impacts identified through step 4 to particular TECs or species

24.4 RELEVANT PRESCRIBED IMPACTS

The following prescribed impact types are relevant to the development:

- Karst, caves, crevices, cliffs, and other geological features of significance
- Rocks
- Human-made structures

- Non-native vegetation
- Habitat connectivity and movement
- Water bodies and hydrological processes
- Vehicle strikes

Prescribed impacts may be associated with direct or indirect impacts. Table 24-1 sets out the potential types of impacts associated with each prescribed impact type that are relevant to the development.

The prescribed impact type 'wind turbine strikes on protected fauna' is not relevant to the development and has not been considered further in this Assessment Report.

Table 24-1: Types of impacts associated with each prescribed impact type

Prescribed impact type	Associated potential direct impacts	Associated potential indirect impacts
Karst, caves, crevices, cliffs	Removal or destruction (e.g. cracking or collapse) of habitat	Recreational use/disturbance Noise or light disturbance
Rocks	Removal of habitat (rocks)	
Human-made structures	Removal of habitat (structures)	Human disturbance Noise or light disturbance
Non-native vegetation	Removal of habitat (non-native vegetation)	Recreational use/disturbance Weed invasion Spread of plant/animal disease Pest animals/predation/competition Soil erosion/sedimentation Urban run-off (water quality)
Habitat connectivity/movement	N/A	Reduction in habitat connectivity
Water bodies/hydrological processes	Removal of habitat (water bodies)	Change in water flows/quantity Urban run-off (water quality)
Vehicle strikes	Death of species individuals	N/A

24.5 PRESENCE/ABUNDANCE OF RELEVANT SPECIES

Table 24-2 identifies the presence and abundance of species and TECs associated with each prescribed impact type.

Note about Koala: development under the Plan within the nominated areas has the potential to impact the Southern Sydney Koala population. Impacts on Koala have been assessed in detail in Chapter 30, and impacts associated with prescribed impacts as defined in the BAM are summarised in this chapter.

Table 24-2: Relevant species/TECs potentially subject to prescribed impacts

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
Plants			
Acacia bynoeana	Bynoe's Wattle	Records occur to the north of GPEC where there are a significant number of populations, and in Wilton in avoided/excluded lands	• Non-native vegetation
Grevillea juniperina subsp. *Juniperina*	Juniper-leaved Grevillea	Records occur in Western Sydney Aerotropolis (WSA) and Greater Penrith to Eastern Creek Investigation Area (GPEC). Most records for the species occur just north of GPEC. The species is	• Non-native vegetation

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
		known to occur in disturbed land at Marsden Park (Weston, 2019)	
Hibbertia fumana		Species is only known from the Moorebank and Bankstown areas outside the nominated areas. However, the species is recently described and if present, could have been recorded under a different name in previous studies	• Non-native vegetation
Hibbertia puberula		Records occur in the Plan Area, primarily near Holsworthy, with more sporadic records between Holsworthy and Campbelltown. There are also three records in Shanes Park close to the northern edge of GPEC. There are no records within the nominated areas	• Non-native vegetation
Persoonia bargoensis	Bargo Geebung	Records occur on the edge of Wilton within avoided/excluded lands. These records are part of a single population of the species that spans from Bargo to Picton in the north-west, through to Appin in the east	• Non-native vegetation
Pimelea spicata	Spiked Rice-flower	Records occur in GPEC and GMAC in avoided/excluded lands. Most records occur in the Blacktown, Prospect, Bankstown, and Narellan districts. One population in GMAC occurs within roadside vegetation within urban capable land	• Non-native vegetation
Bats			
Chalinolobus dwyeri	Large-eared Pied Bat	Records occur throughout the Cumberland subregion. Breeding habitat is associated with sandstone caves, crevices, and cliffs. Most records occur in the south of the subregion around Wilton. Interrogation of BioNet records suggests no roost sites occur in the nominated areas	• Karst, caves, crevices, and cliffs • Non-native vegetation • Habitat connectivity
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Records occur within and surrounding the Cumberland subregion. Most records in the subregion occur in the eastern and northern parts. Few records occur in the nominated areas. The species has not been recorded in WSA	• Human-made structures • Non-native vegetation • Habitat connectivity
Miniopterus australis	Little Bent-winged Bat	Few records occur within the Cumberland subregion. The species has been recorded in three of the nominated areas (not WSA), including recently (< 5 years ago) in Wilton. Most records surrounding the subregion occur in coastal areas to the north	• Karst, caves, crevices, and cliffs • Human-made structures • Non-native vegetation • Habitat connectivity
Miniopterus orianae oceanensis	Large Bent-winged Bat	Records are widespread within and surrounding the Cumberland subregion. The species has been recorded in all four nominated areas, including recently (< 5 years ago)	• Karst, caves, crevices, and cliffs • Human-made structures • Non-native vegetation

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
			• Habitat connectivity
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	Records are widespread within and surrounding the Cumberland subregion. The species has been recorded in all four nominated areas, including recently (< 5 years ago) in Wilton and GPEC	• Human-made structures • Non-native vegetation • Habitat connectivity
Myotis macropus	Southern Myotis	Records are widespread within and surrounding the Cumberland subregion. The species has been recorded in all four nominated areas, including recently (< 5 years ago) particularly in Wilton and GPEC and just outside the northern part of GMAC. Suitable habitat has been mapped within each of the nominated areas. Suitable habitat occurs as scattered small to moderate size patches associated with native vegetation, including vegetation in low to moderate condition	• Human-made structures • Habitat connectivity • Water bodies
Pteropus poliocephalus	Grey-headed Flying-fox	The Plan Area supports significant numbers of the species across a number of camps. The location of breeding and roosting camps within the Cumberland subregion has been monitored since 2012 (Geoscience Australia, 2015). There are no known camps in the urban capable lands	• Non-native vegetation • Habitat connectivity
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Records occur within and surrounding the Cumberland subregion. Few records occur in the nominated areas. The species has not been recorded in WSA. Roost requirements are poorly known	• Human-made structures • Non-native vegetation • Habitat connectivity
Scoteanax rueppellii	Greater Broad-nosed Bat	Records occur within and surrounding the Cumberland subregion. Most records for the species in the subregion occur in the eastern part. Few records occur in the nominated areas	• Human-made structures • Non-native vegetation • Habitat connectivity
Marsupials			
Cercartetus nanus	Eastern Pygmy-possum	No records occur in the nominated areas. Records occur to the south and east of Wilton and east of GMAC outside the Cumberland subregion. Suitable habitat for the species is generally restricted to the gorges and gullies on the edges of Wilton, on the edges and through the middle of the southern part of GMAC, along riparian corridors in WSA and GPEC, and associated with larger patches of native vegetation within Wianamatta Regional Park and Orchard Hills	• Habitat connectivity • Vehicle strikes
Dasyurus maculatus	Spotted-tailed Quoll	Several important populations for the species have been identified within the vicinity of the nominated areas. Suitable habitat is generally restricted to the gorges and gullies on the edges of the nominated areas and along waterways	• Non-native vegetation • Habitat connectivity • Vehicle strikes

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
Petaurus australis	Yellow-bellied Glider	There is one record in the nominated areas, in GPEC. The closest record outside the nominated areas is < 1 km away from Wilton. There are six records north of GPEC, three records west of Wilton, and one record east of Wilton, all within the Plan Area. The majority of records occur outside the Plan Area to the north-east and south-west	• Habitat connectivity • Vehicle strikes
Petaurus norfolcensis	Squirrel Glider	Records in the nominated areas are limited. There are two records in Wilton and one in GPEC, all of which occur on avoided lands	• Habitat connectivity • Vehicle strikes
Frogs			
Litoria aurea	Green and Golden Bell Frog	Records in the nominated areas are limited. There are 12 records within GPEC and two records within GMAC. Potential habitat has been mapped along Ropes Creek in GPEC in the vicinity of six records made between 1998 and 2012. At the time of public exhibition, it was considered the species could still be present in this area. Targeted surveys of Ropes Creek have since been completed and did not find any individuals to be present (see Supporting Document I)	• Non-native vegetation • Habitat connectivity • Water bodies • Vehicle strikes
Pseudophryne australis	Red-crowned Toadlet	There are no records within the nominated areas. Closest records occur within a few kilometres of the nominated areas. Mapped suitable habitat occurs in scattered patches within the vicinity of gorges and gullies that occur mainly around the edges of the nominated areas	• Rocky areas • Habitat connectivity
Reptiles			
Hoplocephalus bungaroides	Broad-headed Snake	There are no recent records in the nominated areas. There is one historical record from 1970 in the Appin area. Mapped suitable habitat occurs along riparian corridors in gorges and gullies that occur mainly around the edges of the nominated areas	• Karst, caves, crevices, and cliffs • Rocky areas • Vehicle strikes
Varanus rosenbergi	Rosenberg's Monitor	No records occur in the nominated areas and very few records occur in the Cumberland subregion. Records occur at the edges of the subregion near Gordon and Dharawal National Park The species is associated with sandstone areas, particularly to north-east, south-east and north-west of Sydney (OEH, 2017j) and is considered unlikely to occur in the nominated areas, and is not considered further in this Chapter	N/A
Birds			
Anthochaera phrygia	Regent Honeyeater	There are 93 records in the Plan Area which mostly occur in larger patches of woodland in the Londonderry area. Records in the nominated areas are limited, with one occurring in east	• Habitat connectivity

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
		Wilton, one in the middle of GMAC, and five in north-east GPEC	
Artamus cyanopterus cyanopterus	Dusky Woodswallow	There are 97 records in the nominated areas. The species is abundant in and around the Cumberland subregion	• Non-native vegetation • Habitat connectivity
Botaurus poiciloptilus	Australasian Bittern	Records in the nominated areas are limited to one record in the north of GPEC. Six records occur to the north of GPEC and four are scattered between WSA, GMAC and Wilton within the Plan Area	• Habitat connectivity • Water bodies
Calidris ferruginea	Curlew Sandpiper	The species occurs in and around the Cumberland subregion, most frequently closer to the coast. There are 40 records in the Plan Area, the majority of which are concentrated around Windsor. One record occurs in GMAC, within avoided/excluded lands	• Habitat connectivity
Callocephalon fimbriatum	Gang-gang Cockatoo	The species occurs in and around the Cumberland subregion. Records within the nominated areas are limited. One record occurs in the north of GPEC, three in Wilton along the boundary, and 11 in GMAC	• Habitat connectivity
Calyptorhynchus lathami	Glossy Black Cockatoo	The species occurs in and around the Cumberland subregion. Records in the nominated areas are limited. There are two records in the north of GPEC, four in Wilton, and three in GMAC	• Habitat connectivity
Circus assimilis	Spotted Harrier	Records in the nominated areas are limited. One record occurs in GPEC and two in GMAC. The majority of records in the Plan Area occur in the north-east around the Richmond area	• Habitat connectivity
Climacteris picumnus victoriae	Brown Treecreeper	This species occurs sparsely in the Cumberland subregion with the highest density of records occurring in the Blue Mountains and Wolgan Valley regions. Records within the nominated areas are limited. There are three records in the GPEC, four in the east of Wilton, and five throughout GMAC	• Habitat connectivity
Daphoenositta chrysoptera	Varied Sittella	The species occurs in and around the Cumberland subregion. There are 17 records in GPEC, three in WSA, one in Wilton, and 14 in GMAC	• Habitat connectivity
Ephippiorhynchus asiaticus	Black-necked Stork	Records in the nominated areas are limited. There are three records in GPEC and one record in GMAC. Outside the nominated areas within the Plan Area there are a further nine records, the majority of which are located in and around Windsor	• Water bodies
Epthianura albifrons	White-fronted Chat	Records within the nominated areas are limited. There is only one record in the nominated areas, located in GMAC. There are a further three records outside the nominated areas within the Plan Area, located in Liverpool, Windsor, and Scheyville National Park	• Habitat connectivity

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
Glossopsitta pusilla	Little Lorikeet	The species is abundant and widespread in and around the Cumberland subregion. There are 17 records in Wilton, five in GPEC, and 23 in GMAC	• Habitat connectivity
Grantiella picta	Painted Honeyeater	The species occurs sparsely in the Cumberland subregion. There are five records within the Plan Area, none of which occur in the nominated areas. Four records occur north of GPEC and one east of WSA in Smithfield	• Non-native vegetation • Habitat connectivity
Haliaeetus leucogaster	White-bellied Sea-eagle	There are several records in the nominated areas (excluding Wilton), including: • One old record and one recent (2019) record in GPEC • Ten records in WSA including several from 2017-2019 • A cluster of relatively recent records (2013) within or just outside the central part of GMAC, and one other record in the southern part of GMAC • Several recent (2018) records just outside the northern part of the GMAC	• Habitat connectivity • Water bodies
Hieraaetus morphnoides	Little Eagle	There are 42 records of the species within the nominated areas or within 5 km of their boundaries. Most records are associated with large patches of open woodland that occur within open grassland areas. Some records are found close to the edges of forests along watercourses. A few records are from woodlands associated with wetlands (Saunders and Debus, 2018a)	• Non-native vegetation • Habitat connectivity
Irediparra gallinacean	Comb-crested Jacana	There are 18 records of the species in the Plan Area, 17 of which occur north of GPEC, with one just north of GMAC. There are no records in the nominated areas	• Habitat connectivity • Water bodies
Ixobrychus flavicollis	Black Bittern	The species occurs sparsely in the Cumberland subregion with the majority of records occurring closer to the coast. There are 16 records in the Plan Area, two of which occur in GPEC	• Habitat connectivity • Water bodies
Lathamus discolor	Swift Parrot	The species is abundant and widespread in and around the Cumberland subregion. There are 266 records in the Plan Area, 26 of which occur in GPEC, eight in GMAC, and one in Wilton	• Habitat connectivity
Limicola falcinellus	Broad-billed Sandpiper	There are no records of the species in the nominated areas or Plan Area. The closest record to the nominated areas is approximately 20 km east towards the coast	• Habitat connectivity
Limosa limosa	Black-tailed Godwit	There are no records in the nominated areas. Eight records occur in the Plan Area, with the closest approximately 2 km west of GPEC	• Habitat connectivity
Lophoictinia isura	Square-tailed Kite	There are 50 records in the Plan Area, with the majority occurring outside the nominated areas north of GPEC. Nine records occur within the	• Non-native vegetation

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
		nominated areas and a further 26 occur within 5 km of the nominated areas (including some outside the Plan Area). The majority of records are from January to April, which represents the post-breeding dispersal phase (Saunders and Debus, 2018b)	• Habitat connectivity
Melithreptus gularis gularis	Black-chinned Honeyeater	The species is widespread in and around the Cumberland subregion, with a higher abundance further north around Glen Davis and the Hunter. There are 48 records in the Plan Area; one in Wilton, two in GPEC and two in GMAC	• Habitat connectivity
Neophema pulchella	Turquoise Parrot	The species occurs in and around the Cumberland subregion with higher densities of records found in Glen Davis, Mellong, and near Yerranderie State Conservation Area. There are 29 records in the Plan Area, six of which occur in GMAC and one in Wilton	• Habitat connectivity
Ninox connivens	Barking Owl	The species occurs in and around the Cumberland subregion. There are 16 records in the Plan Area, one in Wilton and one in GMAC	• Non-native vegetation • Habitat connectivity
Ninox strenua	Powerful Owl	The species occurs in and around the Cumberland subregion. There are 141 records in the Plan Area, including 19 records in GMAC, nine in GPEC and three in Wilton	• Non-native vegetation • Habitat connectivity
Pandion cristatus	Eastern Osprey	There are 4 records in the Plan Area, one of which occurs in GPEC. Relatively more records occur to the east of the Plan Area along the coast	• Habitat connectivity • Water bodies
Rostratula australis	Australian Painted Snipe	The species is sparsely distributed in and around the Cumberland Plain. There are 19 records in the Plan Area, of which one occurs in GPEC and one in GMAC	• Water bodies
Stagonopleura guttata	Diamond Firetail	The species occurs in and around the Cumberland subregion. There are 93 records in the Plan Area of which 15 occur in GPEC, six in GMAC, and one in Wilton	• Habitat connectivity
Stictonetta naevosa	Freckled Duck	The species is sparsely distributed in and around the Cumberland subregion. There are 32 records for the species in the Plan Area, mostly concentrated around Windsor. Of which seven occur in GPEC and one in WSA	• Habitat connectivity • Water bodies
Tyto novaehollandiae	Masked Owl	The species occurs in and around the Cumberland subregion, with higher concentrations occurring around the Central Coast and Nowra. There are 34 records in the Plan Area, of which four occur in GMAC and one in GPEC	• Non-native vegetation • Habitat connectivity
Snail			
Meridolum corneovirens	Cumberland Plain Land Snail	The species is largely endemic to the Cumberland subregion, with a few records occurring just outside. There are 1,097 records in the Plan Area, of which 257 occur in GPEC, 74 in GMAC, 13 in	• Habitat connectivity

Scientific name	Common name	Presence/abundance in nominated areas	Relevant prescribed impact type
		WSA and three in Wilton. Records are scattered across the subregion. Most records occur outside the nominated areas or on excluded land	

24.6 ASSESSMENT OF KARST, CAVES, CREVICES, AND CLIFFS

24.6.1 LIST OF RELEVANT SPECIES AND TECS

The list of species associated with karst, caves, crevices, and cliffs is shown in Table 24-3.

Table 24-3: Species associated with karst, caves, crevices, cliffs, and other geological features

Relevant species	Use and importance of habitat type
Broad-headed Snake	Broad-headed Snake may use rocky areas and crevices for refuge. Adults shelter in rocky outcrops under flat sandstone rocks on exposed cliff edges during autumn, winter, and early spring, then move to adjacent woodland within 500 m of rocky areas during late spring and summer. Pregnant females and juveniles remain in rocky habitat, using cooler, shaded rocks and crevices (DoEE, 2018a)
Large Bent-winged Bat	Large Bent-winged Bat mainly roosts in caves with very specific temperature and humidity regimes. It can also use mines, storm water tunnels, buildings, and other human-made structures. The species disperses widely from breeding colonies (within 300 km). Interrogation of BioNet records suggests no roost sites occur in the nominated areas (OEH, 2021)
Large-eared Pied Bat	Large-eared Pied Bat roosts in sandstone caves, crevices, cliffs, and old mine workings. Habitat within the nominated areas is likely to be used for foraging. Interrogation of BioNet records suggests no roost sites occur in the nominated areas (OEH, 2019g)
Little Bent-winged Bat	Little Bent-winged Bat can roost in the following human-made structures: tunnels, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day. It also roosts in caves and tree hollows. Forages in densely vegetated habitats (OEH, 2019h). Interrogation of BioNet records suggests no roost sites occur in the nominated areas

24.6.2 OCCURRENCE OF HABITAT OR PRESCRIBED IMPACT TYPE

Locations where karst, caves, crevices, cliffs, and other geological features are most likely to occur in the nominated areas are shown in Map 24-1. These areas are associated with the gorges and gullies around the edges and northern part of Wilton and the southern part of GMAC, including along the Nepean and Cataract rivers. All these areas occur outside the urban capable land and major transport corridors within the nominated areas.

Karst, caves, crevices, cliffs, and other geological features were mapped by:

- Manipulation of a bare earth Digital Elevation Model to produce a layer that showed the mean elevation within a 30 m x 30 m grid surrounding each 1 m elevation grid cell
- Creation of a Topographic Position Index to identify the height of each 1 m cell above/below local mean elevation
- Reclassification of the Topographic Position Index to identify only areas that were high enough above the local mean elevation to create a topographic brake that might support cliffs
- Overlay the cliffs layer with a sandstone geology layer to exclude areas outside sandstone geology

The cliffs layer was validated through inspection of aerial photos and knowledge of the topography and landscape of the nominated areas, as well as site observations during surveys.

24.6.3 NATURE, EXTENT, AND DURATION OF RESIDUAL IMPACTS

AVOIDANCE OF IMPACTS

The steps taken to avoid and minimise impacts of the development in the nominated areas are set out in Chapter 14.

Map 24-1 shows that the areas where karst, caves, crevices, cliffs, and other geological features are most likely to occur have been avoided and do not occur within urban capable land or major transport corridors within the nominated areas.

RESIDUAL IMPACTS

Residual impacts to karst, caves, crevices, and cliffs are unlikely to occur as a result of the urban and industrial development, infrastructure, intensive plant agriculture, or major transport corridors under the Plan within the nominated areas.

24.7 ASSESSMENT OF ROCKY AREAS

24.7.1 LIST OF RELEVANT SPECIES AND TECS

The list of species associated with rocky areas is shown in Table 24-4.

Table 24-4: Species associated with rocky areas

Relevant species	Use and importance of habitat type
Broad-headed Snake	Broad-headed Snake may use rocky areas for refuge. Adults shelter in rocky outcrops under flat sandstone rocks on exposed cliff edges during autumn, winter, and early spring, then move to adjacent native vegetation (woodland communities) within 500 m of rocky areas during late spring and summer. Pregnant females and juveniles remain in rocky habitat, using cooler, shaded rocks and crevices (DoEE, 2018a)
Red-crowned Toadlet	Red-crowned Toadlet may use rocky areas for breeding and refuge and is largely restricted to the immediate vicinity of these areas. Breeding habitat comprises dense vegetation and debris beside ephemeral creeks and gutters (OEH, 2019j). The species deposits eggs in terrestrial nests beneath rocks and logs or in leaf litter (NSW Scientific Committee, 2002). Outside the breeding period, the species disperses to refuge areas close to breeding sites, which comprise rocks and masses of dense vegetation or thick piles of leaf litter generally on sandstone ridges (OEH, 2019j)

24.7.2 OCCURRENCE OF HABITAT OR PRESCRIBED IMPACT TYPE

The potential occurrence of rocky areas in each nominated area is described in Table 24-5.

No obvious rock outcrops were observed during targeted surveys done as part of this project (see Chapter 11). However, some areas were not surveyed due to land access restrictions and rock outcrops have the potential to occur.

Table 24-5: Potential occurrence of rocky areas

Nominated area	Potential occurrence of rocky areas
Wilton	Rocky areas may occur on the edges of the nominated area and in the gully lines where the underlying sandstone is exposed
GMAC	Northern part: Several rocky areas comprising small exposures of shale and lithic sandstone may occur
	Southern part: Rocky areas may occur on the edges of the southern section of the nominated area where the underlying sandstone is exposed. Some exposure may also occur along the main gully lines

Nominated area	Potential occurrence of rocky areas
WSA	Several rocky areas comprising small exposures of shale and lithic sandstone may occur
GPEC	Several rocky areas comprising small exposures of shale and lithic sandstone may occur. In the Eastern Creek area there are possible outcrops of basalt and other igneous intrusion

24.7.3 NATURE, EXTENT, AND DURATION OF RESIDUAL IMPACTS

AVOIDANCE OF IMPACTS

The steps taken to avoid and minimise impacts of the development in the nominated areas are set out in Chapter 14.

The relevant species associated with rocky areas, Broad-headed Snake and Red-crowned Toadlet, are generally associated with rocky areas that occur within native vegetation. Approximately 67.2 per cent of native vegetation, including 95.2 per cent of intact condition native vegetation, has been avoided within the nominated areas (not including excluded land) (see Chapter 14). Furthermore, particularly in Wilton and GMAC, rocky areas are more likely to occur on the edges of the nominated areas and in the gully lines where the underlying sandstone is exposed. These areas are generally steep and unsuitable for urban development and have generally been avoided.

RESIDUAL IMPACTS

The nature, extent, and duration of the residual impacts of the urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on rocky areas are set out in Table 24-6.

Table 24-6: Nature, extent, and duration of residual impacts – rocky areas

Species	Nature	Extent	Duration
Broad-headed Snake Red-crowned Toadlet	**Direct impacts:** Rocky areas utilised by these species generally only occur within areas of native vegetation Direct impacts are therefore addressed through impacts to native vegetation and habitat (see Chapter 23) rather than as a prescribed impact	N/A	N/A
	Indirect impacts: The development has the potential to increase bush rock removal in areas of potential habitat for these species as a result of increased human populations in the nominated areas	Risk is highest in publicly accessible habitat areas within and adjacent to the nominated areas	Long-term

24.7.4 GENERAL MITIGATION MEASURES AND IMPLEMENTATION PROCESSES

The collection of bush rock is regulated in NSW and the Plan does not include measures to manage bush rock removal. The removal of bush rock in national parks and nature reserves, as well as state forests and Crown land reserves, is prohibited. Some councils also regulate bush rock removal in council reserves and other bushland areas (DECC, 2009). Furthermore, Councils or other public authorities prepare management plans for many reserves which typically include measures to control public access within reserves, which may reduce the risk of bush rock removal.

24.7.5 ASSESSMENT OF POTENTIAL IMPACTS

An assessment of the potential prescribed impacts from urban and industrial development, infrastructure, intensive plant agriculture and major transport corridors on rocky areas is set out in Table 24-7.

Table 24-7: Assessment of potential prescribed impacts – rocky areas

Relevant species	Assessment of potential prescribed impacts	Residual risk of impacts?
Broad-headed Snake Red-crowned Toadlet	Impacts are unlikely to cause population decline at a local, regional, or state scale because no recent records for the species occur in the nominated areas or nearby, reducing the risk that the species relies to a notable extent on habitat in the vicinity of the nominated areas The removal of bush rock in many reserves is prohibited and management plans for reserves typically include measures to control public access within reserves, which may also reduce the risk of bush rock removal. These existing arrangements are considered adequate for managing the risk of bush rock removal to these species	Unlikely

24.8 ASSESSMENT OF HUMAN-MADE STRUCTURES

24.8.1 LIST OF RELEVANT SPECIES AND TECS

The list of species associated with human-made structures is shown in Table 24-8.

All relevant species associated with this prescribed impact type are microbat species.

Codes within BioNet records ('observation' and 'microhabitat' codes) were interrogated to identify whether there was data on microbats recorded roosting within the nominated areas (Observation Code 'E'), including under bridges (Microhabitat Code 'BR') or in buildings (Microhabitat Code 'BU').

BioNet records suggest no known roost sites occur for any of the species in the nominated areas except for Southern Myotis within GMAC. The records do not indicate whether these roost sites are associated with human-made structures.

Table 24-8: Species associated with human-made structures

Relevant species	Use and importance of habitat type
Large Bent-winged Bat	The Large Bent-winged Bat mainly roosts in caves with very specific temperature and humidity regimes. The species can also use mines, storm water tunnels, buildings, and other human-made structures. The species disperses widely from breeding colonies (within 300 km) (OEH, 2019e). BioNet records suggest no known roost sites occur in the nominated areas
Eastern False Pipistrelle	Roost requirements for Eastern False Pipistrelle are poorly known. The species is thought to mainly roost in tree hollows, but has also been found under loose bark on trees or in buildings. The species may roost in paddock trees. BioNet records suggest no known roost sites occur in the nominated areas (OEH, 2017c)
Eastern Coastal Free-tailed Bat	Eastern Coastal Free-tailed Bat mainly roosts in tree hollows. It can also roost in human-made structures, including buildings (OEH, 2017d). The species changes breeding sites every few days, making it very difficult to record sites. Occasionally aggregates in large breeding groups (including in buildings). BioNet records suggest no known roost sites occur in the nominated areas
Greater Broad-nosed Bat	Greater Broad-nosed Bat mainly roosts in tree hollows. It can also roost inhuman-made structures, including buildings. Forages along creek and river corridors (OEH, 2017f). BioNet records suggests no known roost sites occur in the nominated areas
Little Bent-winged Bat	Little Bent-winged Bat can roost in the following human-made structures: tunnels, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day. It also roosts in caves and tree hollows. Forages in densely vegetated habitats (OEH, 2019h). BioNet records suggest no known roost sites occur in the nominated areas

Relevant species	Use and importance of habitat type
Southern Myotis	Southern Myotis can roost in the following human-made structures: mine shafts, storm water tunnels, buildings, and under bridges and in culverts. The species also roosts in caves, hollow-bearing trees and dense foliage, and forages over waterbodies within 200 m of roost sites (OEH, 2019l). BioNet records show roost sites have been recorded in GMAC. The records do not indicate whether these roost sites are associated with human-made structures
Yellow-bellied Sheathtail-bat	Yellow-bellied Sheathtail-bat is thought to mainly roost in tree hollows and buildings, and sometimes mammal burrows (OEH, 2017m). BioNet records suggest no known roost sites occur in the nominated areas

24.8.2 OCCURRENCE OF HABITAT OR PRESCRIBED IMPACT TYPE

It was not possible to map the location of human-made structures at the scale of the nominated areas.

Human-made structures such as mine shafts, storm water channels, old or derelict buildings, bridges and culverts may provide suitable habitat for several species and are likely to occur throughout each of the nominated areas.

24.8.3 NATURE, EXTENT, AND DURATION OF RESIDUAL IMPACTS

AVOIDANCE OF IMPACTS

Human-made structures are likely to occur throughout each of the nominated areas and it was not possible to determine avoidance outcomes for human-made structures. The Plan includes several specific mitigation measures that will avoid and minimise impacts to micro-bat species (see Section 24.8.6).

RESIDUAL IMPACTS

The nature, extent, and duration of the residual impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on human-made structures are set out in Table 24-9.

Table 24-9: Nature, extent, and duration of residual impacts – human-made structures

Species	Nature	Extent	Duration
All relevant micro-bat species	**Direct impacts:** Direct impacts may occur due to removal or upgrade of bridges, culverts, stormwater channels, old buildings and other human-made structures that contain roost sites	Human-made structures within urban capable land and major transport corridors in each nominated area	Long-term
	Indirect impacts: Indirect impacts may occur due to disturbance to individuals using human-made structures though physical disturbance, lighting, or noise due to construction activities, or increased presence of human populations	Human-made structures adjacent to urban capable land and major transport corridors in each nominated area	Temporary or long-term

GREEN AND GOLDEN BELL FROG

Note that an area of 5.6 hectares mapped as suitable Green and Golden Bell Frog habitat occurs within an existing urban area of human-made structures comprising buildings and roads in GPEC (near Ropes Creek) and will be directly impacted by urban and industrial development and infrastructure. The area of habitat was mapped based on:

- The locations of known records
- The riparian corridor joining those records
- A buffer of 1,000 m around the riparian corridor and records that could be used by the species for foraging, shelter, breeding and as migratory habitat for dispersal between water bodies and riparian corridors (Lemckert, 2019)

This area occurs within the buffer and is very unlikely to provide notable habitat or connectivity for the species as it currently comprises buildings and roads. As such, the impacts on this area are not considered further.

24.8.4 COMMITMENTS AND GENERAL MITIGATION MEASURES TO ADDRESS IMPACTS

This section identifies commitments in the Plan relating to prescribed impacts and general mitigation measures/development controls that are commonly implemented by planning authorities through the development application process and are relevant to managing prescribed impacts. Specific mitigation measures/development controls that will apply to specific species and TECs in certain locations are identified in Section 24.8.6.

This section also summarises the processes to implement the general and specific mitigation measures/development controls for the different development types under the Plan. These processes are described in detail in Chapter 15.

URBAN AND INDUSTRIAL DEVELOPMENT AND INTENSIVE PLANT AGRICULTURE

The Plan includes a commitment (Commitment 5) to mitigate prescribed impacts from urban and industrial development and intensive plant agriculture on TECs, threatened species and their habitat within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Development Control Plans (DCPs) will be prepared for each nominated area that will include development controls to address prescribed impacts. The development controls in DCPs will be implemented through the standard development application process under the EP&A Act that occurs prior to development proceeding.

The Department has prepared a DCP template that provides model provisions to help ensure mitigation measures identified in the Plan to address prescribed impacts are incorporated into DCPs as development controls and are applied consistently across the nominated areas. The DCP template includes both:

- A common set of controls that apply across the nominated areas and inform general biodiversity protection. These controls are commonly implemented by planning authorities to manage prescribed impacts through the development application process – these are identified in Chapter 15 (Table 15-4 to Table 15-13)
- A specific set of controls that apply to specific species and TECs in certain locations. These controls have been identified through this Assessment Report and are needed to address the residual risks that remain after the common set of controls are applied. These are identified in Appendix E of the Plan and Section 24.8.6 below

The common controls included in the DCP template relevant to managing prescribed impacts on micro-bat species due to the disturbance of human-made structures are:

- Where noise or light impacts from development may affect wildlife, measures to manage impacts should be implemented, such as managing the timing of activities and/or installing appropriate noise barriers
- High-intensity outdoor lighting should be designed to avoid light spill into adjoining natural areas
- Development within 100 m of known microbat colonies must include street lighting that does not attract insects

The specific controls included in the DCP template are identified in Section 24.8.6.

A detailed description of the process to implement these development controls in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

INFRASTRUCTURE AND MAJOR TRANSPORT CORRIDORS

Commitment 5 includes mitigating prescribed impacts of infrastructure within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Commitment 6 requires mitigating prescribed impacts of the major transport corridors in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval for certified major transport corridors
- Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E of the Plan

Both infrastructure and the major transport corridors will be subject to future environmental assessment and approval processes under the EP&A Act based on detailed design at the time the projects are proposed (see Part 2).

The assessment of the prescribed impacts of infrastructure and the major transport corridors due to the disturbance of human-made structures in Section 24.8.5 led to the identification of several mitigation measures to address impacts on micro-bat species. These mitigation measures are identified in Appendix E of the Plan and Section 24.8.6 below.

To ensure implementation of these mitigation measures for infrastructure, the Department will prepare a guideline under clause 228 of the EP&A Regulation – the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development. The infrastructure guideline must be taken into account when public authorities consider the likely impact of infrastructure on the environment under the EP&A Act through the future environmental assessment process. The mitigation measures identified in Section 24.8.6 to address prescribed impacts on micro-bat species due to the disturbance of human-made structures will be incorporated into the infrastructure guideline.

For the major transport corridors, an action under Commitment 5 requires Transport for NSW to:

> *'Implement specific mitigation measures prescribed in Appendix E and identify and implement additional mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the SSI (or equivalent) approval process, as well as best practice guidelines, including the RMS Biodiversity Guidelines'*

This requirement ensures the mitigation measures identified in Section 24.8.6 to address prescribed impacts on micro-bat species due to the disturbance of human-made structures are implemented through or alongside the future environmental assessment process and based on detailed design of the project.

A detailed description of the processes to implement mitigation measures for infrastructure and the major transport corridors in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2 (for infrastructure) and Section 15.6.3 (for the major transport corridors).

24.8.5 ASSESSMENT OF POTENTIAL PRESCRIBED IMPACTS

An assessment of the potential prescribed impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on species associated with human-made structures is set out in Table 24-10.

Table 24-10: Assessment of potential prescribed impacts – human-made structures

Relevant species	Assessment of potential prescribed impacts	Residual risk of impact
Southern Myotis	Impacts may cause population decline at a local scale because: • Known roost sites occur in the nominated areas (within GMAC) • Many records for the species occur in the nominated areas suggesting the nominated areas are an important area for these species Impacts are unlikely to cause population decline at a regional or State scale because: • Records are widespread across the Cumberland subregion and Sydney Basin bioregion, suggesting the nominated areas are not a stronghold for the species • The species is widely distributed across a coastal band (generally within 100 km of the coast) within NSW both north and south of the Cumberland subregion General mitigation measures are likely to reduce but not completely negate the risk that the development may lead to a population decline at a local scale as there is uncertainty about the location of roosting sites within man-made structures within the nominated areas. The Plan includes a species-specific mitigation measure to address this risk	Yes

Relevant species	Assessment of potential prescribed impacts	Residual risk of impact
Large Bent-winged Bat Eastern Coastal Free-tailed Bat	Impacts may cause population decline at a local scale because: • Many records for the species occur in the nominated areas suggesting the nominated areas are an important area for these species • The bats have been found to roost in derelict mines, stormwater tunnels, buildings, and other man-made structures Impacts are unlikely to cause population decline at a regional or State scale because: • Records are widespread across the Cumberland subregion and Sydney Basin bioregion, suggesting the nominated areas are not a stronghold for the species • The species is widely distributed across a coastal band (generally within 100 km of the coast) within NSW both north and south of the Cumberland subregion BioNet records suggest no known roost sites occur in the nominated areas, therefore, the risk of population decline is low at a local scale. The general mitigation measures will reduce the risk to these species further, but there is uncertainty about the importance of human-made structures for microbat species in the subregion. The Plan includes a species-specific mitigation measure to address this risk	Yes
Little Bent-winged Bat Yellow-bellied Sheathtail-bat	Impacts are unlikely to cause population decline at a local, regional, or State scale because: • BioNet records suggest no known roost sites occur in the nominated areas • Few records occur for the species in the nominated areas compared to other parts of the Cumberland subregion and Sydney Basin bioregion, which suggests the species is less reliant on these areas for persistence in the subregion or region While the risk of population decline is low and the general mitigation measures will reduce the risk to these species further, there is uncertainty about the importance of human-made structures for microbat species in the subregion. The Plan includes a species-specific mitigation measure to address this risk	Yes
Eastern False Pipistrelle Greater Broad-nosed Bat	Impacts are unlikely to cause population decline at a local, regional, or State scale because: • BioNet records suggest no known roost sites occur in the nominated areas • Species appears to mainly roost in tree hollows and impacts on human-made structures are therefore unlikely to substantially affect roosting habitat • Few records occur in the nominated areas compared to other parts of the Cumberland subregion and Sydney Basin bioregion, which suggests these species is less reliant on these areas for persistence in the subregion or region While the risk of population decline is low and the general mitigation measures will reduce the risk to these species further, there is uncertainty about the importance of human-made structures for microbat species in the subregion. The Plan includes a species-specific mitigation measure to address this risk	Unlikely

24.8.6 ADDITIONAL SPECIFIC MITIGATION TO ADDRESS RESIDUAL RISKS

Table 24-11 identifies additional specific mitigation measures under Appendix E of the Plan to address residual risks to microbat species due to the development. These mitigation measures are considered to adequately address residual risks in the context of the risk and significance of the impacts of the development on microbat species.

Table 24-11: Specific mitigation measures – human-made structures

Relevant species	Specific mitigation measure	Applicable development	Uncertainty or risks of failure
All relevant microbat species	Undertake pre-construction surveys prior to removal or disturbance (seasonally dependent, before torpor) to human-made structures to ensure any roosting habitat for microbat species including mine shafts, storm water tunnels, old or derelict buildings, bridges and culverts are retained where possible	Urban and industrial development, infrastructure, and intensive plant agriculture	There is a low risk that pre-construction surveys may not accurately identify roosting sites for various reasons (e.g. because they are undertaken at the wrong time of year)
	Incorporate artificial breeding and roosting habitat (e.g. bat boxes, structural cavities) in the design of bridges associated with the major transport corridors in accordance with relevant guidelines or standards	Major transport corridors	While bat boxes are used widely as a conservation measure for micro-bat species, there is some uncertainty about their effectiveness for some species (Smith, 2002; Rueegger *et al.*, 2020)

The specific measures will be implemented in the same way as the general mitigation measures as described above and in detail in Chapter 15, Sections 15.6.1, 15.6.2 and 15.6.3.

24.9 ASSESSMENT OF NON-NATIVE VEGETATION

24.9.1 LIST OF RELEVANT SPECIES AND TECS

The list of species associated with the habitat or prescribed impact type is shown in Table 24-12.

Table 24-12: Species/TECs associated with non-native vegetation

Relevant species/TECs	Use and importance of habitat type
Flora	
Acacia bynoeana	These species can occur in areas of non-native vegetation, such as disturbed or partially cleared land, including roadsides or trail margins. However, they mainly rely on native vegetation as habitat All these species were mapped based on expert reports No areas of suitable habitat were mapped outside native vegetation for: • *Acacia bynoeana* • *Grevillea juniperina* • *Persoonia bargoensis* Very small areas of suitable habitat were mapped within areas of non-native vegetation (within areas mapped as 'urban native/exotic'– see Chapter 19) for the following species: • *Pimelea spicata* • *Hibbertia fumana* • *Hibbertia puberula*
Grevillea juniperina subsp. *juniperina*	
Hibbertia fumana	
Hibbertia puberula	
Persoonia bargoensis	
Pimelea spicata	
Bats	
Grey-headed Flying-fox	The species may roost in non-native vegetation with a dense canopy. While blossom from *Eucalyptus* and related genera form a large part of the species diet, non-native trees can form an important part of the diet in urban areas (OEH, 2018f)
Yellow-bellied Sheathtail-bat	
Greater Broad-nosed Bat	

Relevant species/TECs	Use and importance of habitat type
Little Bent-winged Bat	The species primarily use native vegetation or human-made features for roosting. However, some species may occasionally use crevices in non-native trees or dense non-native vegetation for roosting The species prey, such as small insects, may occur within and rely on non-native vegetation to some extent in some areas
Large Bent-winged Bat	
Eastern Coastal Free-tailed Bat	
Eastern False Pipistrelle	
Marsupials	
Spotted-tailed Quoll	The species may use non-native vegetation along waterways for dispersal between areas of suitable habitat. Non-native vegetation may benefit the species by increasing protective vegetation cover along the waterways
Frogs	
Green and Golden Bell Frog	The species may occur in disturbed areas, including non-native vegetation. Habitat comprises water bodies and associated terrestrial habitats with grassy areas and low native or non-native vegetation (DEWHA, 2009c; Lemckert, 2019). The species may use non-native vegetation to disperse between habitat sites Suitable habitat for the Green and Golden Bell Frog that may contain the species has been mapped around St Mary's in GPEC. The area of suitable habitat covers: • The locations of known records • The riparian corridor joining those records • A buffer of 1,000 m around the riparian corridor and records that could be used by the species for foraging, shelter, breeding and as migratory habitat as individuals move between water bodies and riparian corridors (Lemckert, 2019)
Birds	
Dusky Woodswallow	The species occurs primarily in native vegetation (mainly open eucalypt forests and woodland). However, the species may also occur in farmland, usually at the edges of forest or woodland. The species may use deciduous trees for perching
Painted Honeyeater	The species primarily occurs in woodlands and forages on the fruits of mistletoes growing on eucalypts and acacias. The species may forage on planted Silky-Oaks
Little Eagle	The species' prey, such as mammals, may occur within and rely on non-native vegetation to some extent, particularly in the vicinity of urban areas
Square-tailed Kite	
Barking Owl	
Powerful Owl	
Masked Owl	

24.9.2 OCCURRENCE OF HABITAT OR PRESCRIBED IMPACT TYPE

Non-native vegetation was mapped as part of the native vegetation mapping for the nominated areas and is defined as:

> *Vegetation that is not consistent with floristic composition and landscape positions for native plant community types as defined by the NSW BioNet Vegetation Classification system; most common communities comprise of very few native species or consist of an assorted mix of planted native or exotic trees*

Non-native vegetation occurs within urban capable land in all nominated areas. The location of non-native vegetation within the nominated areas is shown in Map 24-2.

24.9.3 NATURE, EXTENT, AND DURATION OF RESIDUAL IMPACTS

AVOIDANCE OF IMPACTS

The steps taken to avoid and minimise impacts of the development in the nominated areas are set out in Chapter 14.

Avoidance was undertaken in accordance with a set of avoidance criteria (see Box 1, Chapter 14). The criteria included prioritising the avoidance of known habitat for species as indicated by BioNet records or surveys undertaken for the project, including any relevant areas of non-native vegetation where species records occur.

Only very small amounts of non-native vegetation comprising suitable habitat for flora species associated with non-native vegetation will be impacted (see Table 24-13). While large areas of non-native vegetation will be impacted that may affect several bats and bird species, these species are generally more reliant on native vegetation, which was appropriately the focus of avoidance effort. Furthermore, while Grey-headed flying Fox may roost in non-native vegetation and non-native trees can form an important part of the diet for this species in urban areas, avoidance outcomes for this species in relation to non-native vegetation are considered adequate as:

- There are no known Grey-headed Flying Fox camps in the urban capable land
- The species is highly mobile, feeds on fruit and nectar from a variety of vegetation communities, and has access to large areas of intact vegetation surrounding the Plan area
- Substantial areas of native and non-native vegetation will be established in open space areas and along major and residential roads as part of the urban development under the Plan

RESIDUAL IMPACTS

The nature, extent, and duration of the residual impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on non-native vegetation are set out in Table 24-13.

Table 24-13: Nature, extent, and duration of residual impacts – non-native vegetation

Species/TEC	Nature	Extent	Duration

Flora	**Direct impacts:**
	Direct impacts will occur to suitable habitat within non-native vegetation for the following species:
	• *Pimelea spicata*
	• *Hibbertia fumana*
	• *Hibbertia puberula*
	Suitable habitat for the other flora species generally occurs within areas of native vegetation and direct impacts for these species are therefore addressed through impacts to native vegetation and habitat (see Chapter 23)
		Following impacts occur across the nominated areas:
		• *Pimelea spicata*
		  ○ Wilton – 0.6 ha
		  ○ Greater Macarthur – 4.96 ha
		  ○ WSAGA – 2.25 ha
		  ○ GPEC – 0.34 ha
		• *Hibbertia fumana*
		  ○ Wilton – 0.06 ha
		  ○ WSAGA – 1.05 ha
		• *Hibbertia puberula*
		  ○ Wilton – 0.06 ha
		  ○ WSAGA – 1.05 ha
			Long-term

	Indirect impacts: The development may cause a range of indirect impacts to suitable habitat within non-native vegetation for these flora species. Key risks are weed invasion, rubbish dumping, and increased risk of fire	Non-native vegetation adjacent to urban capable lands in each nominated area	Temporary or long-term
Bats	**Direct impacts:** The development may directly impact areas of non-native vegetation that provide foraging habitat for Grey-headed Flying-fox and potential roosting habitat for some microbat species. There are no known Grey-headed Flying-fox camps in the urban capable land	Non-native vegetation within urban capable lands in each nominated area	Temporary or long-term

Species/TEC	Nature	Extent	Duration
	Indirect impacts: There may be a decrease in the abundance of prey for some microbat species due to direct impacts on non-native vegetation potentially impacting prey habitat	Non-native vegetation adjacent to urban capable lands in each nominated area	Temporary or long-term
Marsupials	**Direct impacts:** N/A	N/A	N/A
	Indirect impacts: Removal of non-native vegetation along waterways may reduce vegetation cover that facilitates dispersal of the Spotted-tailed Quoll between areas of suitable habitat	Non-native vegetation within riparian corridors	Temporary or long-term
Green and Golden Bell Frog	**Direct impacts:** The development will directly impact a small amount of non-native vegetation within suitable habitat for this species	0.06 ha in the St Mary's area in GPEC	Long-term
	Indirect impacts: The development may cause a range of indirect impacts to suitable habitat within non-native vegetation for Green and Golden Bell Frog. Key risks are weed invasion, rubbish dumping, and increased risk of fire	Adjacent to urban capable land in the St Mary's area in GPEC	Temporary or long-term
Birds	**Direct impacts:** Direct impacts may occur to non-native vegetation used by Dusky Woodswallow and Painted honeyeater for perching or foraging	Within urban capable land in each nominated area	Long-term
	Indirect impacts: There may be a decrease in the abundance of prey for some bird species due to direct impacts on non-native vegetation potentially impacting prey habitat	Within and adjacent to urban capable land in each nominated area	Temporary or long-term

24.9.4 COMMITMENTS AND GENERAL MITIGATION MEASURES TO ADDRESS IMPACTS

This section identifies commitments in the Plan relating to prescribed impacts and general mitigation measures/development controls that are commonly implemented by planning authorities through the development application process and are relevant to managing prescribed impacts. Specific mitigation measures/development controls that will apply to specific species and TECs in certain locations are identified in Section 24.9.6.

This section also summarises the processes to implement the general and specific mitigation measures/development controls for the different development types under the Plan. These processes are described in detail in Chapter 15.

URBAN AND INDUSTRIAL DEVELOPMENT AND INTENSIVE PLANT AGRICULTURE

The Plan includes a commitment (Commitment 5) to mitigate prescribed impacts from urban and industrial development and intensive plant agriculture on TECs, threatened species and their habitat within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Development Control Plans (DCPs) will be prepared for each nominated area that will include development controls to address prescribed impacts. The development controls in DCPs will be implemented through the standard development application process under the EP&A Act that occurs prior to development proceeding.

The Department has prepared a DCP template that provides model provisions to help ensure mitigation measures identified in the Plan to address prescribed impacts are incorporated into DCPs as development controls and are applied consistently across the nominated areas. The DCP template includes both:

- A common set of controls that apply across the nominated areas and inform general biodiversity protection. These controls are commonly implemented by planning authorities to manage prescribed impacts through the development application process – these are identified in Chapter 15 (Table 15-4 to Table 15-13)
- A specific set of controls that apply to specific species and TECs in certain locations. These controls have been identified through this Assessment Report and are needed to address the residual risks that remain after the common set of controls are applied. These are identified in Appendix E of the Plan and Section 24.9.6 below

The common controls included in the DCP template relevant to managing prescribed impacts on species associated with non-native vegetation are:

- Manage water cycles and water quality (relevant to Green and Golden Bell Frog)
- Protect riparian corridors (relevant to Spotted-tailed Quoll)
- Control the spread of weeds (relevant to several species above)
- Ensure native trees are planted in open space areas and along major and residential roads as part of the design of new residential areas (relevant to Grey-headed Flying-fox, micro-bat species and birds)

The specific controls included in the DCP template are discussed in Section 24.9.6.

A detailed description of the process to implement these development controls in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

INFRASTRUCTURE AND MAJOR TRANSPORT CORRIDORS

Commitment 5 includes mitigating prescribed impacts of infrastructure within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Commitment 6 requires mitigating prescribed impacts of the major transport corridors in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval for certified major transport corridors
- Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E of the Plan

Both infrastructure and the major transport corridors will be subject to future environmental assessment and approval processes under the EP&A Act based on detailed design at the time the projects are proposed (see Part 2).

The assessment of the prescribed impacts of infrastructure and the major transport corridors on species associated with non-native vegetation in Section 24.9.5 led to the identification of several mitigation measures to address impacts on Grey-headed Flying-foxes. These mitigation measures are identified in Appendix E of the Plan and Section 24.9.6 below.

To ensure implementation of these mitigation measures for infrastructure, the Department will prepare a guideline under clause 228 of the EP&A Regulation – the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development. The infrastructure guideline must be taken into account when public authorities consider the likely impact of infrastructure on the environment under the EP&A Act through the future environmental assessment process. The mitigation measures identified in Section 24.9.6 to address prescribed impacts on species associated with non-native vegetation will be incorporated into the infrastructure guideline.

For the major transport corridors, an action under Commitment 5 requires Transport for NSW to:

> *'Implement specific mitigation measures prescribed in Appendix E and identify and implement additional mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the SSI (or equivalent) approval process, as well as best practice guidelines, including the RMS Biodiversity Guidelines'*

This requirement ensures the mitigation measures identified in Section 24.9.6 to address prescribed impacts on species associated with non-native vegetation are implemented through or alongside the future environmental assessment process and based on detailed design of the project.

A detailed description of the processes to implement mitigation measures for infrastructure and the major transport corridors in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2 (for infrastructure) and Section 15.6.3 (for the major transport corridors).

24.9.5 ASSESSMENT OF POTENTIAL PRESCRIBED IMPACTS

An assessment of the potential prescribed impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on species associated with non-native vegetation is set out in Table 24-14.

Table 24-14: Assessment of potential prescribed impacts – non-native vegetation

Relevant species/ TECs	Assessment of potential prescribed impacts	Residual risk of impacts?
Flora	Impacts are unlikely to cause population decline at a local, regional, or State scale because: • These species mainly rely on native vegetation as habitat • Only very small areas of potential habitat within non-native vegetation will be impacted for *Pimelea spicata*, *Hibbertia fumana* and *Hibbertia puberula* relative to areas of unimpacted habitat within native vegetation. The 8.1 ha of impact to *Pimelea spicata* occur as a high number of small areas across all nominated areas	Unlikely
Bats	Impacts are unlikely to cause population decline for micro-bat species at a local, regional, or State scale because: • These species mainly use caves, crevices, human-made structures, or tree hollows within native vegetation for roosting • Substantial areas of native and non-native vegetation will be established in open space areas and along major and residential roads, which is likely to negate any low risk of indirect impacts through reduced prey abundance There is a low risk that impacts may cause population decline for Grey-headed Flying-fox at a local scale due to impacts on foraging habitat. Impacts are unlikely to cause population decline for Grey-headed Flying Fox at a regional or State scale because: • There are no known Grey-headed Flying Fox camps in the urban capable land • The species is highly mobile, feeds on fruit and nectar from a variety of vegetation communities, and has access to large areas of intact vegetation surrounding the Plan area • Substantial areas of native and non-native vegetation will be established in open space areas and along major and residential roads as part of the urban development under the Plan The Plan includes a species-specific mitigation measure to address this risk	Yes for Grey-headed Flying-fox

Marsupials	Impacts are unlikely to cause population decline for Spotted-tail Quoll at a local, regional, or State scale because:
	• Urban capable lands have avoided riparian corridors consistent with the *Water Management Act 2000* along waterways, comprising:
	  ○ Strahler stream order 2 - buffer 20 m either side
	  ○ Strahler stream order 3 - buffer 30 m either side
	  ○ Strahler stream order 4 and above - buffer 40 m either side
	• Development controls will be put in place to protect riparian corridors
		Unlikely

Relevant species/ TECs	Assessment of potential prescribed impacts	Residual risk of impacts?
Green and Golden Bell Frog	Impacts are unlikely to cause population decline for Green and Golden Bell Frog at a local, regional, or State scale because only very small areas of potential habitat within non-native vegetation will be impacted. Furthermore, this impact occurs towards the edge of suitable habitat and distant from the riparian corridor of Ropes Creek and is therefore unlikely to significantly contribute to further fragmentation of areas of suitable habitat. Furthermore, recent targeted surveys along Ropes Creek did not detect the species at this location (see Supporting Document I)	Unlikely
Birds	Impacts are unlikely to cause population decline for these species at a local, regional, or State scale because: • These species mainly rely on native vegetation as habitat • Only small areas of potential habitat within non-native vegetation will be impacted for these species relative to areas of unimpacted habitat within native vegetation • Substantial areas of native and non-native vegetation will be established in open space areas and along major and residential roads	Unlikely

24.9.6 ADDITIONAL SPECIFIC MITIGATION TO ADDRESS RESIDUAL RISKS

Table 24-15 identifies additional specific mitigation measures under Appendix E of the Plan to address residual risks to Grey-headed Flying-fox due to the development (these measures will also benefit several other species above, including birds and microbats). These mitigation measures are considered to adequately address residual risks in the context of the risk and significance of the impacts of the development on this species.

Table 24-15: Specific mitigation measures – non-native vegetation

Relevant species	Specific mitigation measure	Applicable development	Uncertainty or risks of failure
Grey-headed Flying-fox	Establish minimum setbacks for urban development around flying fox camps	Urban and industrial development, infrastructure, and intensive plant agriculture	Setbacks are a well-established mitigation measure for camps
	Retain large trees (including dead trees) (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction		Large trees generally provide the greatest sources of nectar, which is the primary food for the species

The specific measures will be implemented in the same way as the general mitigation measures as described above and in detail in Chapter 15, Sections 15.6.1 and 15.6.2.

24.10 ASSESSMENT OF HABITAT CONNECTIVITY AND MOVEMENT

Habitat connectivity refers to the degree of connectedness of areas of habitat. Habitat connectivity can include:

- Corridors of vegetation linking other areas of habitat
- Isolated patches of habitat that provide 'stepping stones' between other areas of habitat
- Habitat features (such as large trees with hollows) scattered within areas of non-habitat (e.g. urban land) that provide habtiat connectivity between intact areas of habitat

The urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors have the potential to lead to changes and disruption to habitat connectivity. Potential habitat connectivity impacts could occur in all four nominated areas.

BIO MAP

The Biodiversity Investment Opportunities Map (BIO Map) is a key deliverable of the NSW Government's $40 million Green Corridors program. The BIO Map project aimed to achieve better biodiversity outcomes by directing biodiversity investment funding to the strategic locations of greatest benefit.

The BIO Map for the Cumberland subregion covers an area of 275,693 ha, including the Cumberland Plain. Mapping criteria were used to identify and map Priority Investment Areas (PIAs). The PIAs comprise of a network of 87 core areas and 27 regional biodiversity corridors within the Cumberland subregion. The 87 core areas include all of the priority conservation lands identified by the Cumberland Plain Recovery Plan (DECCW, 2011).

The total area represented within the mapped PIAs is 42,124 ha. This represents approximately 15 per cent of the Cumberland subregion or approximately 61 per cent of all mapped vegetation within the subregion.

BIO Map identifies PIAs where the protection and management of native vegetation is likely to maximise benefits to biodiversity within the Cumberland subregion. The PIAs comprise:

- BIO Map core areas: large areas of native vegetation and habitat where management will be of greatest benefit to the conservation of biodiversity values. These areas represent the habitat in the subregion most likely to support species persistence and interactions between species and landscape scale ecological processes
- BIO Map regional corridors: linear areas that link core areas and play a crucial role in maintaining connections between species populations that would otherwise be isolated and at greater risk of local extinction

24.10.1 LIST OF RELEVANT SPECIES AND TECS

Habitat connectivity is relevant to all species to some extent for:

- Movement across home ranges/dispersal between areas of suitable habitat
- Breeding or reproduction
- Foraging
- Other important life cycle events

Species reliant on habitat connectivity have been categorised into five groups:

- Fauna more likely to need large habitat corridors and/or large areas of intact native vegetation
- Fauna able to utilise narrower habitat corridors or riparian corridors or waterways
- Fauna able to utilise scattered and/or degraded patches of native vegetation within an urban or agricultural matrix
- Fauna that are relatively immobile and move only short distances
- TECs that rely on habitat connectivity for effective airborne pollination and the movement of pollinators

Table 24-16 shows the groupings for species predicted to occur in the nominated areas.

Table 24-16: Species/TECs associated with areas of habitat connectivity

Group	Relevant species/TECs	Use and importance of habitat type
Large habitat corridors and/or large areas of intact native vegetation	• Koala Most gliders and owls and some birds: • Large-eared Pied Bat • Squirrel Glider • Yellow-bellied Glider • Masked Owl • Barking Owl • Powerful Owl • Gang-gang Cockatoo • Glossy Black Cockatoo	May use large habitat corridors for dispersal between larger patches of suitable habitat, including breeding areas, as well as for foraging

Group	Relevant species/TECs	Use and importance of habitat type
	• Regent Honeyeater • Black-chinned Honeyeater • Brown Treecreeper	
	Raptors: • White-bellied Sea-Eagle • Little Eagle • Square-tailed Kite	
Smaller habitat corridors or riparian corridors or waterways	Smaller marsupials: • Eastern Pygmy-possum • Spotted-tailed Quoll	May use smaller habitat corridors for dispersal between larger patches of suitable habitat, including breeding areas, as well as for foraging Spotted-tailed Quoll relies on habitat connectivity to breed as quolls are solitary and come together to breed
	Birds associated with riparian corridors and/or waterways, including: • Australasian Bittern • Freckled Duck • Comb-crested Jacana • Black Bittern • White-fronted Chat • Eastern Osprey • Curlew Sandpiper • Broad-billed Sandpiper • Black-tailed Godwit	Water birds use waterways and riparian corridors and associated vegetation for shelter, foraging, as well as dispersal between other areas of suitable habitat
Scattered and/or degraded native vegetation within a matrix	• Grey-headed Flying-fox Microbats: • Southern Myotis • Little Bent-winged Bat • Large Bent-winged Bat • Eastern Freetail-bat • Eastern False Pipistrelle • Yellow-bellied Sheathtail-bat	Microbats and birds may use scattered native vegetation for roosting or resting, to move within areas of foraging habitat, or to access other larger areas of suitable habitat for foraging
	Birds: • Dusky Woodswallow • Spotted Harrier • Little Lorikeet • Diamond Firetail • Swift Parrot • Turquoise Parrot • Varied Sittella • Painted Honeyeater	
	• Green and Golden Bell Frog	While the species appears to generally be associated with a single water body for general activities, it is highly mobile and can move some distance as part of migrations to and from breeding sites (Lemckert,

Group	Relevant species/TECs	Use and importance of habitat type
		2019). Movements of up to 5 km may be common and the species may disperse up to 10 km (DoEE, 2018a)
Relatively immobile and moves only short distances	• Cumberland Plain Land Snail • Red-crowned Toadlet	Little is known about Cumberland Plain Land Snail dispersal patterns or over what distances individuals can move (OEH, 2019c). Most populations are small and isolated. The NSW SoS program identifies several actions to ensure connectivity between population, including implementing 'open structure design' when designing structures such as roads which may isolate patches of habitat (EES, 2020) Red-crowned Toadlets are a localised species that are largely restricted to the immediate vicinity of suitable breeding habitat. The species is usually found as small discrete scattered populations along sandstone ridges
TECs	• All TECs	TECs rely on habitat connectivity for effective airborne pollination and the movement of pollinators

24.10.2 OCCURRENCE OF HABITAT OR PRESCRIBED IMPACT TYPE

Key areas of habitat connectivity in the nominated areas are shown in Map 24-3 and described in Table 24-17.

Habitat connectivity was mapped by:

- Identifying BIO Map regional corridors and core areas. These corridors/core areas are likely to be the most important areas of habitat connectivity in the nominated areas for most species. EES had only identified BIO Map corridors within the boundaries of the Cumberland subregion. To undertake the mapping for the small parts of the nominated areas outside the Cumberland subregion the Priority Conservation Lands layer (DECCW, 2010) (EES used this layer as basis for BIO Map) or the native vegetation map (see Chapter 19) was used to extend the BIO Map corridor mapping
- Identifying local corridors using the native vegetation mapping to identify connected patches of native vegetation. This was done visually in GIS, with only contiguous patches identified as being connected
- Identify any remaining native vegetation not within a regional corridor or local corridor as:
    - Connected – within 100 m of another patch of woody vegetation
    - Isolated – greater than 100 m from another patch of woody vegetation

The categories of habitat connectivity identified in Map 24-3 are:

- BIO Map corridors, categorised as either
    - BIO Map Regional Corridor / BIO Map Regional Corridor and Core Area
    - BIO Map Regional Corridor - extended to match PCLs
    - BIO Map Regional Corridor - extended to match vegetation
- Local corridor
- Connected vegetation
- Isolated vegetation

Table 24-17: Key areas of habitat connectivity in the nominated areas

Nominated area	BIO Map regional corridors/core areas	Local corridors	Connected and isolated vegetation
Wilton	Occur around the edges of the entire nominated area and across the middle of the northern part of the nominated area associated with the Nepean River and the middle of the southern part of the nominated area	One large corridor occurs on the eastern side of the nominated area between the Hume Motorway and Wilton Road connected to the BIO Map regional corridors/core areas to the east of the nominated area. The corridor is a 'dead end' and does not connect to other native vegetation to the south or west of the nominated area Primary and tertiary Koala corridors occur in Wilton	Connected vegetation occurs in scattered areas mainly towards the edges of the nominated area adjacent to BIO Map regional corridors/core areas Isolated vegetation occurs in only a few very small patches in the middle parts of the nominated area
GMAC	Occur around the edges of the entire southern part of the nominated area and across the middle of the southern part in three locations associated with waterways. The corridors/core areas connect native vegetation associated with the Cataract River to the west of the nominated area with large areas of native vegetation to the east of the nominated area	One corridor occurs across the middle of the southern part of the nominated area associated with a waterway. The corridor connects regional corridors/core areas to the east and north within the nominated area with native vegetation to the west of the nominated area Primary, secondary and tertiary Koala corridors occur in GMAC. There are several east-west corridors which provide crucial linkages between the Nepean River and Georges River habitat corridors	Connected vegetation occurs in scattered areas across the nominated area mainly in the southern part Isolated vegetation occurs in only a few very small patches in the middle parts of the nominated area
WSA	Occur in the eastern part of the nominated area associated with Wianamatta (South Creek) and Kemps Creek. A regional corridor/core area connects Wianamatta (South Creek) and Kemps Creek in the south-eastern corner of the nominated area in the Kemps Creek area	Two corridors occur in the middle part of the nominated area associated with Badgerys Creek and Cosgrove Creek. The Cosgrove Creek corridor is a 'dead end' and does not connect to other native vegetation. The Badgerys Creek corridor continues outside the nominated area as a narrow strip of native vegetation	Connected vegetation occurs in scattered areas mainly in the middle and north-eastern part of the nominated area Isolated vegetation occurs in only a few very small patches in the middle parts of the nominated area
GPEC	Occur in the northern part of the nominated area around Wianamatta Regional Park and the southern part around Orchard Hills. Two corridors connect Wianamatta Regional Park and Orchard Hills associated with Wianamatta (South Creek) and	No corridors occur within the nominated area	Connected vegetation occurs in scattered areas across the nominated area Isolated vegetation occurs in a few very small patches across the nominated area

	Ropes Creek. A third corridor connects native vegetation at Orchard Hills to native vegetation to the west of the nominated area near Mulgoa Road along a drainage line		

24.10.3 NATURE, EXTENT, AND DURATION OF RESIDUAL IMPACTS

AVOIDANCE OF IMPACTS

The steps taken to avoid and minimise impacts of the development in the nominated areas are set out in Chapter 14.

Avoidance of impacts in each of the nominated areas is discussed below.

Wilton

The vast majority of BIO Map regional corridors/core areas have been avoided in Wilton. Koala was specifically identified in the avoidance criteria as a priority throughout the project. Following public exhibition, more land was avoided along the Nepean River in Wilton to protect the integrity and functionality of the Koala corridor along the river, and to ensure that the corridor is an average of 390-425 m wide (as recommended by the Office of the NSW Chief Scientist & Engineer).

GMAC

The vast majority of BIO Map regional corridors/core areas have been avoided in GMAC. Koala was specifically identified in the avoidance criteria as a priority throughout the project. Following public exhibition, more land was avoided along the Nepean River and Menangle Creek in GMAC to protect the integrity and functionality of the Koala corridors in these areas, and to ensure that the corridors are an average of 390-425 m wide (as recommended by the Office of the NSW Chief Scientist & Engineer).

WSA

The vast majority of BIO Map regional corridors/core areas have been avoided in WSA.

GPEC

The vast majority of BIO Map regional corridors/core areas have been avoided in GPEC.

RESIDUAL IMPACTS

The nature, extent, and duration of the residual impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on habitat connectivity are set out in Table 24-18.

Table 24-18: Nature, extent, and duration of residual impacts – habitat connectivity

Nominated area	Nature	Extent	Duration
Wilton	**Direct impacts:** The main direct impact occurs in the southern part of the nominated area where the development will remove part of a corridor/core area that connects native vegetation either side of the nominated area in this location. The impact reduces the width of the corridor/core area by about half. Connectivity is maintained to the south and east of the impacted area. In all other areas, direct impacts occur only to the edges of corridors/core areas in a few locations and connectivity along these areas is maintained There are very minor direct impacts to the local corridor on the eastern side of the nominated area between the Hume Motorway and Wilton Road The majority of impacts to connected vegetation occur to smaller scattered patches in the middle of the nominated area and to the edge of larger areas of connected vegetation where it occurs adjacent to BIO Map regional corridors/core areas around the nominated area	**Direct impacts:** The following approximate amounts of each category of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 70 ha (6.7%) • Local corridor – 6.5 ha (3.3%) • Connected vegetation – 125.9 ha (23.2%) • Isolated vegetation – 1 ha (45.5%)	Long-term
	Indirect impacts: The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance	**Indirect impacts:** Areas of habitat connectivity adjacent to urban capable lands/transport corridors	Temporary or long-term
GMAC	**Direct impacts:** Direct impacts occur only to the edges of corridors/core areas in a few locations. There are no locations where direct impacts completely sever or significantly narrow a core area/corridor and connectivity is maintained for these areas of habitat connectivity across all parts of the nominated area The vast majority of the local corridor in the middle of the southern part of the nominated area has been avoided and is not directly impacted. Impacts occur only to the edges of the corridor and connectivity is maintained in this location across the nominated area The majority of impacts to connected vegetation occur to smaller scattered patches, where patches will be completely cleared. Impacts also occur to the edges of several larger areas of connected vegetation in the southern part of the nominated area. In these cases, the size of the patches will be reduced, but the impacts will not generally sever connectivity between this connected vegetation and other areas of native vegetation, such as BIO Map corridors/core areas	**Direct impacts:** The following approximate amounts of each category of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 60.7 ha (2.9%) • Local corridor – 20.2 ha (12.8%) • Connected vegetation – 189.6 ha (18.9%) • Isolated vegetation – 1.4 ha (11.8%)	Long-term
	Indirect impacts:	**Indirect impacts:**	Temporary or long-term

Nominated area	Nature	Extent	Duration
	The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance Further, connectivity will be disrupted for two east-west corridors which link the Nepean and Georges River through GMAC through installation of Koala exclusion fencing. The purpose of this is to exclude Koalas from corridors which are too narrow and may pose dangers to the species. As habitat within these corridors will be avoided by development and protected for other biodiversity and amenity values, fencing of these corridors is considered an indirect impact as opposed to a direct impact	Areas of habitat connectivity adjacent to urban capable lands/transport corridors, in addition to two east-west corridors through GMAC which provide linkages between the Georges River and Nepean River	
WSA	**Direct impacts:** The vast majority of BIO Map regional corridors/core areas have been avoided and will not be directly impacted. The main direct impact occurs in the south-eastern part of the nominated area where the development will remove the majority of a corridor/core area that connects Wianamatta (South Creek) and Kemps Creek in the Kemps Creek area. While this area is identified as a regional corridor, connectively has already been completely severed in this location by existing industrial land use. In all other areas, direct impacts occur only to the edges of corridors/core areas in a few locations and connectivity along these areas is maintained The majority of local corridors have been avoided and will not be directly impacted. Direct impacts occur: • At Cosgrove Creek in the middle part of the nominated area where the OSO severs the riparian corridor in two locations • At Badgerys Creek in the middle part of the nominated area where the OSO severs the riparian corridor in one location The majority of impacts to connected vegetation occur to smaller scattered patches, where patches will be completely cleared. Impacts also occur to the edges of several larger areas of connected vegetation in the north-eastern, middle, and southern parts of the nominated area. In some cases, the impacts will sever or reduce connectivity between this connected vegetation and other areas of connected vegetation within and outside the nominated area	**Direct impacts:** The following approximate amounts of each category of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 52.4 ha (16.5%) • Local corridor – 39.2 ha (31.6%) • Connected vegetation – 309.8 ha (55.9%) • Isolated vegetation – 10.2 ha (63.7%)	Long-term
	Indirect impacts: The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance	**Indirect impacts:** Areas of habitat connectivity adjacent to urban capable lands/transport corridors	Temporary or long-term

Nominated area	Nature	Extent	Duration
GPEC	**Direct impacts:** The majority of BIO Map regional corridors/core areas have been avoided and will not be directly impacted. The main direct impacts occur: • Within Wianamatta Regional Park where the OSO severs the eastern part of the regional park that is connected to Ropes Creek with the western part of the park • Along Wianamatta (South Creek) where the OSO directly impacts the Wianamatta (South Creek) riparian corridor and severs the narrow connection along the corridor that links Wianamatta Regional Park and Orchard Hills In all other areas direct impacts have been avoided, except in the western part of the nominated area near Glenmore Park where there is a small direct impact to the edge of a corridor/core area No local corridors occur within the nominated area The majority of impacts to connected vegetation occur to smaller scattered patches, where patches will be completely cleared. Impacts also occur to the edges of several larger areas of connected vegetation in some parts of the nominated area. In these cases, the size of the patches will be reduced, but the impacts will not generally sever connectivity between this connected vegetation and other areas of native vegetation, such as BIO Map corridors/core areas	**Direct impacts:** The following categories of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 189.7 ha (5.8%) • Local corridor – 0 ha (0%) • Connected vegetation – 194 ha (17.5%) • Isolated vegetation – 0.5 ha (5.9%)	Long-term
	Indirect impacts: The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance	**Indirect impacts:** Areas of habitat connectivity adjacent to urban capable lands/transport corridors	Temporary or long-term

24.10.4 COMMITMENTS AND GENERAL MITIGATION MEASURES TO ADDRESS IMPACTS

This section identifies commitments in the Plan relating to prescribed impacts and general mitigation measures/development controls that are commonly implemented by planning authorities through the development application process and are relevant to managing prescribed impacts. Specific mitigation measures/development controls that will apply to specific species and TECs in certain locations are identified in Section 24.10.6.

This section also summarises the processes to implement the general and specific mitigation measures/development controls for the different development types under the Plan. These processes are described in detail in Chapter 15.

URBAN AND INDUSTRIAL DEVELOPMENT AND INTENSIVE PLANT AGRICULTURE

The Plan includes a commitment (Commitment 5) to mitigate prescribed impacts from urban and industrial development and intensive plant agriculture on TECs, threatened species and their habitat within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Development Control Plans (DCPs) will be prepared for each nominated area that will include development controls to address prescribed impacts. The development controls in DCPs will be implemented through the standard development application process under the EP&A Act that occurs prior to development proceeding.

The Department has prepared a DCP template that provides model provisions to help ensure mitigation measures identified in the Plan to address prescribed impacts are incorporated into DCPs as development controls and are applied consistently across the nominated areas. The DCP template includes both:

- A common set of controls that apply across the nominated areas and inform general biodiversity protection. These controls are commonly implemented by planning authorities to manage prescribed impacts through the development application process – these are identified in Chapter 15 (Table 15-4 to Table 15-13)
- A specific set of controls that apply to specific species and TECs in certain locations. These controls have been identified through this Assessment Report and are needed to address the residual risks that remain after the common set of controls are applied. These are identified in Appendix E of the Plan and Section 24.10.6 below

The common controls included in the DCP template relevant to managing prescribed impacts associated with habitat connectivity are:

- Maintain waterways of Strahler order 2 or higher in a natural state, including riparian corridors
- Design road crossings of waterways to minimise impacts to vegetated riparian corridors and species movements
- Retain large trees (including dead trees) (≥50cm DBH) during precinct planning where possible
- Retain areas of high density proteaceae shrubs where possible, particularly along riparian corridors
- Plant native trees in open space areas and along major and residential roads as part of the design of new residential areas (particularly relevant to Grey-headed Flying-fox, micro-bat species and birds)
- A range of controls that would mitigate indirect impacts on habitat that forms part of habitat corridors, including water cycle management and water quality and the spread of weeds

The specific controls included in the DCP template are discussed in Section 24.10.6.

A detailed description of the process to implement these development controls in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, section 15.6.1.

It is also important to note that the conservation program under the Plan (see Part 2) will result in:

- Protecting a minimum of 5,325 hectares of native vegetation and habitat in the subregion (Commitment 8)
- Undertake ecological restoration of up to 25 per cent of the offset target for native vegetation (Commitment 13)
- Managing landscape threats in strategic locations to improve habitat values, including weeds (Commitment 15) and pests (Commitment 16) and fire (Commitment 17)

Importantly, the strategic conservation areas (SCAs) where these commitments will be delivered represent the areas in the Cumberland subregion that are considered most likely to be viable in the long-term and to maximise ecological function and connectivity across the landscape. In determining the location of the SCAs, priority was given to including the largest, best condition and best-connected areas of native vegetation remaining in the subregion (see Part 2).

INFRASTRUCTURE AND MAJOR TRANSPORT CORRIDORS

Commitment 5 includes mitigating prescribed impacts of infrastructure within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Commitment 6 requires mitigating prescribed impacts of the major transport corridors in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval for certified major transport corridors
- Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E of the Plan

Both infrastructure and the major transport corridors will be subject to future environmental assessment and approval processes under the EP&A Act based on detailed design at the time the projects are proposed (see Part 2).

The assessment of the prescribed impacts of infrastructure and the major transport corridors associated with habitat connectivity in Section 24.10.5 led to the identification of several mitigation measures. These mitigation measures are identified in Appendix E of the Plan and Section 24.10.6 below.

To ensure implementation of these mitigation measures for infrastructure, the Department will prepare a guideline under clause 228 of the EP&A Regulation – the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development. The infrastructure guideline must be taken into account when public authorities consider the likely impact of infrastructure on the environment under the EP&A Act through the future environmental assessment process. The mitigation measures identified in Section 24.10.6 to address prescribed impacts associated with habitat connectivity will be incorporated into the infrastructure guideline.

For the major transport corridors, an action under Commitment 5 requires Transport for NSW to:

> *'Implement specific mitigation measures prescribed in Appendix E and identify and implement additional mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the SSI (or equivalent) approval process, as well as best practice guidelines, including the RMS Biodiversity Guidelines'*

This requirement ensures the mitigation measures identified in Section 24.10.6 to address prescribed impacts associated with habitat connectivity are implemented through or alongside the future environmental assessment process and based on detailed design of the project.

A detailed description of the processes to implement mitigation measures for infrastructure and the major transport corridors in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2 (for infrastructure) and Section 15.6.3 (for the major transport corridors).

24.10.5 ASSESSMENT OF POTENTIAL PRESCRIBED IMPACTS

The nominated areas are highly fragmented and key areas of connectivity generally occur along riparian corridors, within steeper land and gully areas, particularly around the edges of Wilton and southern GMAC.

The development will generally reduce habitat connectivity across the nominated areas for species and TECs mainly due to the removal of many smaller connected patches of habitat, which will often generally leave the remaining larger patches along riparian corridors and within steeper land and gully areas more isolated to some extent. This will have a greater impact on the group of species associated with scattered and/or degraded native vegetation within a matrix.

While a reduction in habitat connectivity will occur, the nominated areas are highly fragmented and the majority of key areas of habitat connectivity will be maintained, including the majority of BIO Map core areas and corridors.

An assessment of the potential prescribed impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on species associated with habitat connectivity is set out in Table 24-19.

Table 24-19: Assessment of potential prescribed impacts – habitat connectivity

Relevant species	Assessment of potential prescribed impacts	Residual risk of impacts?
Species associated with large habitat corridors and/or large areas of intact native vegetation	Impacts are unlikely to cause population decline at a local, regional, or State scale for species associated with large habitat corridors and/or large areas of intact native vegetation (BIO Map corridors/core areas) because: • The vast majority of these areas have been avoided and will not be impacted • Direct impacts generally occur only to the edges of corridors/core areas. There are few locations where direct impacts completely sever or significantly narrow a core area/corridor and connectivity is maintained for these areas The most notable impacts occur: • Within Wianamatta Regional Park • Along Wianamatta (South Creek) where the OSO directly impacts Wianamatta (South Creek) riparian corridor • Within GMAC where two east-west habitat corridors will be fenced to prevent fauna such as Koala from entering the corridors (as part of mitigation measures to protect Koala from landscape threats) The commitments and general mitigation measures are generally considered adequate to manage any residual risks of impacts to habitat connectivity for this group of species. Potential residual risks remain for Koala and impacts associated with the OSO. The Plan includes specific measures to address these risks	Potentially for Koala and impacts associated with OSO
Species associated with smaller habitat corridors or riparian corridors or waterways	Impacts are unlikely to cause population decline at a local, regional, or State scale for species associated with smaller habitat corridors or riparian corridors (local corridors) because: • The vast majority of these areas have been avoided and will not be impacted • Impacts often occur only to the edges of the local corridors and connectivity is maintained for these areas The most notable impacts occur in WSA: • At Cosgrove Creek in the middle part of the nominated area where the OSO severs the riparian corridor in two locations • At Badgerys Creek in the middle part of the nominated area where the OSO severs the riparian corridor in one location The commitments and general mitigation measures are generally considered adequate to manage any residual risks of impacts to habitat connectivity for this group of species. Potential residual risks remain for impacts associated with the OSO. The Plan includes a specific measure to address these risks	Potentially for impacts associated with OSO
Species associated with scattered and/or degraded native vegetation within a matrix	Impacts are unlikely to cause population decline at a local, regional, or State scale for species associated with scattered and/or degraded native vegetation (connected vegetation) because impacts generally occur to: • Smaller scattered patches, where patches will be completely cleared • To the edges of larger patches where the size of the patches will be reduced, but the impacts will not generally sever connectivity between this connected vegetation and other areas of native vegetation The most notable impacts occur in WSA, where in some cases, impacts will sever or reduce connectivity between connected vegetation and other areas of vegetation within and outside the nominated area. These impacts may reduce connectivity in this part of the nominated area for microbats and smaller birds The commitments and general mitigation measures are generally considered adequate to manage any residual risks of impacts to habitat connectivity for this group of species	Unlikely

Relevant species	Assessment of potential prescribed impacts	Residual risk of impacts?
Species that are relatively immobile and move only short distances	Red-crowned Toadlet: impacts are unlikely to cause population decline at a local, regional, or State scale for this species as there are no records within the nominated areas, and mapped suitable habitat occurs in scattered patches within the vicinity of gorges and gullies that occur mainly around the edges of the urban capable land, where habitat connectivity will be maintained Cumberland Plain Land Snail: impacts may potentially cause population decline at a local, regional, and State scale for this species. Little is known about this species dispersal patterns or over what distances individuals can move (OEH, 2019c). Most populations are small and isolated. Records for the species are scattered across the Cumberland subregion. However, where records occur within the nominated areas, most occur on excluded land and many occur on land avoided for biodiversity, including around the edges of GPEC and along riparian corridors in WSA and GPEC. The development is likely to reduce habitat connectivity for this species, associated particularly with the removal of many smaller connected and more isolated patches of Cumberland Plain Woodland, leaving populations in remaining larger patches more isolated to some extent The commitments and general mitigation measures are generally considered adequate to manage any residual risks of impacts to habitat connectivity for this group of species. Potential residual risks remain for Cumberland Plain Land Snail. The Plan includes a specific measure to address these risks	Potentially for the land snail
TECs/flora species	The development will reduce habitat connectivity across the nominated areas for TECs and flora habitat due to the removal of many smaller connected and more isolated patches of TECs, causing the isolation of more intact, larger patches of TECs. This is due to vegetation removal and associated reduced movement of mobile pollinators such as birds and bats TECs (and associated flora species) within the Plan Area, at a local, regional and State scale, are already highly fragmented with the majority of key areas of habitat connectivity being maintained, including the majority of BIO Map core areas and corridors and riparian corridors The commitments and general mitigation measures are generally considered adequate to manage any residual risks of impacts to habitat connectivity for this group of TECs and species	Unlikely

24.10.6 ADDITIONAL SPECIFIC MITIGATION TO ADDRESS RESIDUAL RISKS

Table 24-20 identifies additional specific mitigation measures under the Plan to address residual risks due to the development. These mitigation measures are considered to adequately address residual risks in the context of the risk and significance of the impacts of the development on these species.

Table 24-20: Specific mitigation measures – habitat connectivity

Relevant species/TECs	Specific mitigation measure	Applicable development	Uncertainty or risks of failure
• Koala	The Plan includes the following Koala-specific commitments: • Commitment 7 to protect Koala corridors from prescribed impacts, such as through installing exclusion fencing to separate Koalas from development threats, and installing connectivity	Urban and industrial development, infrastructure, and major transport corridors	There are inherent uncertainties with regards to measures to protect Koala habitat connectivity (such as success of exclusion fences in keeping dogs out of Koala corridors). However, protection of Koalas is a key focus of the Plan, and

Relevant species/TECs	Specific mitigation measure	Applicable development	Uncertainty or risks of failure
	structures to support corridor functionality • Commitment 10 to establish the Georges River Koala Reserve and undertake habitat restoration to support north-south connectivity • Commitment 12 to protect Koala corridors in the region • Commitment 13, Action 4 to undertake restoration to widen Koala corridors • A range of Koala-specific measures in Appendix E of the Plan to protect Koala corridors from habitat degradation and threats due to development		ongoing monitoring and review of both the Plan's implementation and the local Koala population means that any future potential issues will be identified and addressed as part of the Plan's evaluation program. As a result, the risk of failure is considered low
• Eastern Pygmy-possum • Spotted-tailed Quoll • Birds associated with riparian corridors	The Plan includes a commitment to ensure major transport corridors, including the OSO are designed to avoid and minimise impacts to areas of potential habitat connectivity, particularly vegetation in riparian corridors (Commitment 3)	Major transport corridors	Outcome not possible to determine at this stage
• Cumberland Plain Land Snail	The Plan includes a specific mitigation measure to implement 'open structure design' when designing structures such as roads which may isolate patches of habitat, consistent with the critical actions for this species under the Save our Species program (EES, 2020)	Urban and industrial development and intensive plant agriculture	Outcome not possible to determine at this stage. Mitigation measures is consistent with critical actions for this species under the Save our Species program (EES, 2020)

The specific measures will be implemented in the same way as the general mitigation measures as described above and in detail in Chapter 15, Sections 15.6.1, 15.6.2 and 15.6.3.

24.11 ASSESSMENT OF WATER BODIES AND HYDROLOGICAL PROCESSES

24.11.1 LIST OF RELEVANT SPECIES AND TECS

WATER BODIES

The list of species or TECs associated with water bodies is shown in Table 24-21.

Table 24-21: Species/TECs associated with water bodies

Relevant species/TECs	Use and importance of habitat type
Green and Golden Bell Frog	The species uses water bodies for breeding and foraging. While it appears to generally be associated with a single water body for general activities, records

Relevant species/TECs	Use and importance of habitat type
	suggest the species is highly mobile and can move some distance as part of migrations to and from breeding sites (Lemckert, 2019). Movements of up to 5 km may be common and the frog may disperse up to 10 km (DoEE, 2018a). Breeding occurs after heavy rains or storms and spawn is laid among aquatic vegetation (DEWHA, 2009b)
Southern Myotis	The species uses water bodies for foraging. It forages over streams and pools, including dams, on insects and small fish (OEH, 2019l)
White-bellied Sea-eagle	Occurs near large areas of open water including larger rivers, swamps, lakes, and the ocean, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs, and saltmarsh. Uses waterbodies for foraging. Feeds mainly on fish and freshwater turtles, but also waterbirds, reptiles, and mammals. Breeding habitat is constrained to living or dead mature trees within forests or tall woodland within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines (OEH, 2017l)
Australasian Bittern	The species uses waterbodies for shelter, foraging and breeding. Inhabits permanent freshwater wetlands with tall, dense vegetation. Shelters during the day amongst dense reeds or rushes and feeds on frogs, fish, yabbies, and insects (OEH, 2018b)
Black-necked Stork	The species uses water bodies for foraging and builds large nests high in tall trees close to water. Primary habitat is floodplain wetlands (swamps, billabongs, watercourses, and dams) of major coastal rivers. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. It usually forages in water 5-30 cm deep for vertebrate and invertebrate prey (OEH, 2017b)
Comb-crested Jacana	The species inhabits permanent freshwater wetlands with a good cover of floating vegetation or fringing vegetation and uses water bodies for breeding and foraging. It feeds primarily on insects and other invertebrates (OEH, 2018d)
Black Bittern	The species inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation and uses water bodies for breeding and foraging. It feeds on frogs, reptiles, fish, and invertebrates. Nests are built on a branch overhanging water (OEH, 2018c)
Eastern Osprey	Inhabits coastal areas, especially the mouths of large rivers, lagoons and lakes and uses water bodies for foraging. Feeds on fish over open water. Nests are made in dead trees or branches, usually within one kilometre of the sea (OEH, 2018e)
Australian Painted Snipe	Inhabits swamps, dams and nearby marshy areas and uses water bodies or fringing habitat for foraging and breeding. Forages on mud flats and in shallow water. Feeds on worms, molluscs, insects, and some vegetation. Nests on the ground in tall vegetation, such as grasses, tussocks or reeds (OEH, 2017a)
Freckled Duck	Inhabits freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times, the species inhabits more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Rests in dense cover, usually in deep water. Nests occur in dense vegetation at or near water level (OEH, 2017e)

HYDROLOGICAL PROCESSES

The list of species or TECs associated with hydrological processes is shown in Table 24-22 and TECs have been grouped based on the potential risk of impacts from changes to hydrological processes associated with the development.

Table 24-22: Species/TECs associated with hydrological processes

Relevant species/TECs	Use and importance of habitat type
Higher Risk TECs	
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	Higher risk TECs are those that either:

Relevant species/TECs	Use and importance of habitat type
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	• Directly reliant on hydrological processes for the maintenance of their floristic assemblage, or • Are located in landscape positions where processes such as regular flooding and deposition are key to maintaining the edaphic conditions that support the floristic assemblage, or • Are particularly susceptible to erosion, or are considered particularly susceptible to changes in water quality and nutrient load
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	
River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	
Shale Gravel Transition Forest in the Sydney Basin Bioregion	
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	
Lower Risk TECs	
Cumberland Plain Woodland in the Sydney Basin Bioregion	Lower risk TECs are those that occur in landscape positions where hydrological processes have a lower level of influence on species assemblage or edaphic conditions
Moist Shale Woodland in the Sydney Basin Bioregion	
Higher Risk threatened flora species	
Allocasuarina glareicola	Higher risk threatened flora species are those that either: • Grow in waterbodies or swampy areas, or • Require regular inundation and deposition to maintain edaphic conditions, or • Are strongly associated with a higher risk TEC, or • Are higher specialised with regards to requirements for soil moisture content and nutrient levels
Dillwynia tenuifolia	
Eucalyptus benthamii Camden White Gum	
Maundia triglochinoides	
Micromyrtus minutiflora	
Persicaria elatior Tall Knotweed	
Pterostylis saxicola Sydney Plains Greenhood	
Lower Risk threatened flora species	
Acacia bynoeana Bynoe's Wattle	Lower risk threatened flora species are those that occur in landscape positions where hydrological processes have a lower level of influence on edaphic conditions
Acacia pubescens Downy Wattle	
Epacris purpurascens var. *purpurascens*	
Grevillea juniperina subsp. *juniperina* Juniper-leaved Grevillea	
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea	
Hibbertia fumana	
Hibbertia puberula	

Relevant species/TECs	Use and importance of habitat type
Marsdenia viridiflora subsp. *viridiflora* Native Pear	
Melaleuca deanei Deane's Paperbark	
Persoonia bargoensis Bargo Geebung	
Persoonia nutans Nodding Geebung	
Pimelea curviflora var. *curviflora*	
Pimelea spicata Spiked Rice-flower	
Pomaderris brunnea Brown Pomaderris	
Pultenaea parviflora	
Pultenaea pedunculata Matted Bush-pea	
Higher Risk threatened fauna species	
Botaurus poiciloptilus Australasian Bittern	Higher risk threatened fauna species are those that are reliant on wetlands, lower Strahler order watercourses and riparian corridors, or soaks and fringing macrophyte vegetation for key aspects of their lifecycle
Ephippiorhynchus asiaticus Black-necked Stork	
Epthianura albifrons White-fronted Chat	
Heleioporus australiacus Giant Burrowing Frog	
Irediparra gallinacean Comb-crested Jacana	
Ixobrychus flavicollis Black Bittern	
Litoria aurea Green and Golden Bell Frog	
Myotis macropus Southern Myotis	
Pseudophryne australis Red-crowned Toadlet	
Rostratula australis Australian Painted Snipe	
Stictonetta naevosa Freckled Duck	
Lower Risk threatened fauna species	
Remaining candidate species and ecosystem credit fauna species	Lower risk threatened fauna species are those not directly reliant on waterbodies or wetlands, those associated with riparian corridors of higher Strahler watercourses, or those species within limited habitat within the nominated areas (such as waders)

24.11.2 OCCURRENCE OF HABITAT OR PRESCRIBED IMPACT TYPE

WATER BODIES

Water bodies comprise non-vegetated wetlands, ponds, rivers, creeks, and other bodies of water, including farm dams, greater than 3 m wide. Water bodies occur in all nominated areas and were identified using the Digital Topographic Database hydro area layer (LPI, 2016).

Direct impacts on Southern Myotis and Green and Golden Bell Frog associated with waterbodies were determined by:

- Intersecting the hydro area layer with the species maps for these three species (see Chapter 11)

- Excluding water bodies that were within native vegetation based on the native vegetation map (see Chapter 11) (direct impacts to these water bodies are assessed through impacts to native vegetation and habitat (see Chapter 23)
- Intersecting water bodies with species habitat that occurs within urban capable lands and transport corridors

The location of water bodies is shown in Map 24-4.

HYDROLOGICAL PROCESSES

Potential areas of hydrological change were mapped across the nominated areas using topographical features such as watercourses and changes in relief through the landscape to determine catchment areas and floodplains.

A digital elevation model was used to help visualise these catchment areas and floodplains and highlight those where development is to occur either within the floodplain or near the top of catchments, which were then mapped.

These mapped areas cover the land outside the urban capable land and transport corridors where it is expected that indirect impacts to species and TECs may occur as a result of the development changing the existing hydrological processes that currently support those ecological values.

Table 24-23 provides details of the areas considered to potentially undergo hydrological changes related to development either in the upper reaches of the water catchment area, or development on a floodplain. These mapped areas are shown on Map 24-4 and are considered to cover the extent of potential hydrological change which may occur as a result of adjacent development within the nominated areas.

Table 24-23: Areas of potential hydrological impacts

Nominated area	Location	Type
Wilton	Allens Creek catchment	Development in catchment area modifying feeder creeks
	Allens Creek tributary catchment	Development in catchment area modifying feeder creeks
	Byrnes Creek catchment	Development in area surrounding catchment
	Nepean River catchment	Development in catchment area modifying feeder creeks
	Stringybark Creek catchment	Development in catchment area modifying feeder creeks
GMAC	Cataract/Elladale/Nepean catchment	Development in upper catchment area modifying feeder creeks
	Cataract/Rocky Ponds catchment	Development in upper catchment area modifying feeder creeks
	Elladale Creek catchment	Development in upper catchment area surrounding watercourses and modifying feeder creeks
	Elladale/Nepean catchment	Development in upper catchment area modifying feeder creeks
	Menangle/Woodhouse/Leafs catchment	Development in upper catchment area modifying feeder creeks
	Nepean River catchment	Development in upper catchment area modifying feeder creeks
	Ousedale Creek catchment	Development in upper catchment area surrounding watercourse and modifying feeder creeks
WSA	Badgerys Creek floodplain	Development on floodplain and within catchment area surrounding watercourse
	Cosgroves Creek floodplain	Development on all sides of floodplain and modification of feeder creeks

Nominated area	Location	Type
	Wianamatta (South Creek) and Kemps Creek floodplains	Development on floodplain and within catchment areas surrounding watercourse
	Wianamatta (South Creek) floodplain	Development on floodplain
GPEC	Wianamatta (South Creek) floodplain	Development on floodplain (major roadway development)
	Surveyors Creek tributary	Development in upper catchment area modifying feeder creeks

24.11.3 NATURE, EXTENT, AND DURATION OF RESIDUAL IMPACTS

WATER BODIES

Avoidance of impacts

Water bodies occur throughout each of the nominated areas and it was not possible to determine avoidance outcomes for water bodies. However, the urban capable land has avoided riparian corridors along waterways (see Chapter 4) that are likely to be preferred movement and foraging habitat for many of the species associated with water bodies. The Plan includes several specific mitigation measures to monitor impacts of hydrological changes to high-risk species and to avoid and minimise impacts to vegetation in riparian corridors (see Section 24.11.6).

Residual impacts

The nature, extent, and duration of the residual impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major infrastructure corridors on water bodies are set out in Table 24-24.

Table 24-24: Nature, extent, and duration of residual impacts –water bodies

Species/TEC	Nature	Extent	Duration
Green and Golden Bell Frog	**Direct impacts:** The development will directly impact three small waterbodies within the potential habitat area for this species	2.7 ha of water bodies in all nominated areas	Long-term
	Indirect impacts: The development may cause indirect impacts to water bodies within suitable habitat for the species associated with urban run-off and changes to hydrology	Adjacent to urban capable land along Ropes Creek in GPEC	Temporary or long-term
Southern Myotis	**Direct impacts:** The development will directly impact approximately 1,000 waterbodies within suitable habitat for this species	786.5 ha of water bodies in all nominated areas	Long-term
	Indirect impacts: The development may cause indirect impacts to water bodies within suitable habitat for the species associated with urban run-off and changes to hydrology	Water bodies adjacent to urban capable land in each nominated area	Temporary or long-term
White-bellied Sea-eagle	**Direct impacts:** The development will directly impact several waterbodies within suitable habitat for this species	Several water bodies within a total of 10 ha of suitable habitat that occurs in each nominated area. An impact of < 1 ha will occur	Long-term

Species/TEC	Nature	Extent	Duration
	Indirect impacts: The development may cause indirect impacts to water bodies within suitable habitat for the species associated with urban run-off and changes to hydrology	Water bodies adjacent to urban capable lands in each nominated area	Temporary or long-term
Water birds	**Direct impacts:** The development will directly impact many waterbodies within suitable habitat for these species	Many water bodies scattered across each nominated area	Long-term
	Indirect impacts: The development may cause indirect impacts to water bodies within suitable habitat for the species associated with urban run-off and changes to hydrology	Water bodies adjacent to urban capable lands in each nominated area	Temporary or long-term

HYDROLOGICAL PROCESSES

Avoidance of impacts

The steps taken to avoid and minimise impacts of the development in the nominated areas are set out in Chapter 14.

The urban capable land has avoided riparian corridors along waterways (see Chapter 14). This ensures the natural waterbodies providing the highest value potential habitat will be retained, and therefore minimising direct impacts to native species and vegetation dependent on those resources.

Development will occur in the upper catchment areas and on some floodplain catchment areas across the nominated areas. However indirect impacts will be avoided and minimised through incorporating best practice urban water management design into future developments (see Chapter 15 and Section 24.11.4).

Residual impacts

The nature, extent, and duration of the impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on species on hydrological processes are set out in Table 24-25.

The figures presented in the table for the total extent of habitat has been calculated based on the total area of habitat for each group of ecological values (high/low risk species or TECs) within each nominated area. Where habitat overlaps between species in the same group of ecological value (high/low risk species or TECs) the overlaps are 'dissolved' and the habitat area is calculated only once. The total amount equates to an approximate area of habitat that could be utilised by multiple species or TECs within each group.

For lower risk fauna, which includes ecosystem credit species, all native vegetation mapped in the nominated areas was used as a surrogate for species habitat. This is considered suitable as all mapped native vegetation within the nominated areas is potential habitat for at least one ecosystem credit species.

The potential impact areas are those areas of each ecological value that are potentially subject to hydrological changes. These figures have been estimated and represent a worst case. It is unlikely that impacts would occur across all extents in the table, but rather are likely to be more localised within these larger areas.

Key areas potentially subject to impacts include:

- To higher risk fauna species in GPEC, where hydrological changes associated with development on floodplain (major transport corridors) may potentially impact on an area of habitat of 696 ha (or 27 per cent of total mapped non-certified habitat)
- To higher risk flora habitat in:
    - Wilton – 429 ha (or 46 per cent of total mapped non-certified habitat) associated with development modifying feeder creeks

- GMAC – 389 ha (or 46 per cent of total mapped non-certified habitat) associated with development in catchment area modifying feeder creeks
- GPEC – 382 ha (or 44 per cent of total mapped non-certified habitat) associated with development on floodplain (major transport corridor)

It should be noted that while impacts associated with hydrological processes described below and in Table 24-27 are predicted to potentially occur over relatively large areas of habitat and native vegetation, the potential for impacts occurring over the entire areas described is considered highly unlikely, with impacts much more likely to occur at a local scale. Therefore, the predicted extent of impacts is very conservative and comprise the total maximum areas within which impacts associated with altered hydrology could potentially occur rather than the area subject to likely impacts.

Table 24-25: Nature, extent, and duration of residual impacts – hydrological processes

Location	Nature	Species/TEC	Total non-certified extent in nominated areas (approx.) (ha)	Non-certified area where potential impacts could occur (approx.) (ha & %)	Duration
Wilton	Development in catchment area modifying feeder creeks	• Higher risk TECs • Lower risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 1,154 • 90 • 942 • 1,799 • 1,085 • 1,718	• 434 (38%) • 16 (187%) • 429 (46%) • 656 (36%) • 438 (40%) • 652 (38%)	Long-term
	Development in area surrounding catchment	• Higher risk TECs • Lower risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 1,154 • 90 • 942 • 1,799 • 1,085 • 1,718	• 57 (5%) • 10 (11%) • 72 (8%) • 92 (5%) • 70 (6%) • 91 (5%)	Long-term
GMAC	Development in catchment area modifying feeder creeks	• Higher risk TECs • Lower risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 1,927 • 337 • 1,820 • 3,009 • 1,856 • 2,909	• 358 (19%) • 26 (8%) • 389 (21%) • 574 (19%) • 351 (19%) • 546 (19%)	Long-term
	Development in upper catchment area surrounding watercourses and modifying feeder creeks	• Higher risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 1,927 • 1,820 • 3,009 • 1,856 • 2,909	• 122 (6%) • 129 (7%) • 133 (4%) • 78 (4%) • 133 (5%)	Long-term
WSA	Development on floodplain and within catchment area surrounding watercourse	• Higher risk TECs • Lower risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 277 • 162 • 187 • 508 • 378 • 465	• 96 (35%) • 7 (4%) • 52 (28%) • 100 (20%) • 121 (32%) • 104 (22%)	Long-term

Location	Nature	Species/TEC	Total non-certified extent in nominated areas (approx.) (ha)	Non-certified area where potential impacts could occur (approx.) (ha & %)	Duration
	Development on all sides of floodplain and modification of feeder creeks	• Higher risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 277 • 187 • 508 • 378 • 465	• 14 (5%) • 2 (1%) • 16 (3%) • 11 (3%) • 14 (3%)	Long-term
	Development on floodplain - avoided areas potentially impacted	• Higher risk TECs • Lower risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 277 • 162 • 187 • 508 • 378 • 465	• 3 (1%) • 14 (9%) • 6 (3%) • 18 (4%) • 12 (3%) • 17 (4%)	Long-term
GPEC	Development on floodplain - major roadway development	• Higher risk TECs • Lower risk TECs • Higher risk flora • Lower risk flora • Higher risk fauna • Lower risk fauna	• 1,003 • 1,647 • 874 • 3,437 • 2,564 • 2,887	• 548 (55%) • 347 (21%) • 382 (44%) • 993 (29%) • 696 (27%) • 1916 (66%)	Long-term
	Development in upper catchment area modifying feeder creeks	• Higher risk TECs • Lower risk TECs • Higher risk flora • Higher risk fauna • Lower risk fauna	• 1,003 • 874 • 3,437 • 2,564 • 2,887	• 7 (<1%) • 6 (<1%) • 7 (<1%) • 1 (<1%) • 7 (<1%)	Long-term

24.11.4 COMMITMENTS AND GENERAL MITIGATION MEASURES TO ADDRESS IMPACTS

This section identifies commitments in the Plan relating to prescribed impacts and general mitigation measures/development controls that are commonly implemented by planning authorities through the development application process and are relevant to managing prescribed impacts. Specific mitigation measures that will apply to specific species and TECs in certain locations are identified in Section 24.11.6.

This section also summarises the processes to implement the general and specific mitigation measures/development controls for the different development types under the Plan. These processes are described in detail in Chapter 15.

URBAN AND INDUSTRIAL DEVELOPMENT AND INTENSIVE PLANT AGRICULTURE

The Plan includes a commitment (Commitment 5) to mitigate prescribed impacts from urban and industrial development and intensive plant agriculture on TECs, threatened species and their habitat within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Development Control Plans (DCPs) will be prepared for each nominated area that will include development controls to address prescribed impacts. The development controls in DCPs will be implemented through the standard development application process under the EP&A Act that occurs prior to development proceeding.

The Department has prepared a DCP template that provides model provisions to help ensure mitigation measures identified in the Plan to address prescribed impacts are incorporated into DCPs as development controls and are applied consistently across the nominated areas. The DCP template includes both:

- A common set of controls that apply across the nominated areas and inform general biodiversity protection. These controls are commonly implemented by planning authorities to manage prescribed impacts through the development application process – these are identified in Chapter 15 (Table 15-4 to Table 15-13)
- A specific set of controls that apply to specific species and TECs in certain locations. These controls have been identified through this Assessment Report and are needed to address the residual risks that remain after the common set of controls are applied. These are identified in Appendix E of the Plan

The common controls included in the DCP template relevant to managing prescribed impacts on species associated with hydrological processes and water quality, including (see Chapter 15, Section 15.6.1):

- Waterways: Maintain waterways of Strahler order 2 or higher in a natural state, including riparian corridors
- Water cycle management: Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
- Water quality: Stormwater systems must be constructed and maintained to achieve EES water quality targets
- Soil erosion and sedimentation: Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application

A detailed description of the process to implement these development controls in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

INFRASTRUCTURE AND MAJOR TRANSPORT CORRIDORS

Commitment 5 includes mitigating prescribed impacts of infrastructure within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Commitment 6 requires mitigating prescribed impacts of the major transport corridors in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval for certified major transport corridors
- Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E of the Plan

Both infrastructure and the major transport corridors will be subject to future environmental assessment and approval processes under the EP&A Act based on detailed design at the time the projects are proposed (see Part 2).

For the major transport corridors, an action under Commitment 5 requires Transport for NSW to:

> *'Implement specific mitigation measures prescribed in Appendix E and identify and implement additional mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the SSI (or equivalent) approval process, as well as best practice guidelines, including the RMS Biodiversity Guidelines'*

This requirement ensures mitigation measures to address prescribed impacts on TECs and species associated with water bodies and hydrological processes are identified and implemented through or alongside the future environmental assessment process and based on detailed design of the project.

A detailed description of the processes to implement mitigation measures for infrastructure and the major transport corridors in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2 (for infrastructure) and Section 15.6.3 (for the major transport corridors).

24.11.5 ASSESSMENT OF POTENTIAL PRESCRIBED IMPACTS

WATER BODIES

An assessment of the potential prescribed impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors in relation to water bodies is set out in Table 24-26. This assessment takes into account any general mitigation measures under the Plan to manage impacts.

Table 24-26: Assessment of potential prescribed impacts – water bodies

Relevant species/TECs	Assessment of potential prescribed impacts	Residual risk of impacts?
Green and Golden Bell Frog	Development under the Plan will impact three small waterbodies within potential habitat for the species. This habitat is known to have supported a population of Green and Golden Bell Frog, with 6 BioNet records made between 1998 and 2012 At the time of public exhibition, it was considered likely that the population at this locality could still be present, and targeted surveys of the site had not been completed. The draft Plan at this stage contained a species-specific measure to undertake surveys within potential habitat along Ropes Creek to determine if the species was still present, and if confirmed to be present, to avoid, protect and enhance key habitat features of the site. Targeted surveys of Ropes Creek have since been completed. The surveys were carried out in December 2020 and January 2021. The surveys did not find any individuals of the species present at the site. Potential shelter and dispersal habitat for the species was identified, yet the habitat of the locality was considered unlikely to be suitable for breeding (see Supporting Document I) Impacts are unlikely to cause population decline for this species at a local, regional, or State scale because the majority (greater than 95 %) of records for the species occur in the eastern third of the Cumberland subregion outside the nominated areas (Lemckert, 2019) and the nominated areas are unlikely to be important for species persistence	Unlikely
Southern Myotis	There is a low risk that direct impacts will cause population decline at a local level. The development will remove 328.4 ha of a total of 786.5 ha of water bodies within suitable habitat for this species in the nominated areas (approximately 41.8 % of water bodies within suitable habitat in the nominated areas). However, inspection of aerial photos suggests many of these water bodies are farm dams that are likely to provide more marginal foraging habitat for the species. Urban capable lands have avoided riparian corridors along waterways (see Chapter 14) that are likely to be preferred foraging habitat for the species. Furthermore, riparian corridors across the nominated areas have been avoided (see Chapter 14) and general mitigation measures will be put in place to further protect riparian corridors. It is also likely that urban landform water bodies will be created within developed lands, potentially providing some habitat Impacts are unlikely to cause population decline for this species at a regional or State scale because records for the species are widespread across the bioregion and NSW and the species does not appear to be highly reliant on the Cumberland subregion	Unlikely
White-bellied Sea Eagle	There is a low risk that direct impacts will cause population decline at a local, regional, or State scale because: • Most water bodies impacted by the development across the nominated areas are farm dams that do not provide suitable foraging habitat for the species • Only very small amounts of potential habitat for the species containing water bodies are being impacted relative to suitable habitat remaining in the subregion Furthermore, riparian corridors across the nominated areas have been avoided (see Chapter 14) and general mitigation measures will be put in place to further protect riparian corridors	Unlikely
Water birds	There is a low risk that direct impacts will cause population decline at a local, regional, or State scale because most water bodies impacted by the development across the nominated areas are farm dams that are likely to provide more marginal foraging habitat for most of these species, as they are generally associated with vegetated waterbodies Furthermore, riparian corridors across the nominated areas have been avoided (see Chapter 14) and generic mitigation measures will be put in place to further protect riparian corridors	Unlikely

HYDROLOGICAL PROCESSES

The risk and consequences of the impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors in relation to hydrological processes are set out in Table 24-27. This assessment takes into account any general mitigation measures under the Plan to manage impacts.

Table 24-27: Assessment of potential prescribed impacts – hydrological processes

Assessment of potential prescribed impacts	Relevant species/TECs	Residual risk of impacts?
Risks associated with development in upper catchment areas include: • An increase in impermeable areas may result in higher levels of fluctuation in overland flow patterns reaching downstream areas. Following rain events downstream areas are more likely to receive higher volumes of water at higher velocities, over a shorter period of time, leading to higher potential for erosion, changes in deposition and sedimentation patterns and changes to water quality and type and volume of nutrient load. Conversely, as less water is being absorbed by vegetated areas there is less water in the soil during drier times leading to longer periods with lower levels of water availability between rain events • Changes to overland flow patterns through channelisation of stormwater into creeks and stormwater management systems may directly impact upon populations of higher risk flora and fauna species and/or TECs downstream that are reliant on current hydrological patterns for survival • Increases in, or changes to, nutrients and pollutants in stormwater and run-off as a result of anthropogenic inputs such fertilisers, herbicides, soil conditioners, and petrol/oil	Higher risk species and TEC	Potentially
Risks associated with development on floodplains include: • Changes in flooding regimes and patterns resulting from construction and earthworks may alter the relief of floodplains. This can confine streamlines to channels and reduce the width of those channels, which results in increased water velocities and impacts on groundcover. Increased water velocity may also impact nutrient deposition reducing the nutrient input for floodplain dependent species and TECs • Changes to flooding regimes and patterns may directly impact populations of higher risk flora and fauna species and/or TECs downstream that are reliant on current hydrological patterns for survival. Changes may result in periodically wet areas being reduced or lost, or formerly drier areas becoming periodically inundated. This could substantially impact upon the vegetation present within the floodplain The general mitigation measures are considered adequate to manage these risks to lower risk species/TECs. The Plan includes specific mitigation measures to manage this risk for higher risk species and TECs	Lower risk species and TECs	Unlikely

24.11.6 ADDITIONAL SPECIFIC MITIGATION TO ADDRESS RESIDUAL RISKS

Table 24-28 identifies additional specific mitigation measures under the Plan to address residual risks due to the development. These mitigation measures are considered to adequately address residual risks in the context of the risk and significance of the impacts of the development on the TECs.

Table 24-28: Specific mitigation measures – water bodies and hydrological processes

Relevant species	Specific mitigation measure	Applicable development	Uncertainty or risks of failure
Higher risk species and TECs	• Actions under Commitment 5 specify that DCPs will be audited to ensure development controls are being	Urban, industrial and infrastructure development	There is a risk that development in water catchments and on

	incorporated in accordance with the Plan and effectively implemented. If monitoring finds that this is not the case, new controls will be reviewed and redrafted to ensure stronger consideration of the controls through council assessment processes • The Plan includes an action under Commitment 3 to ensure major transport corridors are designed to avoid and minimise impacts to vegetation in riparian corridors. As part of this commitment, the Plan will ensure OSO waterway crossings minimise structures within riparian corridors, waterway re-alignments, and bulk earthworks on adjacent floodplain areas	Major transport corridors	floodplains may result in residual localised impacts to high risk species and TECs. Auditing of DCPs to ensure development controls are being incorporated in accordance with the Plan and effectively implemented is considered to adequately reduce this risk

The specific measures will be implemented in the same way as the general mitigation measures as described above and in detail in Chapter 15, Sections 15.6.1, 15.6.2 and 15.6.3.

24.12 ASSESSMENT OF VEHICLE STRIKES

24.12.1 LIST OF RELEVANT SPECIES

Vehicle strikes have been identified as a key threat to several species known or predicted to occur in the nominated areas, including:

- Koala
- Green and Golden Bell Frog
- Eastern Pygmy-possum
- Spotted-tailed Quoll
- Yellow-bellied Glider
- Squirrel Glider
- Broad-headed Snake

24.12.2 OCCURRENCE OF HABITAT OR PRESCRIBED IMPACT TYPE

The development will lead to new roads and an increase in the volume of vehicles on existing roads. The main risks areas associated with these impacts occur in areas of suitable habitat of species vulnerable to vehicle strikes where:

- New roads are built within areas of suitable habitat
- Existing roads occur within areas of suitable habitat, assuming that vehicle volumes will increase on these roads

Risk areas are described for each relevant species in Table 24-29.

24.12.3 LIKELIHOOD OF VEHICLE STRIKES WITHIN RISK AREAS

An analysis of the likelihood of vehicle strikes from traffic associated with urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors is set out in Table 24-29. The analysis was undertaken on the basis of:

- Likelihood of occurrence of species vulnerable to vehicle strikes, based on records
- Evidence of previous roadkill in the area for those species
- Consideration of relevant life history traits

Observation codes within BioNet records were interrogated to identify whether species records were associated with vehicle strikes (Observation Code R – Roadkill).

Table 24-29: Key risk areas and likelihood of vehicle strikes

Relevant species/TECs	Key risk areas	Likelihood of vehicle strikes in key risk areas
Koala	The key risk areas are where busy roads cut through, or are located adjacent to, areas of Koala habitat. Existing roadkill hotspots (where greater than four Koalas are killed within a 2 km stretch of road) are located in the following areas: • Picton Road between Cordeaux Dam and Wilton • Macarthur Drive • Eastern end of Wilton Road • Appin Road between Appin and Campbelltown • Hume Highway at the Bargo exit While the Plan does not propose new roads which cut through substantial areas of Koala habitat, the Plan includes significant areas of urban capable land adjacent to Koala habitat. This poses a risk of road mortality to Koalas who may venture out of Koala habitat into developed areas	The likelihood of vehicle strikes is considered to be high. Increased traffic density has been shown to increase the rate of vehicle strike. The Plan will result in significant areas of new development and without mitigation, the risk of vehicle strike to Koalas will increase substantially as development proceeds
Green and Golden Bell Frog	The key risk area occurs in the northern part of the GPEC, where many existing roads occur across a large patch of suitable habitat associated with a riparian corridor and the OSO intersects the edge of that habitat in Wianamatta Regional Park	The likelihood of vehicle strikes is difficult to predict but is considered to be low because: • Where the OSO intersects suitable habitat, this only occurs on the edges of suitable habitat and does not disrupt any existing movement corridors. This reduces the likelihood the species needs to cross the OSO to move between areas of suitable habitat. Recent targeted surveys at this location along Ropes Creek did not detect the species (see Supporting Document I) • Many existing roads occur within areas of suitable habitat. Despite this, there have been no recorded vehicle strikes on this species. This suggests this species may not be regularly needing to move across existing roads to disperse between areas of suitable habitat, or is able to pass under existing roads where road crossings provide suitable conditions
Eastern Pygmy-possum	The key risk areas occur:	The likelihood of vehicle strikes is considered to be low because:

Relevant species/TECs	Key risk areas	Likelihood of vehicle strikes in key risk areas
	• Northern part of Wilton and southern part of GMAC where urban capable lands and associated roads occur adjacent to suitable habitat • Central part of WSA where the OSO impacts small areas of suitable habitat mainly associated with riparian corridors • Northern and central part of GPEC where the OSO intersects suitable habitat in Wianamatta Regional Park and several riparian corridors	• Few records occur within or in the vicinity of the nominated areas, which suggests this species may not occur in the area or occurs only in small numbers • The vast majority of suitable habitat for this species in Wilton and GMAC is restricted to the gorges and gullies mainly on the edges of the nominated areas. The urban capable lands generally occur outside these areas and no major roads directly cross these areas as part of the development
Spotted-tailed Quoll	The key risk areas occur: • Northern part of Wilton and southern part of GMAC where urban capable lands and associated roads occur adjacent to suitable habitat • Central part of WSA where the OSO impacts small areas of suitable habitat mainly associated with riparian corridors • Northern and central part of GPEC where the OSO intersects suitable habitat in Wianamatta Regional Park and several riparian corridors	The likelihood of vehicle strikes on the important population of the species near Wilton is difficult to predict but is considered low to moderate as: • The vast majority of suitable habitat for this species is restricted to the gorges and gullies of the edges of Wilton. These areas are outside the urban capable lands and there will be no new roads intersecting these areas as part of the development • Several existing roads occur within areas of suitable habitat. Despite this, there have been no recorded vehicle strikes on this species. This suggests this species may not be regularly needing to move across existing roads to disperse between areas of suitable habitat, or is able to pass under existing roads where road crossings provide suitable conditions The likelihood of vehicle strikes in the other nominated areas is considered to be low because: • Few records occur within or in the vicinity of the nominated areas, which suggests this species may not occur in the area or occurs only in small numbers • Many existing roads occur within areas of suitable habitat. Despite this, there have been no recorded vehicle strikes on these species in the nominated areas
Yellow-bellied Glider Squirrel Glider Broad-headed Snake	The key risk areas occur in the northern part of Wilton and southern part of GMAC where urban capable lands and associated roads occur adjacent to suitable habitat	The likelihood of vehicle strikes is considered to be low because: • No records for these species occur in the nominated areas, except for two recent records of Squirrel Glider in the gorge areas in Wilton, and one record of Yellow-bellied Glider in GPEC, which suggests these species may occur only in small numbers

Relevant species/TECs	Key risk areas	Likelihood of vehicle strikes in key risk areas
		• The vast majority of suitable habitat for these species in Wilton and GMAC is restricted to the gorges and gullies mainly on the edges of the nominated areas. The urban capable lands generally occur outside these areas and no major roads directly cross these areas as part of the development
Broad-headed Snake	The key risk areas occur in the northern part of Wilton where urban capable lands and associated roads occur adjacent to suitable habitat	The likelihood of vehicle strikes is considered to be low because: • No records for this species occur in Wilton, which suggests this species may not occur • Suitable habitat for this species in Wilton is likely to be restricted to the gorges and gullies on the edges of the nominated area. The urban capable lands generally occur outside these areas and no major roads directly cross these areas as part of the development

24.12.4 COMMITMENTS AND GENERAL MITIGATION MEASURES TO ADDRESS IMPACTS

This section identifies commitments in the Plan relating to prescribed impacts and general mitigation measures/development controls that are commonly implemented by planning authorities through the development application process and are relevant to managing prescribed impacts. Specific mitigation measures/development controls that will apply to specific species and TECs in certain locations are identified in Section 24.12.6.

This section also summarises the processes to implement the general and specific mitigation measures/development controls for the different development types under the Plan. These processes are described in detail in Chapter 15.

URBAN AND INDUSTRIAL DEVELOPMENT AND INTENSIVE PLANT AGRICULTURE

The Plan includes a commitment (Commitment 5) to mitigate prescribed impacts from urban and industrial development and intensive plant agriculture on TECs, threatened species and their habitat within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Development Control Plans (DCPs) will be prepared for each nominated area that will include development controls to address prescribed impacts. The development controls in DCPs will be implemented through the standard development application process under the EP&A Act that occurs prior to development proceeding.

The Department has prepared a DCP template that provides model provisions to help ensure mitigation measures identified in the Plan to address prescribed impacts are incorporated into DCPs as development controls and are applied consistently across the nominated areas. The DCP template includes both:

- A common set of controls that apply across the nominated areas and inform general biodiversity protection. These controls are commonly implemented by planning authorities to manage prescribed impacts through the development application process – these are identified in Chapter 15 (Table 15-4 to Table 15-13)
- A specific set of controls that apply to specific species and TECs in certain locations. These controls have been identified through this Assessment Report and are needed to address the residual risks that remain after the common set of controls are applied. These are identified in Appendix E of the Plan and Section 24.12.6 below

The common controls included in the DCP template relevant to managing prescribed impacts on species due to vehicle strike are:

- Implement traffic calming measures in development areas not subject to Koala exclusion fencing, including speed limit restrictions for areas adjacent to land with biodiversity values, and installation of wildlife signposting and speed humps and audible surfacing in accordance with relevant standards
- Install and maintain fauna-friendly road design structures in appropriate areas adjacent to fauna habitat, such as underpasses, fauna bridges and overpasses consistent with any approval conditions and the RMS Biodiversity Guidelines

The specific controls included in the DCP template are discussed in Section 24.12.6.

A detailed description of the process to implement these development controls in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, section 15.6.1.

INFRASTRUCTURE AND MAJOR TRANSPORT CORRIDORS

Commitment 5 includes mitigating prescribed impacts of infrastructure within the nominated areas, including meeting specific mitigation requirements in accordance with Appendix E of the Plan.

Commitment 6 requires mitigating prescribed impacts of the major transport corridors in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval for certified major transport corridors
- Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E of the Plan

Both infrastructure and the major transport corridors will be subject to future environmental assessment and approval processes under the EP&A Act based on detailed design at the time the projects are proposed (see Part 2).

The assessment of the prescribed impacts of infrastructure and the major transport corridors associated with vehicle strike in Section 24.12.5 led to the identification of several mitigation measures. These mitigation measures are identified in Appendix E of the Plan and Section 24.12.6 below.

To ensure implementation of these mitigation measures for infrastructure, the Department will prepare a guideline under clause 228 of the EP&A Regulation – the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development. The infrastructure guideline must be taken into account when public authorities consider the likely impact of infrastructure on the environment under the EP&A Act through the future environmental assessment process. The mitigation measures identified in Section 24.12.6 to address prescribed impacts associated with vehicle strike will be incorporated into the infrastructure guideline.

For the major transport corridors, an action under Commitment 5 requires Transport for NSW to:

> *'Implement specific mitigation measures prescribed in Appendix E and identify and implement additional mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the SSI (or equivalent) approval process, as well as best practice guidelines, including the RMS Biodiversity Guidelines'*

This requirement ensures the mitigation measures identified in Section 24.12.6 to address prescribed impacts associated with vehicle strike are implemented through or alongside the future environmental assessment process and based on detailed design of the project.

A detailed description of the processes to implement mitigation measures for infrastructure and the major transport corridors in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2 (for infrastructure) and Section 15.6.3 (for the major transport corridors).

24.12.5 ASSESSMENT OF POTENTIAL PRESCRIBED IMPACTS

An assessment of the potential prescribed impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors in relation to vehicle strikes is set out in Table 24-30. This assessment takes into account any general mitigation measures under the Plan to manage impacts.

Table 24-30: Risks and consequences of impacts – vehicle strike

Relevant species/TECs	Assessment of the potential prescribed impacts	Residual risk of impact
Koala	Without sufficient species-specific mitigation, there is a high risk that impacts may cause population decline at a local level. The Plan will lead to increased traffic on existing roads within or adjacent to habitat areas occupied by the Southern Sydney Koala population. The Plan include species-specific mitigation measures to address this risk	Yes

Relevant species/TECs	Assessment of the potential prescribed impacts	Residual risk of impact
Green and Golden Bell Frog	There is a low risk impacts may cause population decline at a local level. The species may occur in GPEC, and while the development will only intersect the edges of suitable habitat and existing roads already occur in the vicinity of suitable habitat, the development will lead to increased traffic levels on existing roads Impacts are unlikely to cause population decline for this species at a regional or State scale because the majority (greater than 95 %) of records for the species occur in the eastern third of the Cumberland subregion outside the nominated areas (Lemckert, 2019) and the nominated areas are unlikely to be important for species persistence The general mitigation measures are considered adequate to reduce this risk The Plan also includes a specific mitigation measure for the transport corridors that may also benefit this species in the northern part of GPEC	Unlikely
Eastern Pygmy Possum	Impacts are unlikely to cause population decline for this species at a local, regional, or State scale because: • The likelihood of vehicle strikes in key risk areas is considered to be low • Few records occur within or in the vicinity of the nominated areas, which suggests this species may not occur in the area or occurs only in small numbers While risks are considered unlikely, the Plan includes: • General mitigation measures to reduce any actual risk • A specific mitigation measure for the transport corridors that may benefit this species in WSA and GPEC	Unlikely
Spotted-tailed Quoll	There is a low to moderate risk impacts may cause population decline at a local level. An important population of the species occurs immediately to the south of Wilton. While no new major roads will intersect suitable habitat in this area, the development will lead to increased traffic levels on existing roads. Impacts are unlikely to cause population decline for this species at a regional or State scale because: • The vast majority of suitable habitat for this species, including in Wilton and the other nominated areas, are outside the urban capable lands • Few records occur within or in the vicinity of the other nominated areas, which suggests this species may not occur in the area or occurs only in small numbers • There have been no recorded vehicle strikes on this species in the nominated areas suggesting this species may not be regularly needing to move across existing roads to disperse between areas of suitable habitat The general mitigation measures are considered adequate to reduce this risk The Plan also includes a specific mitigation measure for the transport corridors that may also benefit this species in WSA and GPEC	Unlikely

Relevant species/TECs	Assessment of the potential prescribed impacts	Residual risk of impact
Yellow-bellied Glider Squirrel Glider	Impacts are unlikely to cause population decline for this species at a local, regional, or State scale because: • The risk of vehicle strike in key risk areas is considered to be low • Few records occur within or in the vicinity of the nominated areas, which suggests this species may not occur in the area or occurs only in small numbers While risks are considered unlikely, the Plan includes: • General mitigation measures to reduce any actual risk • A specific mitigation measure for the transport corridors that may benefit this species in WSA and GPEC	Unlikely
Broad-headed Snake	Impacts are unlikely to cause population decline for this species at a local, regional, or State scale because: • The risk of vehicle strike in key risk areas is considered to be low • No records occur within or in the vicinity of the Wilton (and the other nominated areas), which suggests this species may not occur in the area	Unlikely

24.12.6 ADDITIONAL SPECIFIC MITIGATION TO ADDRESS RESIDUAL RISKS

Table 24-31 identifies additional specific mitigation measures under the Plan to address residual risks due to the development.

Many areas of suitable habitat for Koala overlap with suitable habitat for other species susceptible to vehicle strikes, such as Spotted-tailed Quoll, Eastern Pygmy Possum, and Yellow-bellied Glider, and the specific mitigation measures for Koala are likely to benefit these other species in many cases.

These mitigation measures are considered to adequately address residual risks in the context of the risk and significance of the impacts of the development on these species.

Table 24-31: Specific mitigation measures – vehicle strikes

Relevant species/TECs	Specific mitigation measure	Applicable development	Uncertainty or risks of failure

Koala	A range of mitigation measures including:
	• Commitment 7, which involves installing exclusion fencing:
	  ○ Between Koala habitat and urban capable land
	  ○ Along both sides of Appin Road
	• A range of measures in Appendix E of the Plan including:
	  ○ Development controls to reduce traffic mortality in areas where exclusion fencing is not feasible
	  ○ A measure to ensure roads constructed as essential infrastructure do not pose a threat of roadkill to Koalas
		Urban and industrial development, and infrastructure (including essential infrastructure)	There are inherent uncertainties with regards to measures to protect Koalas from road mortality (such as success of exclusion fences in preventing Koala movement, for instance if fences become damaged in the future). However, protection of Koalas is a key focus of the Plan, and ongoing monitoring and review of both the Plan's implementation and the local Koala population means that any future potential issues will be identified and addressed as part of the Plan's MER and adaptive management

Relevant species/TECs	Specific mitigation measure	Applicable development	Uncertainty or risks of failure
			framework. As a result, the risk of failure is considered to be low
Green and Golden Bell Frog Yellow-bellied Glider Squirrel Glider Eastern Pygmy Possum Spotted-tailed Quoll	The Plan includes a commitment to ensure certified-major transport corridors are designed to avoid areas of potential habitat connectivity within riparian corridors where possible for these species (Commitment 3). This is expected to reduce the risk of vehicle strike in these areas	Major transport corridors	Exact outcomes not possible to predict, however, the commitment is expected to reduce the risk of vehicle strike

The specific measures will be implemented in the same way as the general mitigation measures as described above and in detail in Chapter 15, Sections 15.6.1 and 15.6.2.

25 Serious and irreversible impacts

25.1 INTRODUCTION

Section 10.2 of the BAM requires the BCAR to assess whether the urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors in the nominated areas will result in serious and irreversible impacts (SAII) to any NSW listed TECs or species. As outlined in the *Guidance to assist a decision-maker to determine a serious and irreversible impact* (DPIE, 2019) an SAII is one that:

- *Will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or*
- *Will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or*
- *Impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or*
- *Impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable*

This section:

- Sets out the approach and results for identifying relevant TECs and species that are potentially subject to serious and irreversible impacts due to the development (SAII entities)
- Provides a detailed assessment for each relevant SAII entity

Impacts to SAII entities were assessed in accordance with the requirements of Section 10.2 of the BAM and Appendix 4 of the DPIE guidelines (DPIE, 2019). The structure of the assessment for each SAII entity in sections 25.3 to 25.14 reflects these requirements.

25.2 IDENTIFYING SAII ENTITIES

25.2.1 APPROACH

The approach to identify SAII entities impacted by the development is described in Chapter 12 and involved:

- Comparing the list of NSW listed TECs and ECS and candidate SCS that occurs within the nominated areas and are potentially impacted by the development with the:
  - List of SAII entities in the DPIE guidelines (DPIE, 2019)
  - Threatened Biodiversity Data Collection (TBDC) that indicates whether a TEC or species is an SAII entity
- Determining whether any other NSW listed TECs or ECS and candidate SCS that occur within the nominated areas have the potential to become an SAII in accordance with the requirement of section 10.2.1.4 of the BAM. This section of the BAM requires an assessment against the DPIE guidelines (DPIE, 2019) that includes four principles under the BC Regulation (see Table 25-1) that determine whether a species or TEC should be considered an SAII entity. This was undertaken by senior ecologists at Biosis by:
  - Undertaking a literature review to ascertain:
    - Distribution, including geographic extent and area of occupancy
    - Known or inferred reductions in geographic extent or area of occupancy
    - Population sizes and current knowledge of declining populations
    - Susceptibility to known threats, such as invasive weeds and pests, disease, or pathogens
    - Life history traits that may make the species particularly vulnerable
  - Investigating existing records and new records found during targeted surveys for this project and the updated native vegetation mapping (see Chapter 11), and using aerial imagery interpretation, to consider likely impacts in areas approved or planned for other future development in the region
  - Considering risk weightings in the TBDC

- Considering levels of existing protection
- Consultation with senior Department biodiversity officers

Table 25-1 summarises the principles under the BC Regulation that determine whether a species or TEC should be considered an SAII entity.

Table 25-1: Summary of serious and irreversible impact principles (DPIE, 2019)

Principle	Description

Principle 1	**Species or ecological community currently in a rapid rate of decline**
	Entities listed as critically endangered under the BC Act
	• The principle would generally capture entities listed as critically endangered under the BC Act where the reason for that listing is a very large reduction in population size
	Rapid rate of decline for species considered to be critically endangered by IUCN
	• The species has an observed, estimated, inferred, suspected, or projected population reduction of ≥80% in 10 years or three generations (whichever is longer).
	Rapid rate of decline for an ecological community considered to be critically endangered by IUCN
	• To be considered under this principle, the ecological community should have been observed, estimated, inferred, or reasonably suspected to have undergone, or be projected to undergo, a very large reduction in distribution, being:
	  ○ ≥ 90 % reduction where the reduction is measured since 1750 (historical decline), or
	  ○ ≥ 80 % reduction where the reduction is over a 50-year period, either in the past, future, or any part of the past, present, and future

Principle 2	**Species or ecological communities with a very small population size**
	Entities listed as critically endangered under the BC Act
	• The principle would generally capture species or ecological communities listed as critically endangered under the BC Act where the reason for that listing is a very small size or very high environmental degradation and/or a very large disruption of biotic processes or interactions, respectively
	Very small population size for species considered to be critically endangered by IUCN
	• Species that have a very small population size are species with a known population size that is either:
	  ○ fewer than 50 mature individuals independent of whether there are any threats, or
	  ○ fewer than 250 mature individuals and the species has an observed, estimated, or projected continuing decline:
	  ▪ of at least 25 % in three years or one generation (whichever is longer) OR
	  ▪ where the number of mature individuals in each subpopulation is < 50 OR
	  ▪ the percentage of mature individuals in one subpopulation is 90–100 % OR
	  ▪ the population is subject to extreme fluctuations in the number of individuals (IUCN, 2017)
	Very high environmental degradation or disruption of biotic processes or interactions for an ecological community considered to be critically endangered by IUCN
	• Ecological communities that are considered to have a very large degree of environmental degradation or disruption of biotic processes or interactions are those with:
	  ○ ≥ 90 % extent and severity where the disruption or impacts are measured since 1970
	  ○ ≥ 80 % extent and severity where the disruption or impacts are over a 50-year period, either in the past, future, or any part of the past, present, and future (as per (Bland *et al.*, 2016))

Principle	Description
Principle 3	**Species or area of ecological community with very limited geographic distribution** Entities listed as critically endangered under the BC Act • The principle would generally capture entities that are listed as critically endangered under the BC Act where the reason for that listing is their very highly restricted geographic distribution Very limited geographic distribution for species considered to be critically endangered by IUCN • Species that have a very limited geographic distribution are generally known to: o have an area of occupancy (sensu (IUCN, 2017)) of ≤ 10 km2 o have an extent of occurrence (sensu (IUCN, 2017)) of ≤ 100 km2 o have at least two of the following three conditions: ▪ are severely fragmented or only known from one location ▪ continuing decline ▪ extreme fluctuations o inhabit less than or equal to three locations in NSW Very limited geographic distribution for an ecological community considered to be critically endangered by IUCN • The geographical distribution of ecological communities is defined by the area of occupancy (sensu (Bland *et al.*, 2016)). Ecological communities with a very limited geographic distribution have an area of occupancy of less than or equal to two 10 x 10 km grid cells or an extent of occurrence of ≤ 1000 km2 (sensu (Bland *et al.*, 2016)) and one of the following: o an observed or inferred continuing decline in: ▪ a measure of spatial extent appropriate to the ecological community ▪ a measure of environmental quality appropriate to characteristic biota of the ecological community ▪ a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecological community o observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality, or biotic interactions within the next 20 years o an ecological community exists at one location
Principle 4	**Species or ecological community that is unlikely to respond to management and is therefore irreplaceable** • These are species or ecological communities with: 1. Life history traits and/or ecology which is known, but the ability to control key threats at the site scale is negligible. In general, these are species significantly threatened by uncontrollable disease (e.g. frogs highly threatened by chytrid fungus) 2. Known reproductive characteristics that severely limit their ability to increase the existing population on, or occupy new habitat at, a stewardship site. In general, these are plants that are sterile or largely clonal with no or very limited capacity to increase in number through seed production and recruitment • Irreplaceable o Whether an impact on an entity is considered irreplaceable takes into account two factors. The first factor is the likely success in achieving gain in condition, abundance, or habitat area. For potential species that are identified in criteria 1 and 2 above, the likelihood of achieving an offset gain is extremely low or highly uncertain

25.2.2 RESULTS

Table 25-2 and Table 25-3 identify the NSW listed TECs and ECS and candidate SCS species that are SAII entities and that are potentially directly or indirectly impacted by the development (highlighted in blue). These are:

- Cooks River/Castlereagh Ironbark Forest
- Cumberland Plain Woodland
- Shale Sandstone Transition Forest
- *Allocasuarina glareicola*
- *Chalinolobus dwyeri (*Large-eared Pied Bat)
- *Hibbertia fumana*
- *Lathamus discolor* (Swift Parrot)
- *Litoria aurea* (Green and Golden Bell Frog)
- *Melaleuca deanei*
- *Micromyrtus minutiflora*
- Raptors - *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Hieraaetus morphnoides* (Little Eagle), and *Lophoictinia isura* (Square-tailed Kite)
- *Pseudophryne australis* (Red-crowned Toadlet)

A TEC or species is an SAII entity either because:

- It is identified in the DPIE guidelines (DPIE, 2019) or TBDC as an SAII entity, or
- It has been assessed as meeting one or more of the four SAII principles in the BC Regulation (section 10.2.1.4 of BAM)

The species assessed under BAM as meeting one or more of the four SAII principles in the BC Regulation were:

- Green and Golden Bell Frog and Red-crown Toadlet – these species are likely to meet SAII Principle 4 because of their very high susceptibility to the disease Chytrid fungus
- *Micromyrtus minutiflora* – this species is likely to meet SAII Principle 3 because of its very highly restricted distribution and the development directly impacting potential habitat
- Three raptor species – White-bellied Sea-Eagle, Little Eagle, and Square-tailed Kite – these species are likely to meet SAII Principle 4 because there is potential for the development to impact breeding habitat for the species (hollows of very old trees) that cannot readily be created at a stewardship site

TECs and species were identified as unlikely to trigger SAII principles generally on the basis that the development will not have significant impacts on the TEC or species, and:

- The TEC or species has a relatively broad distribution across the Cumberland subregion or NSW
- Known populations for species are relatively large (> 250 individuals)

In considering the impacts to each TEC and species, both direct impacts on potential habitat for TECs and species (see Chapter 23) and existing and new records based on targeted surveys for this project, were taken into account.

Each SAII entity impacted by the development is assessed below in accordance with Section 10.2 of the BAM.

Table 25-2: Identification of TEC SAII entities and assessment against SAII principles

TEC name	NSW status	Cth status	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Castlereagh Scribbly Gum Woodland	V	E	No	No – unlikely to trigger SAII principles	N/A	No
Cooks River/Castlereagh Ironbark Forest	E	CE	SAII advice on EES website	N/A	Yes – directly impacted	Yes
Cumberland Plain Woodland	CE	CE	SAII advice on EES website	N/A	Yes – directly impacted	Yes
Freshwater Wetlands on Coastal Floodplains	E	-	No	No – unlikely to trigger SAII principles	N/A	No
Moist Shale Woodland	E	CE	No	No – unlikely to trigger SAII principles	N/A	No
River-flat Eucalypt Forest on Coastal Floodplains	E	-	No	No – unlikely to trigger SAII principles	N/A	No
Shale Gravel Transition Forest	E	CE	No	No – unlikely to trigger SAII principles	N/A	No
Shale Sandstone Transition Forest	CE	CE	SAII advice on EES website	N/A	Yes – directly impacted	Yes
Swamp Oak Floodplain Forest	E	E	No	No – unlikely to trigger SAII principles	N/A	No

Table 25-3: Identification of species SAII entities and assessment against SAII principles

Species name	NSW status	Cth status	Species type	Bio. risk weight.	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Acacia bynoeana	E	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Acacia pubescens	V	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Allocasuarina glareicola	E	E	SCS	3	SAII advice on EES website	N/A	Yes – potential habitat directly impacted	Yes
Anthochaera Phrygia^	CE	CE	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Anthochaera Phrygia**	CE	CE	SCS	3	No	No – unlikely to trigger SAII principles	No. This species is an SAII entity for mapped Important Areas. EES advised that no mapped Important Areas occur in the nominated areas	No
Artamus cyanopterus cyanopterus	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Botaurus poiciloptilus	E	E	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Calidris ferruginea^	E	CE	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Callocephalon fimbriatum**	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Callocephalon fimbriatum^	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Calyptorhynchus lathami**	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Calyptorhynchus lathami^	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No

Species name	NSW status	Cth status	Species type	Bio. risk weight.	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Cercartetus nanus	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Chalinolobus dwyeri	V	V	SCS	3	SAII advice on EES website	N/A	Yes – Habitat within 100 metres of potential breeding habitat (sandstone cliffs) will be directly impacted	Yes
Chthonicola sagittata	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Circus assimilis	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Climacteris picumnus victoriae	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Daphoenositta chrysoptera	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Dasyurus maculatus	V	E	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Dillwynia tenuifolia	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Epacris purpurascens var. *purpurascens*	V	-	SCS	1.5	No	No – unlikely to trigger SAII principles	N/A	No
Ephippiorhynchus asiaticus	E	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Epthianura albifrons	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Eucalyptus benthamii	V	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Falsistrellus tasmaniensis	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No

Species name	NSW status	Cth status	Species type	Bio. risk weight.	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Glossopsitta pusilla	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Grantiella picta	V	V	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Grevillea juniperina subsp. *juniperina*	V	-	SCS	1.5	No	No – unlikely to trigger SAII principles	N/A	No
Grevillea parviflora subsp. *parviflora*	V	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
*Haliaeetus leucogaster**	V	-	SCS	2	No	Yes – likely to trigger SAII principle 4	Yes – potential breeding habitat directly impacted	Yes
*Haliaeetus leucogaster^*	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Heleioporus australiacus	V	V	SCS	1.5	No	No – unlikely to trigger SAII principles	N/A	No
Hibbertia fumana	CE	-	SCS	3	SAII advice on EES website	N/A	Yes – potential habitat directly impacted	Yes
Hibbertia puberula	E	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
*Hieraaetus morphnoides**	V	-	SCS	1.5	No	Yes – likely to trigger SAII principle 4	Yes – potential breeding habitat directly impacted	Yes
*Hieraaetus morphnoides^*	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Hirundapus caudacutus	-	V	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Irediparra gallinacea	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No

Species name	NSW status	Cth status	Species type	Bio. risk weight.	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Ixobrychus flavicollis	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Lathamus discolor^	E	CE	ECS		No	N/A	N/A	Yes
Lathamus discolor	E	CE	SCS		SAII advice on EES website	N/A	SAII threshold applies - this species is an SAII entity for mapped important areas. Mapped important areas are directly impacted	Yes
Limicola falcinellus^	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Limosa limosa^	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Litoria aurea	E	V	SCS	2	No	Yes – likely to trigger SAII principles 1 and 4	Yes – potential habitat directly impacted	Yes
*Lophoictinia isura**	V	-	SCS	1.5	No	No – unlikely to trigger SAII principles	Yes – potential breeding habitat directly impacted	Yes
Lophoictinia isura^	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Marsdenia viridiflora subsp. *viridiflora*	E	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Maundia triglochinoides	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Melaleuca deanei	V	V	SCS	2	SAII advice on EES website	N/A	Yes – potential habitat directly impacted	Yes
Melanodryas cucullata cucullata	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No

Species name	NSW status	Cth status	Species type	Bio. risk weight.	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Melithreptus gularis gularis	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Meridolum corneovirens	E	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Micromyrtus minutiflora	E	V	SCS	2	No	Yes – likely to trigger SAII principle 3	Yes – potential habitat directly impacted	Yes
Micronomus norfolkensis	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Miniopterus australis^*	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Miniopterus orianae oceanensis^*	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Myotis macropus	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Neophema pulchella	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Ninox connivens**	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
*Ninox connivens^*	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Ninox strenua**	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
*Ninox strenua^*	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Pandion cristatus^*	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No

Species name	NSW status	Cth status	Species type	Bio. risk weight.	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Persicaria elatior	V	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Persoonia bargoensis	E	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Persoonia nutans	E	E	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Petaurus australis	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Petaurus norfolcensis	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Petroica boodang	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Petroica phoenicea	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Phascolarctos cinereus**	V	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
*Phascolarctos cinereus^*	V	V	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Pimelea curviflora var. *curviflora*	E	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Pimelea spicata	E	E	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Pomaderris brunnea	E	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Pseudophryne australis	V	-	SCS	1.5	No	Yes – likely to trigger SAII principle 4	Yes – potential habitat directly impacted	Yes

Species name	NSW status	Cth status	Species type	Bio. risk weight.	Identified by EES as SAII entity	Potential to become SAII entity (Section 10.2.1.4 of BAM)	Is the SAII entity potentially directly or indirectly impacted?	SAII assessment needed
Pteropus poliocephalus^	V	V	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Pterostylis saxicola	E	E	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Pultenaea parviflora	E	V	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Pultenaea pedunculata	E	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Rostratula australis	E	E	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Saccolaimus flaviventris	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Scoteanax rueppellii	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Stagonopleura guttata	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Stictonetta naevosa	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
*Tyto novaehollandiae**	V	-	SCS	2	No	No – unlikely to trigger SAII principles	N/A	No
Tyto novaehollandiae^	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No
Varanus rosenbergi	V	-	ECS		No	No – unlikely to trigger SAII principles	N/A	No

* These species are SCS in relation to breeding / important habitat only ^ These species are ECS in relation to foraging habitat only

25.3 COOKS RIVER/CASTLEREAGH IRONBARK FOREST

25.3.1 TEC BACKGROUND

Cooks River Castlereagh Ironbark Forest in the Sydney Basin Bioregion (CRCIF) is a dry sclerophyll open forest to low woodland community with an overstorey dominated by *Eucalyptus fibrosa* and *Melaleuca decora*, with *Eucalyptus longifolia* often present. The midstorey is usually moderate to dense, commonly including *Melaleuca nodosa* and *Lissanthe strigosa*, and to a lesser extent *Melaleuca decora*. The ground layer is generally sparse (OEH, 2019b).

The TEC is equivalent to the ecological community with the same name listed under the EPBC Act (DoE, 2015).

CRCIF primarily occurs in elevations below 100 m above sea level with mean annual rainfall of approximately 700-1,000 mm. It generally occurs on clay soils derived from Tertiary alluvium and on Wianamatta Shale soils found next to Tertiary alluvium. In the eastern areas of its distribution, the TEC can be found on soils with a sandstone influence (DoE, 2015). The TEC can intergrade into Shale-Gravel Transition Forest (where the alluvium is shallow), Castlereagh Swamp Woodland (in moist depressions) and Castlereagh Scribbly Gum Woodland (on sandier soils) (OEH, 2019b).

A range of fauna species occur in CRCIF, including reptiles, amphibians, birds, micro-bats, and marsupials. Most of these species also rely on other native vegetation in the Cumberland subregion (DoE, 2015). Most plant species in the TEC are able to regenerate after fire from lignotubers and buds beneath the bark and seeds stored in the soil (DoE, 2015).

CRCIF is confined to the Sydney Basin Bioregion and mostly restricted to the Cumberland subregion. The majority of the TEC is found in larger patches in the north-west part of the subregion in the Castlereagh area between Penrith and Richmond. Other significant patches occur in the Kemps Creek and Holsworthy areas. Smaller patches of the ecological community occur in the eastern part of the subregion, such as the upper Cooks River Valley (OEH, 2019b).

25.3.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

CRCIF has been identified as a potential serious and irreversible impacts entity based on advice from EES to accredited assessors in January 2019 as it has a very highly restricted geographic distribution (Principle 3 of the BC Regulation) (OEH, 2017g).

CRCIF is associated with PCT 725 – 'Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion'. The TEC has been mapped within the nominated areas and the Cumberland subregion on the basis of the extent and condition of this PCT (see Chapter 11).

25.3.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of CRCIF in relation to the subject land is shown in Map 25-1.

The majority of CRCIF within the Cumberland subregion occurs outside the nominated areas within the Londonderry and Castlereagh areas in the northern part of the subregion.

The TEC has been mapped as occurring in the following nominated areas:

- GPEC
- WSA

The main occurrences of the TEC within these nominated areas are located:

- Within Wianamatta Regional Park in the northern part of GPEC
- In the south-eastern part of WSA

25.3.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.2 of the BAM.

10.2.2.1(A) THE ACTION AND MEASURES TAKEN TO AVOID THE DIRECT AND INDIRECT IMPACT ON THE POTENTIAL ENTITY FOR AN SAII

Avoidance and minimisation of impacts to biodiversity values, including CRCIF, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

The baseline mapping for this assessment has mapped 63.4 ha of CRCIF within the nominated areas (not including excluded lands). Approximately 25.8 ha (40.7 per cent) of this was avoided within the nominated areas as part of the design of the urban capable land and transport corridors (not including excluded lands). Almost all of this was avoided for biodiversity purposes.

A breakdown of avoidance across each nominated area is provided in Table 25-4.

The table shows that the majority of the total avoidance that has occurred (73.1 per cent) has been of CRCIF in intact condition, and that of the 35 ha of intact condition CRCIF (without excluded lands), the majority (18.9 ha or 54.2 per cent) has been avoided.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-4 shows the amounts of habitat within excluded lands for context only.

Table 25-4: Avoidance outcomes for Cooks River Castlereagh Ironbark Forest (PCT 725)

Condition	Total area in nominated areas (ha)	Area in excluded lands (ha)	Area without excluded lands (ha)	Directly impacted (ha)	Avoided for biodiversity purposes (ha)	Avoided for other purposes (ha)	Total avoidance (ha)
Intact	107.2	72.4	34.9	16.0	18.9	<0.1	18.9
Thinned	49.6	24.0	25.6	18.7	6.8	0.1	6.9
Scattered trees	9.5	6.5	3.0	2.9	<0.1	0.0	<0.1
Total	**166.3**	**102.9**	**63.4**	**37.6**	**25.7**	**0.2**	**25.8**

Avoidance of indirect impacts

Potential indirect impacts to CRCIF due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (g).

10.2.2.1(B) THE AREA (HA) AND CONDITION OF THE TEC TO BE IMPACTED DIRECTLY AND INDIRECTLY BY THE DEVELOPMENT

Direct impacts

A total of 37.6 ha of CRCIF will be directly impacted by the development. This is approximately half of the TEC in the nominated areas (without excluded lands). The direct impacts of the development are mainly associated with the transport corridors.

The main direct impacts occur:

- In the northern part of GPEC within Wianamatta Regional Park associated with the OSO
- In the south-eastern part of WSA associated with urban development

Scattered smaller patches of the TEC will also be directly impacted in the central part of GPEC.

The direct impacts of the development on CRCIF are provided in Table 25-5.

Table 25-5: Direct impacts on Cooks River Castlereagh Ironbark Forest (PCT 725)

PCT	Condition	Direct impacts (ha)						Vegetation integrity score
		Wilton*	GMAC*	WSA*	GPEC*	Transport #	Total	
725	Intact	0.0	0.0	0.8	0.0	15.2	**16.0**	49.2
725	Thinned	0.0	0.0	8.6	6.4	3.7	**18.7**	43.3
725	Scattered Trees	0.0	0.0	2.9	0.0	0.0	**2.9**	19.6
Total		**0.0**	**0.0**	**12.4**	**6.4**	**18.9**	**37.6**	

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

Indirect impacts

Potential indirect impacts to CRCIF due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (g).

10.2.2.1(c) THE EXTENT TO WHICH THE IMPACT EXCEEDS THE THRESHOLD FOR THE POTENTIAL ENTITY

No threshold has been established for CRCIF.

10.2.2.1(d) THE EXTENT AND OVERALL CONDITION OF THE POTENTIAL TEC WITHIN AN AREA OF 1,000 HA, AND THEN 10,000 HA, SURROUNDING THE URBAN CAPABLE LANDS

The extent and condition of CRCIF surrounding the urban capable lands are provided in Table 25-6. Due to the scale of the development, calculations were also presented based on a 1 km buffer and a 10 km buffer from the outer edge of the urban capable lands, as well as buffers of 1,000 ha or 10,000 ha as per the BAM.

Table 25-6: Extent and condition of Cooks River Castlereagh Ironbark Forest (PCT 725) surrounding the urban capable lands

PCT	Condition	Area in 1,000 ha buffer	Area in 10,000 ha buffer	Area in 1,000 m buffer	Area in 10,000 m buffer
725	Intact	19.7	83.6	162.4	769.2
725	Thinned	21.4	30.9	46.7	117.2
725	Scattered Trees	3.6	6.8	17.6	267.2
Total		**44.7**	**121.3**	**226.6**	**1,153.6**

10.2.2.1(e) AN ESTIMATE OF THE EXTANT AREA AND OVERALL CONDITION OF THE POTENTIAL TEC REMAINING IN THE IBRA SUBREGION BEFORE AND AFTER THE IMPACT OF THE DEVELOPMENT HAS BEEN TAKEN INTO CONSIDERATION

The development will result in a loss of 2.8 per cent of the remaining area of CRCIF in the Cumberland subregion.

The extent and condition of CRCIF remaining in the subregion before and after the impact of the development is provided in Table 25-7. The largest percentage change relates to the TEC in thinned condition. Only very small changes occur to the TEC in intact condition (-1.9 per cent change).

Table 25-7: Extent and condition of Cooks River Castlereagh Ironbark Forest (PCT 725) before and after development

PCT	Condition	Current area in Cumberland subregion (ha)	Area in Cumberland subregion after the direct impacts of the development (ha)	Per cent loss of current area in Cumberland subregion (%)
725	Intact	836.6	820.6	-1.9
725	Thinned	187.1	168.4	-10.0
725	Scattered Trees	327.4	324.5	-0.9
Total		**1,351.1**	**1,313.5**	**-2.8**

10.2.2.1(f) AN ESTIMATE OF THE AREA OF THE POTENTIAL TEC THAT IS IN THE RESERVE SYSTEM WITHIN THE IBRA REGION AND THE IBRA SUBREGION

The area of CRCIF occurring within protected lands (land reserved under NPW Act) within the Cumberland subregion is 412.2 ha. This represents 30.5 per cent of the total area of the remaining TEC in the subregion.

The extent and condition of CRCIF within protected lands is provided in Table 25-8.

Table 25-8: Extent and condition of Cooks River Castlereagh Ironbark Forest (PCT 725) in protected lands

PCT	Condition	Area in protected lands within the Cumberland subregion (ha)
725	Intact	402.4
725	Thinned	5.8
725	Scattered Trees	4.0
	Total	**412.2**

10.2.2.1(g) THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION PROPOSAL'S IMPACT ON:

(i) ABIOTIC FACTORS CRITICAL TO THE LONG-TERM SURVIVAL OF THE POTENTIAL TEC

(ii) CHARACTERISTIC AND FUNCTIONALLY IMPORTANT SPECIES

(iii) THE QUALITY AND INTEGRITY OF AN OCCURRENCE OF THE POTENTIAL TEC THROUGH THREATS AND INDIRECT IMPACTS

The Final Determination (NSW Scientific Committee, 2011) and BioNet profile (OEH, 2019b) for CRCIF identify a range of threats to the TEC. Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna

These threats and indirect impacts have the potential to degrade the condition of the TEC and reduce the long-term viability of the patches of the TEC, particularly in the following locations:

- Northern part of GPEC where the OSO corridor fragments TEC patches
- South-eastern part of WSA where urban development occurs immediately adjacent to several TEC patches

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. This includes a requirement to undertake mitigation in accordance with the *Best Practice Guidelines: Cooks River/Castlereagh Ironbark Forest* (DECC, 2008) within and adjacent to the TEC. Relevant actions under these commitments and specific mitigation measures for the TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes can affect the structure and species composition of the TEC by altering the mid and ground layers (NSW Scientific Committee, 2011). This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

The diversity and composition of species will change with time since fire, and may also change in response to changes in fire frequency (NSW Scientific Committee, 2011). This is despite most plant species in the TEC being able to regenerate after fire from lignotubers and buds beneath the bark, as well as seeds stored in the soil (OEH, 2019b).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development. For the TEC this includes areas in the north of GPEC, and the south-east of WSA.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.
- A specific requirement in Appendix E of the Plan under Commitments 5 and 6 to apply best practice guidelines for managing the TEC (DECC, 2008). This includes specifics around fire management for the TEC.

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting the TEC

- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas
- The fire management requirements for the TEC specified in the best practice guidelines will be applied

WEED INVASION

The TEC is threatened with invasion and competition by weeds. It typically occurs on soils that are richer in nutrients compared to other soil types in the Sydney Basin bioregion, which means it is particularly susceptible to threats from weeds (DECC, 2008). The most serious threats are African Lovegrass, scramblers and vines, and urban weeds such as Mother of Millions (OEH, 2019b).

These weeds are already present within the nominated areas and pose a threat to the TEC. However, urban and transport development in the vicinity of the TEC has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds. The TEC is most susceptible to the threat of weeds from development under the Plan where new urban development or transport corridors occur adjacent to the TEC and/or fragments patches of the TEC into smaller patches and introduces edge effects. Key risk areas include the northern part of GPEC and south-eastern part of WSA.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds
- A specific requirement in Appendix E of the Plan under Commitments 5 and 6 to apply best practice guidelines for managing the TEC (DECC, 2008). This includes specifics around weed management for the TEC.

Importantly for the TEC, weeds will be actively managed within the 110 ha to be added to conservation as part of the conservation program under the Plan.

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC

- There will be a range of planning controls to minimise the potential spread of weeds during and after construction
- The weed management requirements for the TEC specified in the best practice guidelines will be applied

INAPPROPRIATE HABITAT DISTURBANCE

Damage caused by human disturbance, such as motorbikes, bicycles, 4WD vehicles, rubbish dumping, trampling, and erosion is identified in the BioNet profile as a threat to the TEC (OEH, 2019b).

These activities have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the nominated areas may increase due to the urban development. Occurrences of the TEC considered most at risk are those in the northern part of GPEC and the south-eastern part of WSA.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including in the specific offset for the TEC – see below)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

CHANGES TO HYDROLOGY

The main threat to the TEC is associated with altered hydrology is increased runoff into patches of the TEC carrying high nutrient and sediment loads, as well as weed seeds or propagules. This can both encourage weed invasion and cause siltation and erosion (OEH, 2019b).

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban or transport development occurs adjacent (and upstream or upslope) to the TEC. Key risk areas are those in the northern part of GPEC and the south-eastern part of WSA.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles

        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA and NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

DISEASES, PATHOGENS AND DIEBACK

The TEC is potentially susceptible to dieback caused by the root-rot fungus *Phytophthora cinnamomi* (OEH, 2019b).

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with *Phytophthora cinnamomi*. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans that must set out measures to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora*

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

INVASIVE FAUNA

TECs can be threatened by introduced animals and aggressive native species, including CRCIF (DECC, 2008). These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as foxes, rats, house mice and rabbits which are primarily related to agricultural development

- Aggressive bird species which compete for resources including the introduced Indian Myna, and native species such as the Sulphur-crested Cockatoo

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the nominated areas and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers.

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
  - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
  - Preparation of a Pest Animal Control Implementation Strategy
  - A process to enter into written agreements with delivery partners to implement the pest animal control program
  - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
  - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
  - Require appropriate management and control of pest animals relevant to development sites

10.2.2.1(H) DIRECT OR INDIRECT FRAGMENTATION AND ISOLATION OF AN IMPORTANT AREA OF THE POTENTIAL TEC

Direct loss of CRCIF may cause fragmentation and isolation of remaining patches of the TEC, which may increase the susceptibility of the TEC to weed invasion and other edge effects and reduce its long-term viability.

Fragmentation and isolation of CRCIF will mainly occur in the following areas:

- In the northern part of GPEC within Wianamatta Regional Park associated with the OSO
- In the south-eastern part of WSA associated with urban development

The small area of scattered patches of the TEC in the central part of GPEC will be completed removed.

The most notable impact to CRCIF occurs within Wianamatta Regional Park. The patches of the TEC in this location form part of a larger, well-connected patch of native vegetation, and large parts of the patch are in intact condition. These impacts will lead to fragmentation of the TEC in this location, reducing the size and increasing the isolation of the areas that remain. This will increase the susceptibility of CRCIF in this location to weed invasion and other edge effects and reduce its long-term viability. The patch that is directly impacted is only marginally connected to the second occurrence of the TEC within Wianamatta Regional Park (to the east of Ropes Crossing) and as such, the development is not expected to increase the level of fragmentation to the TEC in this locality more broadly.

The patches of the TEC in the south-eastern part of WSA are already relatively fragmented and isolated as a result of existing industrial land use and farming. The urban development in this location is not considered to greatly increase the level of fragmentation and isolation in this location.

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE POTENTIAL TEC IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of CRCIF in the Cumberland subregion. Several commitments are described in more detail the sections above.

Key commitments relevant to the TEC are:

- TEC-specific commitments or mitigation measures to:
  - Secure an offset target of 115 ha of CRCIF (Commitment 8.2) in conservation lands within the Cumberland subregion. This would increase the area of TEC protected within the Cumberland subregion from approximately 30 percent to approximately 39 per cent
  - Undertake management of fire, weeds and pest animals and disease control consistent with the *Best Practice Guidelines: Cooks River/Castlereagh Ironbark Forest* (DECC, 2008) (under Commitment 5 and 6)
- As part of securing a minimum of 5,325 ha of native vegetation in the SCA, undertake ecological restoration of priority areas secured for conservation within the Cumberland subregion (Commitment 13). This includes restoring up to 1,330 ha of native vegetation, including targeting CRCIF
- Manage weeds (Commitment 15) and pest animals (Commitment 16) in strategic locations in the Cumberland subregion to reduce threats to conservation lands secured within SCAs. This includes preparing:
  - A Weed Control Strategy to guide and co-ordinate delivery of a weed control program
  - A Pest Animal Control Implementation Strategy to guide and co-ordinate delivery of a pest control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within SCAs. This includes:
  - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
  - Preparing a Fire Management Strategy to guide and co-ordinate fire management

25.4 CUMBERLAND PLAIN WOODLAND

25.4.1 TEC BACKGROUND

Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) is a woodland or forest with an overstorey dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*), with Narrow-leaved Ironbark (*E. crebra*), Spotted Gum (*Corymbia maculata*) and Thin-leaved Stringybark (*E. eugenioides*) occurring less frequently. The TEC typically comprises an open tree canopy, a near-continuous groundcover dominated by grasses and herbs, sometimes with layers of shrubs and/or small trees (NSW Scientific Committee, 2009).

The TEC is listed under the EPBC Act as part of *Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest in the Sydney Basin Bioregion* (DEWHA, 2009a).

CPW generally occurs on flat to undulating or hilly terrain up to about 350 m elevation but may also occur on locally steep sites and at slightly higher elevations, and on clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain (NSW Scientific Committee, 2009).

Several other TECs may intergrade with CPW, including CRCIF, *Shale Gravel Transition Forest in the Sydney Basin Bioregion (SGTF)* and *Moist Shale Woodland and Shale Sandstone Transition Forest* (SSTF) (NSW Scientific Committee, 2009).

CPW is restricted to the Sydney Basin Bioregion. It is known to occur in the Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly LGAs (NSW Scientific Committee, 2009). The remaining area of the TEC is severely fragmented, with more than half of the remaining area occurring in patches of less than 80 ha in 2009 (NSW Scientific Committee, 2009).

25.4.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

CPW has been identified as a potential serious and irreversible impacts entity under the EES guidelines because it is currently in a rapid rate of decline (Principle 1 of the BC Regulation) and is subject to high levels of degradation or disruption of biotic processes (Principle 2 of the BC Regulation) (DPIE, 2020).

CPW is associated with the following PCTs:

- PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain
- PCT 850 – Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain

The TEC has been mapped within the nominated areas and the Cumberland subregion on the basis of the extent and condition of these PCTs (see Chapter 11).

25.4.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of CPW in relation to the subject land is shown in Map 25-2.

CPW is relatively evenly distributed in scattered patches across the Cumberland subregion generally west of Parramatta and Liverpool, with the majority of large patches occurring in the centre and northern parts of the subregion.

The TEC has been mapped as occurring in all nominated areas.

25.4.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.2 of the BAM.

10.2.2.1(a) THE ACTION AND MEASURES TAKEN TO AVOID THE DIRECT AND INDIRECT IMPACT ON THE POTENTIAL ENTITY FOR AN SAII

Avoidance and minimisation of impacts to biodiversity values, including CPW, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

The baseline mapping for this assessment has mapped 812.8 ha of CPW within the nominated areas (not including excluded lands). Approximately 303.8 ha (37.4 per cent) of this was avoided within the nominated areas as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 252.9 ha was avoided for biodiversity purposes
- 50.9 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-9.

The table shows that of the 147 ha of intact condition CPW (without excluded lands), the majority (109 ha or 74 per cent) has been avoided.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-9 shows the amounts of habitat within excluded lands for context only.

Table 25-9: Avoidance outcomes for Cumberland Plain Woodland (PCT 849 and 850)

Condition	Total area in nominated areas (ha)	Area in excluded lands (ha)	Area without excluded lands (ha)	Directly impacted (ha)	Avoided for biodiversity purposes (ha)	Avoided for other purposes (ha)	Total avoidance (ha)
Intact condition	613.5	524.0	89.4	31.5	47.6	10.4	57.9

Condition	Total area in nominated areas (ha)	Area in excluded lands (ha)	Area without excluded lands (ha)	Directly impacted (ha)	Avoided for biodiversity purposes (ha)	Avoided for other purposes (ha)	Total avoidance (ha)
Thinned condition	1,869.8	1,289.8	580.0	345.3	195.0	39.6	234.6
Scattered trees	335.0	191.6	143.4	132.2	10.3	0.9	11.2
DNG	539.9	99.9	440.1	422.5	17.0	0.5	17.5
Total	**3,358.2**	**2,105.3**	**1,252.8**	**931.5**	**269.9**	**51.4**	**321.3**

Avoidance of indirect impacts

Potential indirect impacts to CPW due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (g).

10.2.2.1(b) THE AREA (HA) AND CONDITION OF THE TEC TO BE IMPACTED DIRECTLY AND INDIRECTLY BY THE DEVELOPMENT. THE CONDITION OF THE TEC IS TO BE REPRESENTED BY THE VEGETATION INTEGRITY SCORE FOR EACH VEGETATION ZONE

Direct impacts

A total of 931.5 ha of CPW will be directly impacted by the development. This is approximately 62.6% per cent of the TEC in the nominated areas (without excluded lands). The direct impacts of the development are mainly associated with urban development. The direct impacts mainly occur:

- Wilton: to most remaining patches of the TEC, including several large patches. These patches are mainly low condition (DNG or scattered trees) and occur primarily in the northern and central parts of the nominated area. Many of these patches are relatively isolated, although some occur adjacent to other native vegetation associated with the gorges and gullies along the edges of the nominated area
- GMAC: to many small to moderate sized scattered patches of mainly low to moderate condition (DNG, scattered trees or thinned) throughout the nominated area. Most of these patches are isolated, particularly in the northern section of the nominated area, although some occur adjacent to other native vegetation associated with the gorges and gullies along the edges of the southern part of the nominated area. Development will impact some intact patches in the southern part of the nominated area. These patches are generally small and narrow
- WSA: to several moderate to large patches of mainly low to moderate condition TEC (DNG, scattered trees or thinned) in two main areas – the southern arm of the nominated area, and the northern part of the nominated area near Luddenham Road, which will be impacted by the transport corridors (Outer Sydney Orbital (OSO)). Most patches are relatively isolated and surrounded by either farmland or existing urban development
- GPEC: to many scattered mostly small patches in moderate condition that are generally isolated from larger patches of native vegetation and surrounded by farmland or existing urban development. Two large areas of CPW occur in this nominated area around Jordan Springs west of Wianamatta Regional Park, and at Orchard Hills.

The direct impacts of the development on CPW are provided in Table 25-10.

Table 25-10: Direct impacts on Cumberland Plain Woodland (PCT 849 and 850)

PCT	Condition	Direct impacts (ha)						Vegetation integrity score
		Wilton*	GMAC*	WSA*	GPEC*	Transport#	Total	
849	Intact	1.6	10.7	6.1	0.1	9.0	**27.4**	53.9
849	Thinned	23.4	37.4	154.4	56.7	29.9	**301.7**	42.3
849	Scattered trees	23.8	26.3	57.1	3.3	10.1	**120.7**	18.3
849	DNG	148.7	28.2	38.8	8.9	2.8	**227.4**	24.1
850	Intact	0.0	4.0	0.0	0.0	0.0	**4.0**	58.1
850	Thinned	0.0	21.8	5.8	16.1	0.0	**43.6**	41.9
850	Scattered trees	0.9	6.9	1.6	2.2	0.0	**11.5**	38.1
850	DNG	159.6	12.3	0.2	23.0	0.0	**195.1**	25.7
Total		**357.9**	**147.7**	**263.9**	**110.2**	**51.7**	**931.5**	

* Impacts from urban development only within each nominated area
\# Impacts from transport corridors across all nominated areas

Indirect impacts

Potential indirect impacts to CPW due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (g).

10.2.2.1(c) A DESCRIPTION OF THE EXTENT TO WHICH THE IMPACT EXCEEDS THE THRESHOLD FOR THE POTENTIAL ENTITY

No threshold has been established for CPW.

10.2.2.1(d) THE EXTENT AND OVERALL CONDITION OF THE POTENTIAL TEC WITHIN AN AREA OF 1,000 HA, AND THEN 10,000 HA, SURROUNDING THE URBAN CAPABLE LANDS

The extent and condition of CPW surrounding the urban capable lands are provided in Table 25-11. Due to the scale of the development, calculations were also presented based on a 1 km buffer and a 10 km buffer from the outer edge of the urban capable lands, as well as buffers of 1,000 ha or 10,000 ha as per the BAM.

Table 25-11: Extent and condition of Cumberland Plain Woodland (PCT 849 and 850) surrounding the urban capable lands

PCT	Condition	Area in 1,000 ha buffer	Area in 10,000 ha buffer	Area in 1,000 m buffer	Area in 10,000 m buffer
849	Intact	35.6	198.0	648.1	3,022.5
849	Thinned	357.1	703.0	1,221.9	3,253.7
849	Scattered trees	133.4	248.7	669.9	4,190.4
849	DNG	235.3	283.7	296.2	332.1
850	Intact	10.1	89.3	267.3	1,870.1
850	Thinned	53.3	138.4	251.5	1,010.9
850	Scattered trees	15.0	95.5	407.2	4,059.4
850	DNG	200.0	206.8	207.5	208.1
Total		**1,039.8**	**1,963.4**	**3,969.6**	**17,947.3**

10.2.2.1(E) AN ESTIMATE OF THE EXTANT AREA AND OVERALL CONDITION OF THE POTENTIAL TEC REMAINING IN THE IBRA SUBREGION BEFORE AND AFTER THE IMPACT OF THE DEVELOPMENT HAS BEEN TAKEN INTO CONSIDERATION

The development will result in a loss of 4.1 per cent of the remaining area of CPW in the Cumberland subregion.

The extent and condition of CPW remaining in the subregion before and after the impact of the development is provided in Table 25-12. The largest percentage changes relate to the TEC in very low condition (DNG). Only very small changes occur to the TEC in intact condition (-0.6 per cent change for PCT 849, and -0.2 per cent change for PCT 850).

Table 25-12: Extent and condition of Cumberland Plain Woodland (PCT 849 and 850) before and after the development

PCT	Condition	Current area in Cumberland subregion (ha)	Area in Cumberland subregion after the direct impacts of the development (ha)	Per cent loss of current area in Cumberland subregion (%)
849	Intact	4,292.6	4,265.1	-0.6
849	Thinned	3,552.5	3,250.8	-8.5
849	Scattered trees	5,940.8	5,820.1	-2.0
849	DNG	332.1	104.7	-68.5
850	Intact	2,657.3	2,653.3	-0.2
850	Thinned	1,117.2	1,073.5	-3.9
850	Scattered trees	4,895.2	4,883.7	-0.2
850	DNG	208.1	13.0	-93.8
Total		**22,995.7**	**22,064.2**	**-4.1**

Trend analysis for PCT 849

As part of the EPBC Act strategic assessment process for the nominated areas and transport corridors, a trend analysis looking at the extent and condition of PCT 849 over the life of the Plan was undertaken by RMIT University (Gordon and Peterson, 2019) (see Supporting Document D). The project (while only looking at one of the two PCTs that make up CPW) has direct relevance to the assessment of CPW as an SAII entity.

The trend analysis examined the potential impacts of development and offsetting under various scenarios on PCT 849 in the Cumberland subregion. It considered a summed score across the landscape for the PCT of extent and ecological condition (the latter being based on an approximation of the BAM vegetation integrity score).

The project involved two major components:

- A formal expert elicitation to gather quantitative knowledge regarding how the condition of PCT 849 will change over time under:
  - High or low intensity management
  - The case where the PCT is exposed to typical ongoing private land activities
- Quantitative modelling to simulate the urban development within the designated nominated areas and compensation via managing areas as biodiversity offsets in a strategically defined offset region and the ecological response of the PCT. The modelling included eight scenarios exploring different options for implementing biodiversity offsets which varied:
  - The timing of when offsets are implemented
  - The total area of offsets implemented
  - The type of management implemented for the offsets (low or high intensity)

The analysis found that:

- Existing landscape scale threats (e.g. weed invasion, grazing, rubbish dumping, disturbance from recreational activities) across the Cumberland subregion are significant and will result in an approximate 5.8% decline in the extent and condition of the PCT over the life of the Plan unless additional areas are managed
- The proposed impacts of development under the Plan will lead to approximately the same magnitude of losses (~ 5.8 %) to the PCT that will result due to existing landscape threats
- High intensity management and early offsetting will provide the greatest benefits to the outcomes of the PCT over the life of the Plan
- Securing approximately 1,600 ha of offsets for the PCT:
    - Will compensate for the impacts of development where earlier offsetting and higher intensity management is preferential by improving the extent and condition of the PCT over the life of the Plan
    - Has the potential to also contribute significantly to addressing the declines across the subregion due to existing landscape scale threats

Subsection (i) below sets out the actual offsets that are proposed under the Plan for CPW. These include a commitment to protect 2,803 ha of PCT 849 which is significantly greater than the modelled amount of 1,600 ha used in the trend analysis. The results of the trend analysis when considered in the context of the actual commitments of the Plan strongly indicate that PCT 849 will be substantially better off due to implementation of the Plan.

10.2.2.1(F) AN ESTIMATE OF THE AREA OF THE POTENTIAL TEC THAT IS IN THE RESERVE SYSTEM WITHIN THE IBRA REGION AND THE IBRA SUBREGION

The area of CPW occurring within protected lands (land reserved under NPW Act) within the Cumberland subregion is 1,289 ha. This represents 6 per cent of the total area of the remaining TEC in the subregion.

The extent and condition of CPW within protected lands is provided in Table 25-13.

Table 25-13: Extent and condition of Cumberland Plain Woodland (PCT 849 and 850) in protected lands

PCT	Condition	Area in protected lands within the Cumberland subregion (ha)
849	Intact	989.8
849	Thinned	323.3
849	Scattered trees	110.8
849	DNG*	N/A
850	Intact	152.1
850	Thinned	8.2
850	Scattered trees	25.3
850	DNG*	N/A
Total		**1,609.6**

* DNG mapping is not available outside of the nominated areas

10.2.2.1(G) THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION PROPOSAL'S IMPACT ON:

(I) ABIOTIC FACTORS CRITICAL TO THE LONG-TERM SURVIVAL OF THE POTENTIAL TEC

(II) CHARACTERISTIC AND FUNCTIONALLY IMPORTANT SPECIES THROUGH IMPACTS

(III) THE QUALITY AND INTEGRITY OF AN OCCURRENCE OF THE POTENTIAL TEC THROUGH THREATS AND INDIRECT IMPACTS

The Final Determination (NSW Scientific Committee, 2009) and BioNet profile (OEH, 2009) for CPW identify a range of threats to the TEC. Where these threats are present in the nominated areas and have the potential to be exacerbated

under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna

The greatest risk areas for these relevant threats are:

- Wilton: along the edges of the urban capable lands mainly around the outer edges of the nominated area, particularly in the northern part of the area
- GMAC: along the edges of the urban capable lands within the southern part of the nominated area
- WSA: along the edges of the urban capable lands
- GPEC: along the edges of the urban capable lands, in particular in the west and north of the nominated area

Impacts from inappropriate livestock grazing regimes was also identified in the Conservation Advice as a key threat. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate this risk across the nominated areas.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes can affect the structure and species composition of the TEC (OEH, 2009). This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Fire regimes influence the plant species composition and vegetation structure of the TEC and are also likely to influence other components of the community (NSW Scientific Committee, 2009). Fire intervals of 4 to 12 years are likely to maintain most understorey species within the TEC. Fire intervals which are too short are associated with reduced native plant diversity (NSW Scientific Committee, 2009). Disruption of ecological processes associated with altered fire regimes contributes to a very large reduction in the ecological function of the TEC (NSW Scientific Committee, 2009).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development. For the TEC, this includes areas in and around GPEC, WSA and GMAC, and to a lesser degree in Wilton, where the TEC is much less extensive.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values

  - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
  - A process to work with delivery partners to implement the fire management strategy
  - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

WEED INVASION

Weed invasion also poses a major threat to the TEC (NSW Scientific Committee, 2009). Weeds can displace native plants and reduce the diversity and regenerative capacity of the TEC. The Final Determination lists a wide range of weed species that threaten the TEC, including African Olive (O*lea europa* subsp. *cuspidata*), Bridal Creeper (*Asparagus asparagoides*) and a range of exotic grasses (NSW Scientific Committee, 2009).

These weeds are already present within the nominated areas and pose a threat to the TEC. However, urban development and transport have the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban development occurs adjacent to the TEC and introduces edge effects. Key risk areas include in and around GPEC, WSA and GMAC, and to a lesser degree in Wilton where the TEC is much less extensive.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
  - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction

  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Importantly for the TEC, weeds will be actively managed within the offset to be secured for the TEC (see below).

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified as a threat to the TEC (OEH, 2009). This relates to a wide range of different mechanisms for disturbance including:

- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as cause weed invasion
- Inappropriate recreational activities such as 4WD and trail bike use which can directly impact areas of the TEC and facilitate processes such as erosion
- Removal of woody debris and firewood collection which changes the structure and habitat features of the TEC

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the nominated areas may increase due to the urban development. Occurrences of the TEC considered most at risk are those in and around GPEC, WSA and GMAC, and to a lesser degree in Wilton where the TEC is much less extensive.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those location (including the offset to be secured for the TEC – see below)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction

- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

CHANGES TO HYDROLOGY

The creation of hard surfaces associated with urban development and transport results in changes to the hydrology of surrounding areas. The main threat to the TEC associated with altered hydrology is increased runoff into patches of the TEC carrying high nutrient and sediment loads, as well as weed seeds or propagules (OEH, 2009). This can both encourage weed invasion and cause erosion and sedimentation.

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban or transport development occurs adjacent (and upstream or upslope) to the TEC. Key risk areas include in and around GPEC, WSA and GMAC, and to a lesser degree in Wilton where the TEC is much less extensive.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA and NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

DISEASES, PATHOGENS AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens and dieback which can substantially affect their long-term viability. CPW at a Commonwealth level is recognised as being susceptible to dieback caused by the root-rot fungus *Phytophthora cinnamomi* (DoEE, 2018b).

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with *Phytophthora cinnamomi*. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
  - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
  - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans that must set out the measures to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora*

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

INVASIVE FAUNA

TECs can be threatened by introduced animals and aggressive native species. Predation of native fauna by cats and foxes is specifically identified as a threat to the TEC (OEH, 2009). Pest animals can lead to declines in biodiversity through:

- Predation on native fauna
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the nominated areas and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and foxes are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats in the local area, which, in turn, may lead to an increase in feral cat numbers.

The Plan incorporates a range of measures to manage these risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
  - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
  - Preparation of a Pest Animal Control Implementation Strategy
  - A process to enter into written agreements with delivery partners to implement the pest animal control program
  - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
  - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
  - Require appropriate management and control of pest animals relevant to development sites

10.2.2.1(H) DIRECT OR INDIRECT FRAGMENTATION AND ISOLATION OF AN IMPORTANT AREA OF THE POTENTIAL TEC

Direct loss of CPW may cause fragmentation and isolation of remaining patches of the TEC, which may increase the susceptibility of the TEC to weed invasion and other edge effects and reduce its long-term viability.

Fragmentation and isolation of patches of CPW will mainly occur in the following areas:

- Wilton: Development will remove most remaining patches of the TEC. Three larger patches of mostly moderate condition TEC will be reduced in size. These patches will not be isolated by the development and will remain contiguous with larger areas of native vegetation associated with the gorges and gullies on the edges of the nominated area, which will reduce the effects of fragmentation
- GMAC: Development will mostly remove scattered patches of mainly low to moderate condition TEC. Patches of the TEC that will remain are already generally isolated and surrounded by farmland or existing urban development, particularly in the southern part of the nominated area and the development will not generally result in further isolation of remaining patches. In some areas, remaining patches will remain contiguous with larger areas of native vegetation associated with the gorges and gullies on the edges and middle of the southern part of the nominated area, which will reduce the effects of fragmentation
- WSA: In the northern part of the nominated area near Luddenham Road, the OSO will fragment a large patch of mainly low to moderate condition TEC. In the southern part of the nominated area, an area of relatively well-connected patches of the TEC will be mostly removed and the TEC will only remain along a narrow riparian corridor. In both these cases, the development will reduce the size of the patch and increase the susceptibility of the TEC to weed invasion and other edge effects, which may reduce its long-term viability
- GPEC: In the northern part of the nominated area, a relatively narrow patch of the TEC that occurs within Wianamatta Regional Park will be fragmented by the OSO. This will reduce the size of the patch and increase the susceptibility of the TEC within the Regional Park to weed invasion and other edge effects. This is not expected to reduce the long-term viability of the TEC in this locality as the remaining patches will be managed for conservation in the Regional Park. In other parts of the nominated area, the development usually removes entire patches of the TEC and will not generally result in increased fragmentation or increased isolation of patches

10.2.2.1(i) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE POTENTIAL TEC IN THE IBRA SUBREGION

The Plan includes a range of commitments and actions that will contribute to the recovery of CPW in the Cumberland subregion. Several commitments are described in more detail the sections above.

The key commitments relevant to the TEC are:

- TEC-specific commitments to secure an offset target of 2,885 ha of CPW (Commitment 8.2) in conservation lands within the SCA. This includes a target of 2,150 ha of PCT 849 and a target of 735 ha of PCT 850. This would increase the area of TEC protected within the Cumberland subregion from approximately 6.9 percent to 19.5 percent.
- As part of securing a minimum of 5,325 ha of native vegetation in the SCA, undertake ecological restoration of priority areas secured for conservation within the Cumberland subregion (Commitment 13). This includes restoring up to 1,330 ha of native vegetation, including targeting CPW
- Manage weeds (Commitment 15) and pest animals (Commitment 16) in strategic locations in the Cumberland subregion to reduce threats to conservation lands secured within the SCA. This includes preparing:
    - A Weed Control Strategy to guide and co-ordinate delivery of a weed control program
    - A Pest Animal Control Implementation Strategy to guide and co-ordinate delivery of a pest control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
    - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
    - Preparing a Fire Management Strategy to guide and co-ordinate fire management

As outlined previously in subsection (e), the trend analysis (Gordon and Peterson, 2019) when considered in the context of the commitments of the Plan, strongly indicates that PCT 849 will be substantially better off due to implementation of the Plan under scenarios of high intensity management and early offsetting. While care needs to be taken in extrapolating the results of the analysis to PCT 850, it is considered highly likely that the commitments in the Plan will also provide substantial benefits to that PCT over the life of the Plan.

25.5 SHALE SANDSTONE TRANSITION FOREST

25.5.1 TEC BACKGROUND

Shale Sandstone Transition Forest in the Sydney Basin Bioregion (SSTF) is a forest or woodland with an overstorey that may include *Eucalyptus punctata*, *Eucalyptus resinifera*, one of the stringybarks (*Eucalyptus globoidea, Eucalyptus eugenioides, Eucalyptus sparsifolia, Eucalyptus agglomerata*). One or more ironbark species may be locally important. The understorey may be either grassy and herbaceous or shrubby with a notable amount of grass cover (although the presence of some shrubs, such as *Banksia* and *Persoonia* species, indicate the site may not be SSTF). In areas that have not been burnt for long periods the understorey may be dense. Species composition varies between sites depending on geographical location and local conditions (e.g. topography, relative influence of sandstone or shale) (NSW Scientific Committee, 1995).

The TEC is equivalent to the ecological community with the same name listed under the EPBC Act, although it is important to note that condition thresholds apply to the EPBC listed community (DoE, 2014a).

SSTF generally occurs on soils derived from a shallow shale or clay material overlying sandstone, or where shale-derived materials have washed down over sandstone-derived substrate. Such sites are generally close to the geological boundary between the Wianamatta Shale and the Hawkesbury Sandstone (NSW Scientific Committee, 1995). The contributing shale must come from the Wianamatta group. Shale lenses that occur in the Hawkesbury Sandstone provide a different chemistry and may relate to a different TEC (O'Hares Creek Shale Forest).

The TEC is confined to the Sydney Basin Bioregion and mostly restricted to areas transitional between clay soils derived from Wianamatta Shale and sandy soils derived from Hawkesbury Sandstone on the margins of the Cumberland Plain (NSW Scientific Committee, 1995). The main occurrences of the TEC are in the Hawkesbury, The Hills, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly LGAs (OEH, 2019k) and it extends west into the lower Blue Mountains. Many occurrences are linear s, which may be as narrow as 20 m wide (NSW Scientific Committee, 1995).

25.5.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

SSTF has been identified as a potential SAII entity under the OEH guidelines because it is it subject to high levels of degradation or disruption of biotic processes (Principle 2 of the BC Regulation) and a very highly restricted geographic distribution (Principle 3 of the BC Regulation) (OEH, 2017g).

SSTF is associated with PCT 1395 – 'Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion'. The TEC has been mapped within the nominated areas and the Cumberland subregion on the basis of the extent and condition of this PCT (see Chapter 11)

25.5.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of SSTF in relation to the subject land is shown in Map 25-3.

The majority of SSTF within the Cumberland subregion occurs on the edges of the subregion outside the nominated areas north-west of Richmond, west of the Nepean River around Gulguer Nature Reserve, and in the southern part of the subregion around Tahmoor, Wilton, and Appin.

The TEC has been mapped as occurring in the following nominated areas:

- Wilton
- GMAC, mainly in the southern part of the nominated area
- A small area in far western GPEC

25.5.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.2 of the BAM.

10.2.3.1(A) THE ACTION AND MEASURES TAKEN TO AVOID THE DIRECT AND INDIRECT IMPACT ON THE POTENTIAL ENTITY FOR AN SAII

Avoidance and minimisation of impacts to biodiversity values, including SSTF, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

The baseline mapping for this assessment has mapped 2,640.2 ha of SSTF within the nominated areas (not including excluded lands). Approximately 2,180.5 ha (82.6 per cent) of this was avoided within the nominated areas as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,929.2 ha was avoided for biodiversity purposes
- 251.3 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-14.

The table shows that the majority of the total avoidance that has occurred (66.4 per cent) has been of SSTF in intact condition, and that of the 1,492.6 ha of intact condition SSTF (without excluded lands), the vast majority (1,446.8 ha or 96.9 per cent) has been avoided.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-14 shows the amounts of habitat within excluded lands for context only.

Table 25-14: Avoidance outcomes for Shale Sandstone Transition Forest (PCT 1395)

Condition	Total area in nominated areas (ha)	Area in excluded lands (ha)	Area without excluded lands (ha)	Directly impacted (ha)	Avoided for biodiversity purposes (ha)	Avoided for other purposes (ha)	Total avoidance (ha)
Intact condition	1,841.4	348.9	1,492.6	45.7	1,229.7	217.2	1,446.8
Thinned condition	986.8	270.8	716.0	145.6	538.1	32.3	570.5
Scattered trees	125.3	50.7	74.6	41.0	32.8	0.8	33.6
DNG	403.7	46.7	357.0	227.5	128.6	1.0	129.6
Total	**3,357.3**	**717.1**	**2,640.2**	**459.8**	**1,929.2**	**251.3**	**2,180.5**

Avoidance of indirect impacts

Potential indirect impacts to SSTF due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (g).

10.2.2.1(b) THE AREA (HA) AND CONDITION OF THE TEC TO BE IMPACTED DIRECTLY AND INDIRECTLY BY THE DEVELOPMENT. THE CONDITION OF THE TEC IS TO BE REPRESENTED BY THE VEGETATION INTEGRITY SCORE FOR EACH VEGETATION ZONE

Direct impacts

A total of 459.8 ha of SSTF will be directly impacted by the development. This is approximately 17.4 per cent of the TEC in the nominated areas (without excluded lands). The direct impacts of the development are mainly associated with urban development. The direct impacts mainly occur:

- Wilton: along the edges of the urban capable lands mainly around the outer edges of the nominated area, particularly in the northern part of the area
- GMAC: along the edges of the urban capable lands within the southern part of the nominated area

The direct impacts of the development on SSTF are provided in Table 25-15.

Table 25-15: Direct impacts on Shale Sandstone Transition Forest (PCT 1395)

PCT	Condition	Direct impacts (ha)						Vegetation integrity score
		Wilton*	GMAC*	WSA*	GPEC*	Transport#	Total	
1395	Intact	10.9	34.8	0.0	0.0	0.0	**45.7**	72.9
1395	Thinned	70.8	74.7	0.0	0.0	0.0	**145.6**	63.9
1395	Scattered trees	17.9	23.1	0.0	0.0	0.0	**41.0**	30
1395	DNG	171.2	56.3	0.0	0.0	0.0	**227.5**	28.4
Total		**270.9**	**188.9**	**0.0**	**0.0**	**0.0**	**459.8**	

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

Indirect impacts

Potential indirect impacts to SSTF due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (g).

10.2.2.1(c) A description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact

No threshold has been established for SSTF.

10.2.2.1(d) The extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the urban capable lands

The extent and condition of SSTF surrounding the urban capable lands are provided in Table 25-16. Due to the scale of the development, calculations were also presented based on a 1 km buffer and a 10 km buffer from the outer edge of the urban capable lands, as well as buffers of 1,000 ha or 10,000 ha as per the BAM.

Table 25-16: Extent and condition of Shale Sandstone Transition Forest (PCT 1395) surrounding the urban capable lands

PCT	Condition	Area in 1,000 ha buffer	Area in 10,000 ha buffer	Area in 1,000 m buffer	Area in 10,000 m buffer
1395	Intact	85.8	1,178.0	2,409.1	5,410.8
1395	Thinned	198.6	674.5	963.6	1,657.0
1395	Scattered trees	45.5	103.7	439.6	2,676.4
1395	DNG	244.3	363.6	384.5	403.8
Total		**574.2**	**2,319.8**	**4,196.7**	**10,148.0**

10.2.2.1(e) An estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the development has been taken into consideration

The development will result in a loss of 3.7 per cent of the remaining area of SSTF in the Cumberland subregion.

The extent and condition of SSTF remaining in the subregion before and after the impact of the development is provided in Table 25-17. The largest percentage change relates to the TEC in very low condition (DNG). Only very small changes occur to the TEC in intact condition (-0.7 per cent change).

Table 25-17: Extent and condition of Shale Sandstone Transition Forest (PCT 1395) before and after the development

PCT	Condition	Current area in Cumberland subregion (ha)	Area in Cumberland subregion after the direct impacts of the development (ha)	Per cent loss of current area in Cumberland subregion (%)
1395	Intact	6,404.7	6,358.9	-0.7
1395	Thinned	1,642.6	1,497.0	-8.9
1395	Scattered trees	4,085.3	4,044.3	-1.0
1395	DNG	402.1	174.7	-56.6
Total		**12,534.7**	**12,074.9**	**-3.7**

10.2.2.1(f) AN ESTIMATE OF THE AREA OF THE POTENTIAL TEC THAT IS IN THE RESERVE SYSTEM WITHIN THE IBRA REGION AND THE IBRA SUBREGION

The area of SSTF occurring within protected lands (land reserved under NPW Act) within the Cumberland subregion is 507.1 ha. This represents 4 per cent of the total area of the remaining TEC in the subregion.

The extent and condition of SSTF within protected lands is provided in Table 25-18.

Table 25-18: Extent and condition of Shale Sandstone Transition Forest (PCT 1395) in protected lands

PCT	Condition	Area in protected lands within the Cumberland subregion (ha)
1395	Intact	420.3
1395	Thinned	27.9
1395	Scattered trees	58.8
1395	DNG*	N/A
Total		**507.1**

* DNG mapping is not available outside of the nominated areas

10.2.2.1(g) THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION PROPOSAL'S IMPACT ON:

(i) ABIOTIC FACTORS CRITICAL TO THE LONG-TERM SURVIVAL OF THE POTENTIAL TEC

(ii) CHARACTERISTIC AND FUNCTIONALLY IMPORTANT SPECIES THROUGH IMPACTS

(iii) THE QUALITY AND INTEGRITY OF AN OCCURRENCE OF THE POTENTIAL TEC THROUGH THREATS AND INDIRECT IMPACTS

The Final Determination (NSW Scientific Committee, 1995) and BioNet profile (OEH, 2019k) for SSTF identify a range of threats to the TEC. Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology

The greatest risk areas within Wilton and GMAC for these relevant threats are:

- Wilton: along the edges of the urban capable land mainly around the outer edges of the nominated area, particularly in the northern part of the area

- GMAC: along the edges of the urban capable land within the southern part of the nominated area

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes can affect the structure and species composition of the TEC (OEH, 2019k). This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development. For the TEC this includes areas in and around Wilton and the southern part of GMAC where significant areas of the TEC are present.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas
- The measures in the Plan for Koalas in terms of protecting and managing habitat, and constraining access to bushland will help protect the TEC

WEED INVASION

The TEC is threatened with invasion of weeds. Weeds can displace native plants and reduce the diversity and regenerative capacity of the TEC. Weeds that are a particular threat are invasive exotic grasses like African love grass (*Eragrostis curvula*) and Chilean needle grass (*Nassella neesiana*), as well as Lantana (*Lantana camara*), Broad-leafed and Small-leaf Privet (*Ligustrum lucidum* and *L. Sinense*), African olive (*Olea europaea* subsp. *cuspidate*), and Bridal Creeper (*Myrsiphyllum asparagoides*), and environmental weeds such as Sweet Pittosporum (*Pittosporum undulatum*) (OEH, 2019k).

These weeds are already present within the nominated areas and pose a threat to the TEC. However, development within the nominated areas has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban development occurs adjacent to the TEC and introduces edge effects. Key risk areas include:

- In north and north-west of Wilton, where the urban capable land impacts the edges of patches of the TEC connected to gorges and gullies on the edge of the nominated area
- In the southern part of GMAC, where the urban capable land impacts the edges of patches of the TEC connected to gorges and gullies on the edge and middle of the nominated area

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Importantly for the TEC, weeds will be actively managed within the offset to be secured for the TEC (see below).

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Final Determination and BioNet profile as a threat to the TEC. Disturbance can relate to a wide range of different mechanisms for disturbance including:

- Inappropriate mowing, slashing, or scrubbing of the understorey for reasons such as bushfire fuel reduction, grazing and perceived aesthetics
- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants
- Inappropriate recreational activities such as mountain bike use and 4WDs which can directly impact areas of the TEC and facilitate processes such as erosion

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance may increase due to development within the nominated areas. Occurrences of the TEC considered most at risk are those that occur in close proximity to development within Wilton and GMAC.

The Plan incorporates a range of measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- A commitment (Commitment 7) to mitigate indirect and prescribed impacts from urban, infrastructure and major infrastructure (transport) development on Koalas. This is relevant to the TEC because large areas are identified as important Koala habitat. Of particular relevance to habitat disturbance are associated actions around the use of exclusion fencing which will assist in controlling access to Koala habitat. These measures will help minimise inappropriate habitat disturbance to the TEC within both Wilton and GMAC
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the offset to be secured for the TEC)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- The measures in the Plan for Koalas in terms of protecting and managing habitat, and constraining access to bushland will help protect the TEC
- A program of education for the community will be run to help them understand the biodiversity values they live near

CHANGES TO HYDROLOGY

The creation of hard surfaces associated with urban development and transport results in changes to the hydrology of surrounding areas. The main threat to the TEC associated with altered hydrology is increased runoff into patches of the TEC carrying high nutrient and sediment loads, as well as weed seeds or propagules (OEH, 2019k). This can both encourage weed invasion and cause erosion.

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban development occurs adjacent (and upstream or upslope) to the TEC. Key risk areas are:

- In north and north-west of Wilton
- In the southern part of GMAC

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA and NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

10.2.2.1(H) DIRECT OR INDIRECT FRAGMENTATION AND ISOLATION OF AN IMPORTANT AREA OF THE POTENTIAL TEC

Direct loss of SSTF may cause fragmentation and isolation of remaining patches of the TEC, which may increase the susceptibility of the TEC to weed invasion and other edge effects and reduce its long-term viability.

Fragmentation and isolation of patches of SSTF will mainly occur in the following areas:

- Wilton: along the edges of the urban capable lands mainly around the outer edges of the nominated area, particularly in the northern part of the area
- GMAC: along the edges of the urban capable lands within the southern part of the nominated area

Within both nominated areas, patches of the TEC are relatively well connected around the edges of the urban capable lands. In Wilton, this occurs mainly around the outer edges of the nominated area, particularly in the northern part. In GMAC, this occurs around the outer edges as well as through the middle of the southern part of the nominated area.

Urban development in these nominated areas mainly directly impacts the edges of the TEC and does not generally impact this connectivity. While direct impacts will reduce the size and width of some patches around the edges of the urban capable lands, it does not generally result in isolation of these patches.

Where direct impacts will impact connectivity between patches of the TEC, these areas are generally already only marginally connected as a result of existing urban development or farming, and as such, the development is not expected to increase the level of fragmentation to the TEC in the locality more broadly.

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE POTENTIAL TEC IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of SSTF in the Cumberland subregion. Several commitments are described in more detail the sections above.

The key commitments relevant to the TEC are:

- TEC-specific commitments to secure an offset target of 1,455 ha of SSTF (Commitment 8.2) in conservation lands within the Cumberland subregion. This would increase the area of TEC protected within the Cumberland subregion from approximately 4 per cent to approximately 15.6 per cent
- As part of securing a minimum of 5,325 ha of native vegetation in the SCA, undertake ecological restoration of priority areas secured for conservation within the Cumberland subregion (Commitment 13). This includes restoring up to 1,330 ha of native vegetation, including targeting SSTF
- Manage weeds (Commitment 15) and pest animals (Commitment 16) in strategic locations in the Cumberland subregion to reduce threats to conservation lands secured within SCAs. This includes preparing:
    - A Weed Control Strategy to guide and co-ordinate delivery of a weed control program
    - A Pest Animal Control Implementation Strategy to guide and co-ordinate delivery of a pest control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
    - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
    - Preparing a Fire Management Strategy to guide and co-ordinate fire management

25.6 ALLOCASUARINA GLAREICOLA

25.6.1 SPECIES BACKGROUND

Allocasuarina glareicola is an erect, smooth-barked shrub with cones that grows to approximately 2 m tall (DoEE, 2018a; OEH, 2018a). The species is monoecious or dioecious and flowers around October each year. The time taken for the plants to flower and set seed is not known. Regeneration is commonly by suckers. Root suckers can appear up to 3 m from the parent plant, where clumps of hundreds of stems may be a single individual. Seedling recruitment has only been observed at one site. The species is wind pollinated which means the distance between individuals may be a critical factor in enabling pollination and seed set (DoEE, 2018a; OEH, 2018a).

A. glareicola inhabits Castlereagh woodland and open woodland (with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla and Melaleuca decora*). It occurs on strongly acidic soils with low fertility (DoEE, 2018a; OEH, 2018a).

Records are primarily restricted to the Castlereagh and Londonderry areas of the Cumberland Plain where there are 36 known occurrences of the species, with an outlier population found in Liverpool (Holsworthy Military Area). The total range of the species is approximately 36 km^2.

25.6.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

A. glareicola is being assessed as a candidate species credit species for GPEC. The species has been also identified as a potential SAII entity under the DPIE guidelines (Principle 3 of the BC Regulation) (DPIE, 2019), as it has a very highly restricted geographic distribution.

25.6.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of *A. glareicola* in relation to the subject land is shown in Map 25-4.

GPEC occurs within the southern extent of *A. glareicola's* stronghold in the Castlereagh and Londonderry areas.

There is one known population of *A. glareicola* within the nominated areas. This occurs in GPEC, located within a rail corridor along Hobart St in St Marys. This population is disjunct from the majority of known records which occur approximately 8 km to the north and are generally associated with larger, more intact remnants of native vegetation. The population in St Marys is located approximately 1.2 km from the nearest urban capable land.

Approximately 200 ha of potential habitat for the species has been identified in the nominated areas. This occurs in GPEC. The majority of potential habitat occurs within the Wianamatta Regional Park in the northern part of GPEC. A smaller patch of potential habitat has been mapped in Orchard Hills towards the middle of GPEC. The remaining habitat areas exist as scattered and isolated remnants across the eastern half of GPEC.

25.6.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM.

10.2.3.1(A) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including *A. glareicola*, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

The population of *A. glareicola* within GPEC occurs outside the urban capable land and has been avoided.

The baseline mapping for this assessment has mapped 32.3 ha of potential habitat for *A. glareicola* within GPEC (not including excluded lands). Approximately 14.8 ha (46.1 per cent) of this was avoided within GPEC as part of the design of the urban capable land and transport corridors (not including excluded lands). All of this was avoided for biodiversity purposes.

A breakdown of avoidance across each nominated area is provided in Table 25-19.

Table 25-19: Avoidance outcomes for *A. glareicola*

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential habitat (ha)	200	167.7	32.3	17.4	14.8	0.1	14.9

Avoidance of indirect impacts

Potential indirect impacts to *A. glareicola* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(B) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Development within the nominated areas will not directly impact on any records or known populations of *A. glareicola.*

Potential indirect impacts to *A. glareicola* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(C) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

No threshold has been established for *A. glareicola.*

10.2.3.1(D) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

A total of 17.4 ha of potential habitat will be directly impacted by the development. This is 53.9 per cent of the potential habitat in the nominated areas (not including excluded lands). The direct impacts of the development are associated with urban development and a transport corridor (the M7/Ropes Crossing Link Road). The main direct impacts occur:

- Along the northern boundary of GPEC within the alignment of the M7/Ropes Crossing Link Road
- Two scattered patches of potential habitat at Orchard Hills, which will be impacted by urban development

Although survey confirmed the species is absent from the OSO, the OSO alignment does bisect two areas of mapped potential habitat to the east of west of the OSO alignment.

The direct impacts of the development on *A. glareicola* are provided in Table 25-20.

Table 25-20: Direct impacts on *A. glareicola*

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Potential habitat (ha)	0	0	0	12.9	4.5	17.4

Impacts to habitat within northern GPEC

The M7/Ropes Crossing Link Road impacts on 4.4 ha of potential habitat along the northern boundary of GPEC. The habitat impacted is contiguous with mapped habitat in Shanes Park.

Although not directly impacting on mapped habitat, the OSO corridor will lead to fragmentation of potential habitat within Wianamatta Regional Park, leading to a number of smaller, isolated patches of vegetation. This fragmentation may increase impacts associated with edge effects (primarily weeds) and this has the potential to compromise the suitability of remaining habitat areas directly adjacent to development.

The species was confirmed absent within the OSO corridor during project surveys, and the likelihood that the species actually occurs within lands adjacent to the corridor is considered low given:

- The area forms part of a Regional Park which is managed by the NSW NPWS and would be well traversed
- The species is a conspicuous shrub which can be surveyed for throughout the year

This low likelihood of occurrence considerably reduces the risk of impacts to *A. glareicola* on key life-cycle processes. Furthermore, the species primarily regenerates through suckers and occasionally via wind pollination and neither of these processes are likely to be affected by fragmentation of potential habitat in this location.

Impacts to habitat at Orchard Hills

The loss of potential habitat for *A. glareicola* at Orchard Hills is associated with small remnants of scattered vegetation surrounded by houses and farmland. The extent of cleared land in the area means that impacts are unlikely to increase edge effects to retained habitat areas or further reduce their viability.

A section of potential habitat within the urban capable land which could be accessed as part of this biodiversity certification process was surveyed and the species was not observed. It is generally considered unlikely that potential habitat in this area contributes to the ongoing survival or viability of the species more broadly.

Indirect impacts

Potential indirect impacts to *A. glareicola* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(e) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of potential habitat areas within GPEC is unlikely to affect the ecology of *A. glareicola* in the locality because:

- There is a low likelihood the species occurs within this habitat
- The loss and extent of fragmentation of potential habitat will not affect the key life-cycle processes of the species, which primarily regenerates through suckers and occasional seed production via wind pollination

10.2.3.1(f) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the loss of potential habitat areas within GPEC is unlikely to fragment or isolate any local populations of *A. glareicola.* There will be fragmentation of potential habitat from impacts caused by the M7/Ropes Crossing Link Road. Further fragmentation may occur within Wianamatta Regional Park as a result of the

OSO corridor bisecting two areas of potential habitat. However, this is considered to have limited implications for the species in the region given the low likelihood of occurrence within this habitat.

10.2.3.1(G) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

Potential habitat within GPEC occurs within the southern extent of the *A. glareicola* stronghold in the Castlereagh and Londonderry areas, and is within the geographic extent of the species.

There is one known population within the nominated area in St Marys. This population is disjunct from the majority of known records which occur approximately 8 km to the north and are generally associated with larger, more intact remnants of native vegetation and will not be directly or indirectly impacted by development.

10.2.3.1(H) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profile and additional available information for *A. glareicola* identify a range of threats to the species (DoEE, 2018a; OEH, 2018a). Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Habitat degradation from rubbish dumping and unrestricted access
- Weed invasion
- Inappropriate fire regimes

The greatest risk areas within GPEC for these relevant threats are:

- The southern end of Shanes Park where M7/Ropes Crossing Link Road occurs adjacent to potential habitat areas
- The north-eastern section of Wianamatta Regional Park, where the OSO corridor bisects two areas of potential habitat

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *A. glareicola* are discussed below for each identified indirect impact.

HABITAT DEGRADATION

Habitat degradation through unrestricted public access and rubbish dumping have been identified as a key threat to *A. glareicola* (OEH, 2018a). Development within GPEC may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand

and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

WEED INVASION

A. glareicola is threatened with invasion and competition by weeds, with African lovegrass *(Eragrostis curvula)*, Whisky grass (*Andropogon virginicus*), *Pennisetum clandestinum*, *Ricinus communis* and Asparagus fern considered to be the main competitors (OEH, 2018a). These weeds are already present within the Strategic Assessment Area. However, urban and transport development within GPEC has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA. This includes a number of actions, of which the following are the most relevant to the outcome for *A. glareicola*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

INAPPROPRIATE FIRE REGIMES

A. glareicola can regenerate following fire. However, plants may be damaged and fruit production and seed set prevented by too frequent fires (OEH, 2018a). Increased human activity within GPEC increases the risk of fire to habitat areas supporting the species.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for *A. glareicola* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans

- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *A. glareicola*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

There is currently approximately 1,159.6 ha of potential habitat mapped within protected areas. This includes potential habitat within:

- Wianamatta Regional Park
- Wianamatta Nature Reserve
- Castlereagh Nature Reserve
- Agnes Banks Nature Reserve
- Windsor Downs Nature Reserve

Eleven records (likely to comprise a single biological population) occur within the Castlereagh Nature Reserve. No other occurrences of the species are currently protected.

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of *A. glareicola* in the Cumberland subregion. Several commitments are described in more detail the sections above.

Key commitments relevant to the species are:

- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential habitat for *A. glareicola* in the SCA, as there is approximately 453.7 ha of mapped potential habitat in the SCA for this species
- Manage weeds (Commitment 15) in strategic locations in the Cumberland subregion to reduce threats to conservation lands secured within the SCA. This includes preparing a Weed Control Strategy to guide and co-ordinate delivery of a weed control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
    - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
    - Preparing a Fire Management Strategy to guide and co-ordinate fire management

25.7 CHALINOLOBUS DWYERI

25.7.1 SPECIES BACKGROUND

Large-eared Pied Bat (*Chalinolobus dwyeri*) is a small to medium insectivorous bat with shiny, black fur (DERM, 2011).

The species appears to roost predominantly in caves and crevices in sandstone cliffs and forage in nearby high-fertility forest or woodland near watercourses and in gullies (DERM, 2011). Roosting areas can also include old mines and disused mud nests. The species is generally constrained to 'areas within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels' (OEH, 2019a).

Large-eared Pied Bat has specific requirements in relation to the structure of breeding roosts. Caves need to be high and deep enough to allow juvenile bats to learn to fly and have indentations in the roof to allow the capture of heat. These physical characteristics are very uncommon in the landscape (DERM, 2011). The species is not known to roost in tree hollows (DERM, 2011). The species breeds in early winter and young are born in early summer. The species uses the same maternity roosting sites over many years (DERM, 2011).

Almost all records of the Large-eared Pied Bat are within several kilometres of cliff lines or rocky terrain. Evidence suggests the species does not usually forage in sandstone habitat and prefers fertile valleys and plains, as well as areas with moderately-tall to taller trees along waterways (DERM, 2011).

Habitat critical to the survival of the species comprises:

- Breeding sites
- Sandstone cliffs and fertile wooded valley habitat within close proximity of each other (DERM, 2011)

Large-eared Pied Bat occurs from Shoalwater Bay in central Queensland to Ulladulla in south-eastern NSW. In NSW, the species is generally rare with a very patchy distribution. It is found in the north east at Coolah Tops, Mt Kaputar and Warrumbungle National Park and in sandstone areas of the Sydney Basin and the western slopes and plains including Pilliga Nature Reserve (DERM, 2011). The area of occupancy is estimated to be 9,120 km^2 (DoEE, 2018a).

The species is known to breed in very few locations across NSW and the distance bats move from the maternity roost to over-wintering roosts has not been established, but is likely to be less than 100 km (DoEE, 2018a). As such all records within the Cumberland subregion are considered likely to be from the same breeding population.

Records for the Large-eared Pied Bat are widespread surrounding the Cumberland subregion and some records occur within the subregion. Records occur within Wilton and GMAC and adjacent to GPEC.

25.7.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

The Large-eared Pied Bat is being assessed as a candidate Species Credit Species for Wilton, WSA and GMAC.

The species has been identified as a potential SAII entity under the TBDC because it has a very highly restricted geographic distribution (Principle 3 of the BC Regulation) (DPIE, 2020). The species is also likely to be a potential entity because of Principle 4 of the BC Regulation as breeding habitat is likely to be irreplaceable.

The species has been identified as a potential SAII entity in relation to potential breeding habitat and the presence of breeding individuals. Potential breeding habitat comprises:

> *PCTs associated with the species within 100 m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings*

For the purposes of this BCAR, potential breeding habitat was mapped on the basis of:

- Associated PCTs as defined in TBDC in 'intact', 'thinned' and 'scattered trees' condition, and that are:
  - Within areas of Hawkesbury Sandstone and Minchinbury Sandstone geology, and
  - Within 200 m of locations where caves, crevices and cliffs are more likely to occur

Locations where caves, crevices and cliffs are more likely to occur were mapped by:

- Manipulation of a bare earth Digital Elevation Model to produce a layer that showed the mean elevation within a 30 m x 30 m grid surrounding each 1 m elevation grid cell
- Creation of a Topographic Position Index to identify the height of each 1 m cell above/below local mean elevation
- Reclassification of the Topographic Position Index to identify only areas that were high enough above the local mean elevation to create a topographic brake that might support cliffs
- Overlay the cliffs layer with a sandstone geology layer to exclude areas outside sandstone geology

The cliffs layer was validated through inspection of aerial photos and knowledge of the topography and landscape of the nominated areas, as well as site observations during surveys.

The potential breeding habitat was not able to be confirmed as actual breeding habitat. While Anabat surveys were undertaken for the species within a part of the northern section of Wilton, the surveys did not confirm the presence of breeding habitat or breeding individuals. The species was not detected during surveys.

25.7.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of Large-eared Pied Bat in relation to the subject land is shown in Map 25-5.

Records for the Large-eared Pied Bat are widespread surrounding the Cumberland subregion and some records occur within the subregion. A population of Large-eared Pied Bat occurs within Wilton and the southern part of GMAC associated with several records. Within Wilton, a cluster of recent records (as recent as 2016) occur in the vicinity of existing development in the central-eastern section of the nominated area. Within GMAC, a few recent records (as recent as 2014) occur in the Gilead area around the centre of the southern section of the nominated area.

Interrogation of the observation codes of records for the species indicate there are no known roost or breeding sites for the species within the nominated areas (OEH, 2019a).

Approximately 1,093.9 ha of potential breeding habitat for the Large-eared Pied Bat has been identified in the nominated areas. This occurs within Wilton and the southern section of GMAC.

25.7.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM.

10.2.3.1(a) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including Large-eared Pied Bat, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

Records associated with a population of Large-eared Pied Bat have been avoided within the nominated areas, although one record in GMAC occurs on the very edge of the urban capable land.

The baseline mapping for this assessment has mapped 882.2 ha of potential breeding habitat for Large-eared Pied Bat within Wilton and GPEC (not including excluded lands). Approximately 876.5 ha (99.3 per cent) of this was avoided as part of the design of the urban capable land and transport corridors (not including excluded lands). Of this:

- 452 ha was avoided for biodiversity purposes
- 424.5 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-21.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-21 shows the amounts of habitat within excluded lands for context only.

Table 25-21: Avoidance outcomes for Large-eared Pied Bat

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential breeding habitat (ha)	1,093.9	211.6	882.2	5.8	452	424.5	876.5

Avoidance of indirect impacts

Potential indirect impacts to Large-eared Pied Bat due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(b) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Development in the nominated areas will not directly impact on records or known populations of Large-eared Pied Bat.

Potential indirect impacts to Large-eared Pied Bat potential breeding habitat due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(c) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

Breeding habitat has been identified as an impact threshold for Large-eared Pied Bat.

While Anabat surveys were undertaken for the species within a part of the northern section of Wilton, the surveys did not confirm the presence of breeding habitat or breeding individuals.

10.2.3.1(d) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

A total of 7.5 ha of potential breeding habitat will be directly impacted by the development. This is 0.8 per cent of the potential habitat in the nominated areas (without excluded lands). The direct impacts of the development are associated with urban development. The main direct impacts occur at the edges of Wilton and the southern part of GMAC.

The direct impacts of the development on Large-eared Pied Bat are provided in Table 25-22.

Table 25-22: Direct impacts on Large-eared Pied Bat

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Potential breeding habitat (ha)	3.6	2.2	0	0	0	5.8

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

The impacts to potential breeding habitat within Wilton and GMAC are unlikely to affect life cycle processes or impact the viability of any local population of Large-eared Pied Bat because:

- While roosting or breeding sites may occur, there are no known roosting or breeding sites for the species in the area
- Only a very small proportion of potential breeding habitat is directly impacted. The vast majority of potential breeding habitat has been avoided for biodiversity or other purposes
- The impacts are unlikely to cause fragmentation or isolation of potential breeding habitat because only the fringes of potential breeding habitat that occurs on the edges of gorges and gullies are impacted
- The corridors of potential breeding habitat that exist along the gorges and gullies are maintained
- Potential breeding habitat in the nominated areas forms a relatively small part of much broader and intact areas of habitat to the north and west of the Plan Area and to the south of Sydney

10.2.3.1(e) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of potential breeding habitat within the Wilton and GMAC is unlikely to affect the ecology of any local population of Large-eared Pied Bat in the area, including because:

- Only a very small proportion of potential breeding habitat is directly impacted

- The impacts are unlikely to cause fragmentation or isolation of potential breeding habitat and the corridors of potential breeding habitat that exist along the gorges and gullies are maintained

10.2.3.1(f) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the loss of potential breeding habitat within Wilton and GMAC is unlikely to cause fragmentation or isolation of habitat because only the edges of potential breeding habitat are impacted and the corridors of habitat that exist along the gorges and gullies are maintained.

10.2.3.1(g) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

All records within the Cumberland subregion are considered likely to be from the same breeding population.

While roosting or breeding sites may occur, development within Wilton and GMAC will not directly impact any known roosting or breeding sites for Large-eared Pied Bat and will only impact a very small proportion of potential breeding habitat for the species in the nominated areas around the edges of this habitat.

The development is therefore not considered likely to affect the broader population in the Cumberland subregion.

Potential breeding habitat within Wilton and GMAC is not at the limit of the species range. Records for the species are widespread surrounding the Cumberland subregion.

10.2.3.1(h) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profile (OEH, 2017h) and Recovery Plan (DERM, 2011) for the Large-eared Pied Bat identify a range of threats to the species Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Use of pesticides
- Disturbance of roosts from human recreational activities
- Fire in the proximity of roosts
- Predation by introduced predators

The greatest risk areas within Wilton and GMAC for these relevant threats are around the edges of the nominated areas along gorges and gullies associated with waterways, including the Nepean River.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Large-eared Pied Bat are discussed below for each identified indirect impact.

USE OF PESTICIDES

Use of pesticides has been identified as a threat to the Large-eared Pied Bat. Poisoning of pest animals may occur during implementation of the Plan as part of the Pest Animal Control Implementation Strategy (Commitment 16).

The Plan includes Action 3 under Commitment 16, as follows: "*Ensure that the Pest Animal Control Implementation Strategy specifies the use of pest control techniques that will reduce the risk of secondary poisoning from Pindone or second-generation rodenticides*"

This measure is considered to be sufficient to address the threat posed to the Large-eared Pied Bat.

DISTURBANCE OF ROOSTS FROM HUMAN RECREATIONAL ACTIVITIES

Disturbance of roosts from recreational activities such as bushwalking, caving and abseiling is identified as a threat to the Large-eared Pied Bat. Regular disturbance can lead to bats abandoning roosts or depleting essential fat reserves (DERM, 2011).

Areas considered most at risk from increased disturbance due to recreational activities are those that occur in close proximity to development within Wilton and GMAC. Roosting and maternity caves are most likely to be located within the sandstone areas adjacent to and surrounding the Strategic Assessment Area. Much of this land is protected for conservation or as part of Sydney's drinking water catchment and should have existing management frameworks to prevent inappropriate access and use.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- A commitment (Commitment 7) to mitigate indirect impacts from urban, infrastructure and major infrastructure (transport) development on Koalas. This is relevant to the species because a lot of the mapped habitat for the Large-eared Pied Bat is identified as important Koala habitat. Of particular relevance to habitat disturbance are associated actions around the use of exclusion fencing which will assist in controlling access to Koala habitat. These measures will help minimise inappropriate habitat disturbance to potential habitat within both Wilton and GMAC
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 2,413.1 ha of potential habitat for the Large-eared Pied Bat is contained within the three conservation reserves proposed by the Plan
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan, combined with existing management of protected areas adjacent to the Plan Area is expected to adequately manage the risk to the species from inappropriate recreational use.

FIRE IN THE PROXIMITY OF ROOSTS

Bushfires and prescribed burning are identified as a key threat to the Large-eared Pied Bat as they are potentially susceptible to direct mortality from heat and smoke if the fire is close to their relatively shallow cave roosts (DERM, 2011). Changes in foraging resources and prey species as a result of altered fire regimes may also impact the species (DERM, 2011).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for the Large-eared Pied Bat being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk

- Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Large-eared Pied Bat. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

PREDATION BY INTRODUCED PREDATORS

Predation by introduced predators such as cats, foxes and rats has been identified in the Recovery Plan as a possible, but unknown, threat to the Large-eared Pied Bat. Concerns relate to predation on individuals where they are forced to roost close to the ground (DERM, 2011).

Existing land use within the nominated areas and surrounding region includes residential areas and farming, which means cats are unlikely to pose a novel threat to the species in the area. However, the extent of proposed new urban development under the Plan means the threat is likely to be exacerbated.

Appendix E of the Plan contains the following measure: "Where permitted and appropriate, contain domestic cats and dogs in new residential areas during operation of the development at the urban/bushland interface consistent with relevant Council guidelines." This measure will be implemented via the Mitigation Measures Guideline and DCP template and applies in Wilton and GMAC. Although this measure does not specifically identify the Large-eared Pied Bat as a target species, it nonetheless is likely to benefit the species through mitigating the threat of increased densities of domestic cats.

The Plan incorporates a range of measures to manage the risks associated with introduced predators. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCAs. This includes a number of actions with the most relevant to the outcome for the species being:
  - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
  - Preparation of a Pest Animal Control Implementation Strategy
  - A process to enter into written agreements with delivery partners to implement the pest animal control program
  - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
  - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
  - Require appropriate management and control of pest animals relevant to development sites

These measures are considered to adequately mitigate the threat to the species.

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

There is currently approximately 25 ha of potential breeding habitat for the Large-eared Pied Bat mapped within protected areas in the nominated areas. The number of known breeding sites in NSW is very limited. However, other protected areas in NSW where the species is known to occur include (DERM, 2011):

- Bouddi National Park
- Big Scrub Flora Reserve
- Blue Mountains National Park
- Bungonia Nature Reserve
- Coolah Tops National Park
- Goulburn River National Park
- Mt Kaputar National Park
- Morton National Park
- Munghorn Gap Nature Reserve
- Pilliga Scrub Nature Reserve
- Richmond Range National Park
- Royal National Park
- Warrumbungle National Park
- Wollemi National Park
- Yengo National Park

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of Large-eared Pied Bat in the Cumberland subregion. Several commitments are described in more detail the sections above.

The key commitments relevant to the species are:

- Manage pest animals in strategic locations in the Cumberland subregion (Commitment 16) to reduce threats to conservation lands secured within the SCA. This includes preparing a Pest Animal Control Implementation Strategy to guide and co-ordinate delivery of a pest control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
    - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
    - Preparing a Fire Management Strategy to guide and co-ordinate fire management

Due to the low risk of direct impacts on Large-eared Pied Bat potential breeding habitat, the Plan does not include any specific commitment to secure any known or potential breeding habitat in conservation lands.

However, the Plan includes a commitment (Commitment 8) to secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA. Given that several records of Large-eared Pied Bat occur within and immediately adjacent to the SCA, some of this land is likely to contain potential breeding habitat for this species.

25.8 HIBBERTIA FUMANA

25.8.1 SPECIES BACKGROUND

Hibbertia fumana is a small low shrub or sub-shrub (OEH, 2020).

Little is known about the life history and ecology of the species. Regeneration can occur through suckers, suggesting it may be able to resprout from rootstock following fire (TSSC, 2016b). Peak flowering times are spring to early summer, although the species appears to be capable of minor sporadic flowering at other times of the year as a response to suitable climatic conditions (Miller, 2018b).

H. fumana inhabits areas of woodland generally with an open understorey. Within the nominated areas, the species is associated with the following PCTs and transition zones between these (Miller, 2018a):

- PCT 724 - Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain
- PCT 725 Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain
- PCT 808 – Derived shrubland on Tertiary Gravels of the Cumberland Plain
- PCT 883 Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain
- PCT 1067 - Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain

The species has a highly restricted range and until very recently was only known from only two populations:

- Moorebank (population size of approximately 370 individuals)
- Bankstown Airport (population size unknown) (Miller, 2018b)

However, it appears that as a result of recent surveys "populations of this species have been detected over a wider range within greater Sydney stretching from Richmond to Mittagong" (OEH, 2020). These records are not available to inform the assessment at this stage.

At Moorebank, the population mainly occurs within a transition zone between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest, and in soils of fine sandy clay loam. It has the potential to occur in similar intergrade alluvial habitats rich in sands and laterite in other parts of Western Sydney (OEH, 2020).

The population at Moorebank is surrounded by existing development, including urban development, particularly to the north, east and west of the site. A rail line occurs along the boundary of southern end of the site. Habitat at the site is disturbed, and the population is traversed by a disused railway line. Proposed infrastructure in the area will result in further habitat loss and disturbance (TSSC, 2016b). Habitat at the site at Bankstown Airport is heavily disturbed – the site is managed and is routinely slashed to a height of about 10 cm (Miller, 2018b).

It should be noted that *H. fumana* is difficult to survey and may have been overlooked in past surveys as it:

- Has only recently been described
- Is extremely cryptic
- Is easily misidentified and/or overlooked as a depauperate version of other species

25.8.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

Hibbertia fumana is being assessed as a candidate species credit species in all four nominated areas.

The species has been identified as a potential SAII entity under the EES guidelines because it has a very highly restricted geographic distribution (Principle 3 of the BC Regulation) (OEH, 2017g).

Two expert reports have been prepared for *H. fumana* by Cumberland Flora & Fauna Interpretive Services. One for GPEC and WSA (Miller, 2018a) and one for Wilton and GMAC (Miller, 2018b).

25.8.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of *H. fumana* in relation to the subject land is shown in Map 25-6.

There are no records of *H. fumana* in the nominated areas.

Targeted surveys for the species were undertaken as part of the expert report for *H. fumana* within some areas of habitat similar to the sites that support the populations of the species. Areas targeted for survey are shown in the expert report (see Supporting Document C). Targeted surveys were also undertaken in small areas of the nominated areas by ecological consultants as part of the biodiversity certification process. The species was not recorded during any of these surveys.

The two known populations of *H. fumana* occur outside the nominated areas. The population at Moorebank occurs 1.2 km to the north-east of GMAC, and the population at Bankstown Airport occurs about 9 km from GMAC.

Approximately 1,716.4 ha of potential habitat for *H. fumana* has been identified within the nominated areas.

25.8.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM.

10.2.3.1(a) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including *H. fumana*, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

The only known populations of *H. fumana* occur outside the nominated areas. Avoidance of impacts to these populations were therefore not a relevant consideration.

The baseline mapping for this assessment has mapped 1,299 ha of potential habitat for *H. fumana* within the nominated areas (not including excluded lands). Approximately 1,225.3 ha (94.3 per cent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,083.7 ha was avoided for biodiversity purposes
- 141.6 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-23.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-23 shows the amounts of habitat within excluded lands for context only.

Table 25-23: Avoidance outcomes for *H. fumana*

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential habitat (ha)	1,716.4	417.3	1,299	73.8	1,083.7	141.6	1,225.3

Avoidance of indirect impacts

Potential indirect impacts to *H. fumana* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(b) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Development within the nominated areas will not directly impact on any records or known populations of *H. fumana*.

Potential indirect impacts to *H. fumana* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(c) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

There are currently no impact thresholds for *H. fumana*.

10.2.3.1(D) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

A total of 73.8 ha of potential habitat will be directly impacted by the development. This is 5.7 per cent of the potential habitat in the nominated areas (without excluded lands). The direct impacts of the development are associated with urban development. The direct impacts mainly occur:

- WSA: habitat mapped in the south-east corner of WSA
- GMAC: within the areas mapped as 'likely habitat' by the expert in the south-west corner of GMAC (see Supporting Document C)
- Wilton: along the edges of the urban capable land in the northern part of the nominated area

Surveys confirmed *H. fumana* as absent within the OSO corridor, however mapped potential habitat remains present within the Wianamatta Regional Park in the northern part of GPEC. The OSO alignment bisects two areas of 'low probability' habitat for the species.

The direct impacts of the development on *H. fumana* are provided in Table 25-24.

Table 25-24: Direct impacts on *H. fumana*

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Potential habitat (ha)	28.3	7.1	6.9	0	31.5	73.8

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

Impacts to potential habitat within GPEC

Surveys for the species confirmed that the species was not present within the OSO alignment, however the OSO does bisect potential habitat for *H. fumana* within the north-eastern part of Wianamatta Regional Park. This will lead to loss and fragmentation of potential habitat at this location, leading to a number of smaller, isolated patches of habitat. This fragmentation may increase impacts associated with edge effects and weed invasion and this has the potential to compromise the suitability of remaining habitat areas directly adjacent to the development.

Surveys for *H. fumana* were undertaken within Wianamatta Regional Park (see Supporting Document C). The species was not recorded during surveys and the expert report concluded that the potential for the species to occur was low. This reduces the risk of impacts to life-cycle processes and viability of any local population.

Impacts to potential habitat within WSA

Urban capable land impacts on potential habitat for *H. fumana* in the south-east corner of WSA. The impacts are generally around the edges of larger potential habitat polygons, with a total impact of 6.9 ha recorded across WSA. The likelihood that the species occurs within the urban capable footprint is low as:

- The likelihood the species occurred within the potential habitat mapped in the Kemps Creek area was assessed as moderate to low potential
- The species was not recorded during surveys of the area undertaken as part of the strategic biodiversity certification by either the expert (see Supporting Document C) or the ecological consultants

Impacts to potential habitat within GMAC

The urban capable land directly impacts potential habitat for *H. fumana* along the edges of a corridor of habitat that occurs along the outer perimeter of the southern part of GMAC.

This potential habitat currently occurs adjacent to farmland, which means that the impacts of urban development are unlikely to greatly increase edge effects to retained habitat areas or further reduce their viability. Furthermore, the likelihood that the species occurs within the urban capable land is considered low for the following reasons:

- The expert report for *H. fumana* concluded that the species has low potential to occur in GMAC because areas of potential habitat with similar attributes to known sites are highly modified and of limited extent (Miller, 2018b)
- The species was not recorded during surveys of the area undertaken as part of the strategic biodiversity certification by either the expert (see Supporting Document C) or the ecological consultants

The expert identified mostly small areas of 'likely habitat' for the species in the centre and north of GMAC, including at Menangle Park, Milton Part, Kayess Park and Bunbury Curran Creek. These areas are not directly impacted by the urban capable lands. The indirect impacts of the development are considered unlikely to further reduce the viability these areas because these areas are distant from the urban capable lands.

Impacts to potential habitat within Wilton

The urban capable land directly impacts potential habitat for *H. fumana* along the edges of a corridor of habitat that occurs along the outer edge of the northern section of Wilton.

This potential habitat currently occurs adjacent to farmland, which means that the impacts of urban development are unlikely to greatly increase edge effects to retained habitat areas or further reduce their viability. Furthermore, the likelihood that the species occurs within the urban capable land is considered low for the following reasons:

- The expert report concluded that while the species could possibly occur within Wilton, the species is unlikely to occur within the urban capable land because the majority of this area is confined to the Wianamatta Shale-derived soils which, based on current knowledge, is not potential habitat for the species
- The species was not recorded during surveys of the area undertaken as part of the strategic biodiversity certification by either the expert (see Supporting Document C) or the ecological consultants

10.2.3.1(e) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of potential habitat within the nominated areas is unlikely to affect the ecology of any local population of *H. fumana* because the potential for the species to occur is low.

10.2.3.1(f) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the loss of potential habitat within the nominated areas is unlikely to fragment or isolate any local population of *H. fumana* because the potential for the species to occur is low.

Two areas of potential habitat will be fragmented within Wianamatta Regional Park as a result of the OSO corridor. The low likelihood of occurrence of *H. fumana* in the area considerably reduces the risk of these impacts.

10.2.3.1(g) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

H. fumana is currently only known from two populations at Moorebank and Bankstown outside the nominated areas. The distance between the populations suggest they are unlikely to interact.

10.2.3.1(h) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The Final Determination and BioNet profile for *H. fumana* identify a range of threats to the species. Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Habitat disturbance

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species

and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *H. fumana* are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes are recognised as a threat to the species (OEH, 2020). This can relate to fire that is either:

- Too frequent which has the potential to limit recruitment, or
- Too rare which may allow the midstorey to thicken

Inappropriate fire regimes can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for *H. fumana* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *H. fumana*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

WEED INVASION

Weeds are recognised as a threat to the species. In particular low shrubs, dense shrubs and smothering grasses (OEH, 2020). Weeds are present in the Strategic Assessment Area and are unlikely to pose a novel threat to *H. fumana*. However, development within the nominated has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA. This includes a number of actions, of which the following are the most relevant to the outcome for *H. fumana*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
- Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

HABITAT DISTURBANCE

Habitat disturbance is a recognised as a threat to the species (OEH, 2020). This relates to mechanisms such as land management practices (e.g. mowing) and uncontrolled vehicle movements.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

The two known populations of *H. fumana* are not within reserves but are managed for conservation – the site at Moorebank is a BioBank/stewardship site, and the site at Bankstown is managed within the airport complex.

There is currently approximately 92 ha of potential habitat for the species mapped within protected areas in the Plan Area. This comprises potential habitat within Wianamatta Regional Park.

Potential habitat also occurs within several Council reserves.

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments and actions that will contribute to the recovery of *H. fumana* in the Cumberland subregion. The key commitments and actions relevant to the species are:

- A species-specific commitment to secure 1 offset location of *H. fumana* in conservation lands within the SCA (Commitment 9)
- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential habitat for *H. fumana* in the SCA, as there is approximately 1,665.5 ha of mapped potential habitat in the SCA for this species
- Manage weeds in strategic locations in the Cumberland subregion (Commitment 15) to reduce threats to conservation lands secured within the SCA. This includes preparing a Weed Control Strategy to guide and co-ordinate delivery of a weed control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
    - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
    - Preparing a Fire Management Strategy to guide and co-ordinate fire management

25.9 LATHAMUS DISCOLOR

25.9.1 SPECIES BACKGROUND

Lathamus discolor (Swift Parrot) is a medium-sized bright green parrot. It has dark-blue patches on the crown and a red face. It grows to approximately 25 cm in length, with a wingspan of 32-36 cm. It weighs around 65 g (TSSC, 2016a).

Swift Parrots breed in east and south-east Tasmania in summer. During winter, the species migrates to mainland Australia, where it disperses widely through the coast of Victoria, NSW and south-eastern Queensland (Saunders & Tzaros, 2011). In NSW, the species forages in forests and woodlands throughout the coastal and western slopes regions (TSSC, 2016a). The species shows high site fidelity (at both breeding and non-breeding sites) and return to the same locations on an irregular cyclic basis (Saunders & Tzaros, 2011).

Swift Parrots forage on flowers, seeds, fruit, and psyllid lerps in *Eucalyptus* species. The species forages preferentially on larger trees, as larger trees provide more reliable foraging resources than younger trees (Saunders & Tzaros, 2011).

Swift Parrots are adept at foraging in a variety of habitats, from continuous intact vegetation, through to vegetation remnants, scattered trees and vegetation in urban areas (Brereton, Mallick and Kennedy, 2004). It is not a guarantee that more disturbed environments (such as urban or agricultural environments) contain fewer foraging resources than intact vegetation. For instance, within the species' breeding range in Tasmania, Swift Parrots have been observed to forage in higher densities in urban areas than in neighbouring bushland as the trees in urban areas flower more prolifically than the trees in bushland (Hingston and Piech, 2011).

It is thought that trees in disturbed areas including suburban and agricultural environments may produce more food than trees in areas of native vegetation because (Brereton, Mallick and Kennedy, 2004; Hingston and Piech, 2011):

- More isolated trees have greater light penetration in the canopy
- Suburban trees typically have less fire damage
- Farmland/parkland/garden sites are typically managed for soil enrichment
- Agricultural sites are more likely to have more fertile soil than uncleared remnant vegetation which typically occurs on less fertile soil

However, the Swift Parrot's distribution is also strongly influenced by the presence of aggressive competitors (Saunders & Heinsohn, 2008). Aggressive competitors are more likely to be present in disturbed environments. Urban environments also have higher threat densities which reduce habitat suitability for Swift Parrots (Saunders & Tzaros, 2011).

Within NSW, higher densities of Swift Parrots have been recorded in remnant vegetation than in scattered trees or continuous forest (Saunders & Heinsohn, 2008). Saunders & Heinsohn (Saunders & Heinsohn, 2008b) found that the distribution of Swift Parrots in NSW was primarily associated with food availability and the presence of non-aggressive competitors.

Food availability in different regions fluctuates across different years, as a result of variation in climatic conditions. For instance, during periods of drought, higher densities of the species occur in coastal habitats in NSW and Victoria, suggesting these areas function as drought refuge habitat. It is important to maintain a broad range of habitats across the mainland foraging range of the species, as resource availability in any one locality may increase or decrease depending on local conditions each year (Saunders & Tzaros, 2011).

Swift Parrots are usually seen in groups of up to 30 birds, although it may also occur in larger flocks (of hundreds of individuals) around abundant food sources. There are a small number of records of over 1,000 birds (TSSC, 2016a). The population of Swift Parrots was estimated to be approximately 2,000 in 2010. It is likely to have declined since then (TSSC, 2016a).

The species occurs as a single migratory population (Saunders & Tzaros, 2011).

25.9.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

The Swift Parrot has been identified as a potential SAII entity under the DPIE guidelines (Principle 1 of the BC Regulation) (DPIE, 2019), as the species is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.

The Swift Parrot is a dual credit species. The species credit component occurs in sites mapped as important areas. Mapped important areas do not require survey as it is presumed that the species is present at the site. Any impact from development to important areas is considered to have potential to cause serious and irreversible impacts.

To enable a comprehensive assessment of impacts to this species, this assessment considers impacts to three different types of mapped habitat:

- Important areas (prepared by EES)
- Potential important areas (prepared by the consulting team)
- Potential foraging habitat (prepared by the consulting team)

Assessing mapped important areas, potential important areas and potential foraging habitat provides sufficient context to properly understand the species' occurrence and use of habitat within the nominated areas.

IMPORTANT AREAS

Important areas mapping has been produced by EES as part of the BAM process. Mapping was completed as follows:

Swift Parrot sighting records from 1990-2018 were extracted from BioNet and BirdLife Australia Atlas. Records were checked and cleaned. Records were filtered to include only sightings with five or more birds. A 2km radial buffer was applied.

Important areas were defined by:

1. Areas with five or more records, where observations have occurred over two or more years and are within 2km of one another, or
2. Areas with a single record of 40 or more birds

The NSW State Vegetation Type Map (including draft East Coast classification) was used to select Plant Community Types associated with the swift parrot within the buffers. Any areas of vegetation less than one hectare were excluded.

It is noted that the important areas map prepared by EES will be progressively updated over time.

POTENTIAL IMPORTANT AREAS

The important areas mapping produced by EES only includes Swift Parrot records up to 2018. It is noted that a substantial number of new records for the Swift Parrot were recorded within the Strategic Assessment Area in 2019

which fit the criteria identified in the important areas mapping method, and which are important to consider as part of the assessment process for this species.

Therefore, potentially important areas were identified through replicating the important areas mapping method and including new records from 2019, to indicate the localities which are likely to be included in the important areas mapping by EES when the map is next updated.

POTENTIAL FORAGING HABITAT

It is recognised that the important areas mapping method is based upon the distribution of species' records. However, bias may be present in species' record databases. For instance, localities which are highly likely contain suitable habitat for the species may have access restrictions (either due to land use, such as the Orchard Hills military base, or due to inaccessible terrain features). While it is possible that the Swift Parrot may utilise habitat in these inaccessible localities in large numbers, if sites are inaccessible, then people will not be able to record the species' presence in these localities, and as such there will be an absence of species records in these areas in species databases.

To account for this possible bias, mapped potential foraging habitat for the Swift Parrot has also been considered as part of this assessment. Potential habitat has been mapped using a knowledge-based mapping method and is based on the distribution of PCTs and vegetation condition associated with the species.

The ecosystem credit component occurs in sites mapped as potential foraging habitat. It is noted that impacts ecosystem credit areas are considered unlikely to have potential serious and irreversible impacts.

25.9.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of the Swift Parrot in relation to the subject land is shown in Map 25-7.

RECORDS

As a wide-ranging species, scattered records of the Swift Parrot occur within each nominated area, and throughout the Cumberland subregion. In total, there are 266 records of the Swift Parrot within the Plan area.

Areas of note where larger numbers of Swift Parrots (flocks of 40 or more birds) have been recorded, or where the species has been recorded to return on a periodic basis, include:

- Scattered areas within GPEC, where numerous records identify large flocks of Swift Parrots
- To the north of GPEC, including the Londonderry, North Richmond, and Hawkesbury Heights localities
- To the west of GPEC in the Glenmore Park/Mulgoa locality
- To the east of GPEC near Prospect Reservoir
- To the south of WSA in the Camden and Cobbitty localities
- To the north-west of GMAC near Denman Prospect
- Adjacent to GMAC in the locality of Mount Annan, where recent records from 2019 identify flocks of up to 200 birds
- Just outside the northern boundary of the Strategic Assessment Area in the Cattai locality

IMPORTANT AREAS

Important areas have been mapped by EES to incorporate species' records from 1990-2018. A total of 5,626.1 ha of important areas have been identified within the Strategic Assessment Area, of which 493.4 ha is located within GPEC. Within GPEC, important areas consist of scattered occurrences which comprise of small areas of remnant vegetation within otherwise heavily developed environments.

Within the broader locality of the Cumberland subregion, important areas occur across the following localities:

- To the north of GPEC, including the Londonderry, North Richmond, and Hawkesbury Heights localities
- To the west of GPEC in the Glenmore Park/Mulgoa locality
- To the east of GPEC near Prospect Reservoir
- To the south of WSA in the Camden locality
- To the north-west of GMAC near Denman Prospect

POTENTIAL IMPORTANT AREAS

Potential important areas have been mapped by the consulting team, based on the mapping method used by EES, incorporating more recent records of the species within the Strategic Assessment Area. A total of 731.7 of potential important areas have been identified within the Strategic Assessment Area, of which 80.2 is located within GMAC. Potential important areas occur:

- To the south of WSA in the Cobbitty locality
- Within and adjacent to GMAC in the locality of Mount Annan
- In the north of the Strategic Assessment Area in the Cattai locality

POTENTIAL FORAGING HABITAT

A total of 8,679 ha of potential foraging habitat has been mapped within the nominated areas. Potential foraging habitat broadly aligns with the locations of all remnant vegetation within the Strategic Assessment Area. This area is large because of the broad associations the species has with flowering woodland.

25.9.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM:

10.2.3.1(A) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including Swift Parrot, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

A breakdown of avoidance of each identified habitat type is provided below. It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. The amounts of habitat within excluded lands are provided for context only.

In addition, the Plan includes a specific measure for the Swift Parrot to retain large trees (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction.

Important areas

The baseline mapping for this assessment has mapped 83.7 ha of potential foraging habitat for Swift Parrot within the nominated areas (not including excluded lands). Approximately 40.4 ha (48.3 percent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 19.9 ha was avoided for biodiversity purposes
- 20.6 ha was avoided for other purposes

A breakdown of avoidance of important areas across each nominated area is provided in Table 25-25.

Table 25-25: Important areas avoidance outcomes for Swift Parrot

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Important areas (ha)	493.4	409.7	83.7	43.3	19.9	20.6	40.4

Potential important areas

The baseline mapping for this assessment has mapped 2.8 ha of potential important areas for Swift Parrot within the nominated areas (not including excluded lands). None of this area was avoided.

A breakdown of avoidance of potential important areas across each nominated area is provided in Table 25-26.

Table 25-26: Potential important areas avoidance outcomes for Swift Parrot

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential important areas (ha)	80.2	77.5	2.8	2.8	0	0	0

Potential foraging habitat

The baseline mapping for this assessment has mapped 4,514.3 ha of important areas for Swift Parrot within the nominated areas (not including excluded lands). Approximately 3,414.6 ha (75.6 per cent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,568.9 ha was avoided for biodiversity purposes
- 845.8 ha was avoided for other purposes

A breakdown of avoidance of potential foraging habitat across each nominated area is provided in Table 25-27.

Table 25-27: Potential foraging habitat avoidance outcomes for Swift Parrot

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential foraging habitat (ha)	8,679	4,164.8	4,514.3	1099.8	2,568.9	845.8	3,414.6

Avoidance of indirect impacts

Potential indirect impacts to Swift Parrot due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(B) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

The Swift Parrot is a migratory species which visits mainland Australia to forage during the winter, before returning to Tasmania in the summer to breed. The species consists of a single population.

Therefore, there is no separate residential population of Swift Parrots within the nominated areas; rather, the parrots which do occur are seasonal visitors from a larger national population of the species.

The proportion of the population of Swift Parrots which utilises habitat within the nominated areas is unknown. However, a record from June 2019 recorded 200 Swift Parrots adjacent to the western boundary of GMAC. Given that the total population size of the species was estimated to be 2,000 individuals (TSSC, 2016a), this record accounts for approximately 10 per cent of the total population of the species. While this record was not located within the nominated areas, it indicates that the wider locality is visited by at least 10 per cent of the total population of the species.

10.2.3.1(C) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

The threshold for potential serious and irreversible impacts is any impact to mapped important areas.

10.2.3.1(D) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

Important areas

A total of 43.3 ha of important areas for Swift Parrot will be directly impacted by development. This is 51.7 per cent of the important areas within the nominated areas (without excluded lands). Impacts are associated with urban development and transport corridors within GPEC only.

Impacted areas mainly involve small, scattered patches of remnant vegetation within already-developed urban areas. The direct impacts of the development on important areas are provided in Table 25-28.

It is noted that of the 43.3 ha of impacts, 13.2 ha of this mapped habitat is mapped over areas of waterbodies, while 4.1 is mapped over areas of exotic vegetation. Therefore, 17.3 ha of this impacted area is not likely to contain real habitat for the Swift Parrot. Total impacts to real habitat within this mapped area is therefore closer to 26 ha.

The impacts to the areas of important areas within GPEC are unlikely to impact the ongoing survival or viability of the Swift Parrot because:

- The areas to be impacted primarily include small, scattered patches of vegetation within already developed urban areas. The long-term viability of vegetation in these highly disturbed localities (which directly influences their long-term capacity to provide foraging habitat for the species) is reduced
- Avoidance of impacts to important areas has prioritised avoidance of larger and more intact areas of vegetation. The vegetation of these areas is more likely to have improved long-term viability, meaning these sites are more likely to be able to continue to provide foraging habitat into the future
- Given the wide-ranging and mobile nature of the species, impacts are unlikely to cause fragmentation or isolation of habitat
- Large trees will be retained during precinct planning, which are preferred foraging resource for the species
- The Plan commits to securing 100 ha for important habitat for the Swift Parrot for conservation purposes to address residual impacts (Commitment 9)

Potential important areas

A total of 2.8 ha of potential important areas for Swift Parrot will be directly impacted by development, with all impacts occurring in a single location within GMAC. This is 100 per cent of the potential important areas within the nominated areas (without excluded lands). Impacts are associated with urban development.

The vegetation which is impacted is a small patch of vegetation located on the edge of urban development. It is therefore unlikely that the vegetation of this site will be fully cleared, and sections will instead be maintained as an APZ. Further, this area of vegetation is known to support an important population of another threatened species, the shrub *Pimelea spicata*. To protect *Pimelea spicata*, Appendix E of the Plan includes a species-specific measure to ensure that management activities within the APZ protect this species. While this measure does not directly relate to protection of species utilised for foraging by the Swift Parrot, it is considered likely that, if management of the APZ in this locality is conducted with conservation of environmental values as a priority, the likelihood of substantial habitat degradation at this site is reduced.

The direct impacts of the development on potential important areas are provided in Table 25-28.

The impacts to the areas of potential important areas within GMAC are unlikely to impact the ongoing survival or viability of the Swift Parrot because:

- The area to be impacted comprises only a small area of vegetation
- Some of the vegetation within this impact area will be retained as part of the APZ, and will benefit indirectly from conservation focused APZ management activities associated with the protection of another threatened species at this site (*Pimelea spicata*)
- The impacts are unlikely to cause fragmentation or isolation of habitat
- Precinct planning will ensure that large trees will be retained, which are preferred foraging resource for the species

- The Plan commits to securing 100 ha of important areas for conservation to address residual impacts (Commitment 9)

Potential foraging habitat

A total of 1099.8 ha of potential foraging habitat for Swift Parrot will be directly impacted by the development. This is 24.4 per cent of the potential habitat in the nominated areas (without excluded lands). The direct impacts of the development are associated with urban development and transport corridors. The direct impacts to potential habitat mainly occur:

- Within GPEC:
  - Within Wianamatta Regional Park and in the locality of Orchard Hills, associated with the development of the Outer Sydney Orbital
  - Within the Mulgoa locality in the south-west corner of GPEC
  - In small, scattered areas of remnant vegetation patches throughout the nominated area
- Within WSA:
  - In the Bringelly and Luddenham localities in the south of the nominated area
  - In smaller scattered areas of remnant vegetation throughout the nominated area
- Within GMAC and Wilton, impacts generally occur to the edges of potential habitat that in most cases remains connected to larger patches of habitat associated with gullies and gorges that run down to the Nepean River or along riparian corridors

The direct impacts of the development on potential foraging habitat are provided in Table 25-28.

The impacts to the areas of potential foraging habitat within GPEC, WSA, GMAC and Wilton are unlikely to impact the ongoing survival or viability of the Swift Parrot because:

- Only a small proportion of potential foraging habitat is directly impacted. The majority of potential foraging habitat has been avoided for biodiversity or other purposes
- The impacts are unlikely to cause fragmentation or isolation of habitat
- Large trees will be retained, which are preferred foraging resource for the species
- The Plan contains a commitment (Commitment 9) to protect 4,410 ha of potential foraging habitat for the Swift Parrot to address residual impacts

Table 25-28: Direct impacts on Swift Parrot

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Important areas (ha)	0	0	0	42.4	0.9	43.3
Potential important areas (ha)	0	2.7	0	0	0.1	2.8
Potential foraging habitat (ha)	149.3	247.4	302.7	127.8	575.3	1099.8

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

Indirect impacts

Potential indirect impacts to the Swift Parrot due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(e) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of habitat within the nominated areas is unlikely to affect the ecology of any local population of the Swift Parrot because:

- The majority of habitat has been avoided, and avoidance has prioritised larger, more intact and more important areas of vegetation which are more likely to have long-term viability
- Precinct planning measures will be implemented to retain large trees within urban capable land, which is the preferred foraging habitat for the species
- The Plan commits to securing offsets for the species (4,410 ha of potential foraging habitat, including 100 ha of important habitat) to address residual impacts (Commitment 9)

10.2.3.1(f) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

The Swift Parrot is a migratory visitor to mainland Australia which is highly mobile and has the capacity to cover large distances. The Swift Parrot species occurs as a single population.

Development under the Plan will not result in fragmentation or isolation of the Swift Parrot population.

10.2.3.1(g) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

As the Swift Parrot occurs as a single migratory population (Saunders & Tzaros, 2011), there are no other populations of the species.

10.2.3.1(h) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profile, in addition to the Conservation Advice and Recovery Plan for the Swift Parrot identify a range of threats to the species (Saunders & Tzaros, 2011; TSSC, 2016). Where these threats are present in the Plan area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Collision mortality
- Inappropriate fire regimes
- Predation by feral cats

Predation by sugar gliders, competition from honeyeaters, Psittacine Beak and Feather Disease, and illegal wildlife capture and trade are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the threat across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Swift Parrot are discussed below for each identified indirect impact.

<u>Collision mortality</u>

Mortality from collisions with human-made objects in urban areas is an identified threat to the species (TSSC, 2016a). The Conservation Advice states that:

- Continuing urban encroachment into breeding and foraging habitat is increasing the threat
- Collisions are a particular concern in the greater Hobart and Melbourne areas, and the New South Wales central and north coast regions where fatalities have been recorded

There are no records in BioNet of collision mortalities in the Strategic Assessment Area. However, expanding urban development within the nominated areas and development of transport corridors has the potential to increase the threat of collision mortality to the species.

While the threat will remain (and potentially increase), it is unlikely to significantly affect the species within the nominated areas given that:

- Important areas and potential important areas for the species within the nominated areas are already subject of current development
- Larger and more intact areas of potential habitat for the species (such as Orchard Hills) will not be impacted by development

Inappropriate fire regimes

Inappropriate fire regimes, in particular frequent fire, is identified as a threat to the species (Saunders & Tzaros, 2011; TSSC, 2016). Fire can reduce tree flowering events and affect maturation of nectar rich plant species, resulting in reduced foraging resources (Saunders & Tzaros, 2011).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact Swift Parrot habitat. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for the Swift Parrot being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for Swift Parrot. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the Swift Parrot from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the Swift Parrot and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

Predation by feral cats

Predation from feral cats is identified as a threat to the Swift Parrot in the species recovery plan. New urban development within the nominated areas is very likely to increase the number of domestic cats in the local area, which in turn, may lead to an increase in feral cat populations within adjacent areas of potential Swift Parrot habitat.

Existing land use within the nominated areas and surrounding region includes residential areas and farming, which means cats are unlikely to pose a novel threat to the species in the area. However, the extent of proposed new urban development under the Plan means the threat is likely to be exacerbated.

As outlined in Chapter 15, development controls will be incorporated into DCPs for each nominated area that will:

- Ensure that domestic animals are appropriately contained at urban/bushland interfaces
- Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
- Require appropriate management and control of pest animals relevant to development sites

These measures are considered to adequately mitigate the threat to the species.

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

The Swift Parrot occurs as a single migratory population which visits mainland Australia in the winter to forage, and which returns to Tasmania in summer to breed. It is estimated that there are approximately 2,000 individuals of the species (TSSC, 2016a). Up to 200 parrots have been recorded at a time in the vicinity of the nominated areas, indicating that at least 10 per cent of the population of the species visits the locality.

An estimate of the important areas for the Swift Parrot in protected lands in the area covered by the Plan is 1,025.2 ha.

An estimate of the potential important areas for the Swift Parrot in protected lands in the area covered by the Plan is 241.1 ha.

An estimate of the potential foraging habitat for the Swift Parrot in protected lands in the area covered by the Plan is 6,699.9 ha.

The Swift Parrot has also been recorded within several of the following protected lands within and outside the Cumberland subregion, including:

- Scheyville National Park
- Castlereagh Nature Reserve
- Royal National Park
- Heathcote National Park
- Dharawal National Park
- Upper Nepean State Conservation Area
- Nattai National Park
- Blue Mountains National Park

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of the Swift Parrot in the Cumberland subregion. Several commitments are described in more detail the sections above.

The key commitments and actions relevant to the species are:

- A commitment to protect 4,410 ha of potential foraging habitat, including 100 ha of important habitat, for the Swift Parrot (Commitment 9)
- A mitigation measure within Appendix E of the Plan to retain large trees (including dead trees) (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction
- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential foraging habitat for the Swift Parrot in the SCA, as there is approximately 17,178 ha of mapped potential foraging habitat in the SCA for this species
- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion

- The introduction of development controls to manage impacts of domestic and pest animals

25.10 LITORIA AUREA

25.10.1 SPECIES BACKGROUND

Green and Golden Bell Frog (*Litoria aurea*) is a relatively large, dull, olive to bright emerald-green frog.

The species requires different habitats for foraging, breeding, over-wintering, and dispersal. The species also uses certain habitats on a periodic or seasonal basis (DEWHA, 2009b). Habitat comprises one or more water bodies, and associated terrestrial habitats with grassy areas and low vegetation, although the species tends not to disperse far from waterbodies into more terrestrial non-breeding habitats (DEWHA, 2009c; Lemckert, 2019). The species has been found in a wide range of water bodies except those that are fast flowing and the species can occur in disturbed habitats (DEWHA, 2009b).

Breeding habitat includes water bodies that are still, shallow, temporary, unshaded, with aquatic plants and free of mosquito fish. Ephemeral water bodies are important habitat for the species as they can provide habitat stepping stones between otherwise disconnected areas and they are less likely to contain mosquito fish (DEWHA, 2009b).

Records suggest that Green and Golden Bell Frog is highly mobile and moves between breeding sites. Movements of up to 5 km may be common and the frog may disperse up to 10 km (DoEE, 2018a). Connectivity between habitat sites is vital as the species exhibits a 'metapopulation structure', which relies on dispersal between 'local' populations within a larger 'metapopulation'. The species is more likely to be present, and habitat more likely to be important, where:

- Multiple suitable breeding sites are within a close enough proximity for individuals to migrate between them
- Multiple non-breeding water bodies are present in an area and within close enough proximity to allow migration between them (and breeding sites) with relative ease
- The connectivity of breeding and non- breeding habitat contains vegetation and shelter that facilitates migration
- There are other individuals occupying waterbodies in close proximity (Lemckert, 2019)

Breeding of the Green and Golden Bell Frog occurs generally between September and February after heavy rains or storms, and spawn is laid among aquatic vegetation (DEWHA, 2009b). The species has high fecundity and clutch sizes have been known to contain between over 2000 to 11,000 eggs (DEWHA, 2009b).

Records of the species in NSW are widely separated and isolated (OEH, 2019f). Approximately 30 populations are known. The largest populations of the species are located in Sydney and the Shoalhaven and mid north coast areas (OEH, 2019f). Most populations have fewer than 20 adults. Over 1,000 individuals have been recorded at Homebush, Kooragang Island and Broughton Island (DoEE, 2018a).

Nearly all known populations of Green and Golden Bell Frog are located with 10 km of the coast or saline waterways. This is likely due to the species being susceptible to the amphibian chytrid fungus, as the fungus is intolerant of salt. These locations therefore provide some refuge from the impacts of chytrid (Lemckert, 2019).

25.10.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

Green and Golden Bell Frog is being assessed as a candidate species credit species for all four nominated areas.

The species has been identified as a potential SAII entity in accordance with the requirement of section 10.2.1.4 of the BAM because of its very high susceptibility to the disease Chytrid fungus (Principle 4 of the BC Regulation).

An expert report has been prepared for the Green and Golden Bell Frog (Lemckert, 2019).

The expert report involved:

- Targeted surveys within the most likely areas of potential habitat for this species
- Identification of potential habitat within the nominated areas

25.10.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of Green and Golden Bell Frog in relation to the subject land is shown in Map 25-8.

A total of 13,146 records for the Green and Golden Bell Frog occur within the Cumberland subregion. The majority (greater than 95 per cent) occur in the eastern third of the subregion outside the nominated areas (Lemckert, 2019).

In relation to the records in the subregion, the expert report concluded that:

- Few records occur in the Cumberland subregion, and it appears the species has never been common in this area, reflecting the fact that the region is over 10 km from the coast where chytrid fungus is more likely to be present
- The majority of records are from prior to 1990, indicating that most populations are likely to now be extinct. This is consistent with the pattern of declines noted for the species by Mahony et al (2013), who noted that populations rarely persist more than 10 kilometres from the coast (i.e. east of the nominated areas)

Records of the species within the nominated areas are limited. There are:

- 12 records within GPEC. The records primarily occur around St Marys and Ropes Creek. Surveys of this site have been completed since public exhibition and no individuals of the species were identified at this site. Further, habitat features of the site were considered suitable for shelter and dispersal only, and not suitable for breeding. Therefore, it is considered unlikely that this population is still present at this site. See Supporting Document I for further information regarding the surveys and results
- Three records within GMAC, all of which occur at Blair Athol. The expert report concluded that the records at Blair Athol are likely to be from individuals that escaped a captive colony and the population is no longer likely to persist in that location (Lemckert, 2019). However, since that time, further records have since become available, suggesting that the population may be present and self-sustaining
- One record in WSA. This record is considered to relate to a single and transient individual dispersing from a non-natural population of the species in Riverston (with habitats created by a 'backyard breeder'), and does not equate to a natural or self-sustaining population of the species (Dr Frank Lemckert pers. comm.)

There are no records in Wilton.

As part of the EPBC assessment for the development, two important populations of Green and Golden Bell Frog were identified in proximity to the nominated areas:

- A population at Gow Park in Mulgoa, approximately 2.4 km south of the nearest urban capable land within GPEC. This population was recorded in 1999 in a non-permanent creek
- A population along the eastern boundary of the Strategic Assessment Area, approximately 17 km east of WSA

The population around St Marys and Ropes Creek occurs within the urban capable land.

Approximately 1,654.5 ha of potential habitat for Green and Golden Bell Frog has been identified within the nominated areas. This occurs GPEC and GMAC. The majority of potential habitat occurs around St Marys between Ropes Crossing in the north and Minchinbury in the south. A smaller area occurs around Blair Athol.

25.10.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM:

10.2.3.1(a) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including Green and Golden Bell Frog, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

There are no known populations of the Green and Golden Bell Frog within the nominated areas. It is noted that surveys undertaken since public comment did not find the species in GPEC, and the new record of the species within WSA is not considered to be that of a natural, self-sustaining population.

The baseline mapping for this assessment has mapped 24.6 ha of potential habitat for Green and Golden Bell Frog within GPEC and GMAC (not including excluded lands). Approximately 11.3 ha (45.8 per cent) of this was avoided as part of

the design of the urban capable land and transport corridors (not including excluded lands). All of this was avoided for biodiversity purposes.

A breakdown of avoidance across each nominated area is provided in Table 25-29.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-29 shows the amounts of habitat within excluded lands for context only.

Table 25-29: Avoidance outcomes for Green and Golden Bell Frog

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential habitat (ha)	1,654.5	1,629.9	24.6	13.3	11.2	<0.1	11.3

Avoidance of indirect impacts

Potential indirect impacts to Green and Golden Bell Frog due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(b) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Direct impacts

Development within GPEC will directly impact records of a historical population of the Green and Golden Bell Frog associated with Ropes Creek. This population comprises 6 BioNet records made between 1998 and 2012. The development will impact an area associated with one of these records made in 1998. The impact is associated with urban development.

At the time of public exhibition, it was considered likely that the population at this locality could still be present, and targeted surveys of the site had not been completed. The draft Plan at this stage contained a species-specific measure to undertake surveys within potential habitat along Ropes Creek to determine if the species was still present, and if confirmed to be present, to avoid, protect and enhance key habitat features of the site.

Targeted surveys of Ropes Creek have since been completed. The surveys were carried out in December 2020 and January 2021. The surveys did not find any individuals of the species present at the site. Potential shelter and dispersal habitat for the species was identified, yet the habitat of the locality was considered unlikely to be suitable for breeding. Further information regarding the species survey is available in Supporting Document I.

Given that the riparian habitat available for the species at this site is suitable for shelter and dispersal only, and that the species was not found to be present during survey, the risk posed to the species of impacts to this habitat is considered to be very low. It is recognised that the Plan includes a species-specific commitment (Commitment 3) to avoid and minimise impacts to the Green and Golden Bell Frog and its habitat within certified major transport corridors through detailed planning and design. This includes avoiding areas of potential habitat connectivity within riparian corridors where possible. This measure will help to minimise potential impacts to riparian habitat for the Green and Golden Bell Frog within GPEC.

A smaller area of potential habitat occurs around Blair Athol between the Hume Motorway and Campbelltown in GMAC. There is potential that the species may occur in GMAC, as recent records at Blair Athol suggest a population may be persisting at this site. There will not be any direct impacts to this population.

Indirect impacts

Potential indirect impacts to Green and Golden Bell Frog due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(c) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

There are currently no impact thresholds for Green and Golden Bell Frog.

10.2.3.1(d) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

The area of potential habitat within and around the Ropes Creek corridor at St Marys in GPEC covers:

- The locations of known records
- The riparian corridor joining those records
- A buffer of 1,000 m around the riparian corridor and records that could be used by the species for foraging, shelter, breeding and as migratory habitat as individuals move between water bodies and riparian corridors (Lemckert, 2019)

Approximately 13.3 ha of potential habitat will be directly impacted by the development within GPEC along Ropes Creek. This is about half of the potential habitat in the nominated areas (without excluded lands). This includes:

- 1.9 ha of aquatic/riparian habitat
- 7.11 ha of terrestrial habitat less than 200 m from aquatic habitat
- 4.4 ha of terrestrial habitat greater than 200 m from aquatic habitat

The direct impacts of the development on Green and Golden Bell Frog are provided in Table 25-30.

Table 25-30: Direct impacts on Green and Golden Bell Frog^

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Potential habitat (ha)	0	0	0	11	2.3	13.3^

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

^ Note that this total impact of 13.3 ha includes:

- 0.06 ha of impact on non-native vegetation (see Chapter 24)
- 0.62 ha of impact on a non-vegetated waterbody (see Chapter 24)
- 5.63 ha of impact on an existing urban area comprising buildings and roads ('man-made structures' - see Chapter 24)

The majority of habitat loss within GPEC is associated with the site of the current St Marys Rugby League Club adjacent to the Ropes Creek corridor and includes at least two mapped water bodies. A smaller impact occurs to the north-west of St Marys Rugby League Club associated with the OSO.

The development is unlikely to cause fragmentation or isolation of potential habitat at Ropes Creek because the area impacted occurs at the edge of the area of potential habitat (excluding areas that are already developed) and distant from the riparian corridor of Ropes Creek, as well as being adjacent to existing urban development, including two major roads. The corridor of habitat along the riparian corridor at Ropes Creek will therefore be maintained.

Indirect impacts

Potential indirect impacts to Green and Golden Bell Frog due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(e) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (b) and (d) above, the Plan is will not result in direct impacts on known populations of the species.

10.2.3.1(f) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the development is unlikely to cause fragmentation or isolation of any local population because impacts occur at the edge of the area of potential habitat and distant from the riparian corridor of Ropes Creek. The corridor of habitat along the riparian corridor at Ropes Creek will be maintained.

10.2.3.1(g) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

Potential habitat for the Green and Golden Bell Frog within GPEC and GMAC occurs towards the western edge of the distribution of the species in the Cumberland subregion. The potential population at Ropes Creek is disjunct from the majority of known records which generally occur over 20 km to the east.

10.2.3.1(h) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profile and Conservation Advice for the Green and Golden Bell Frog identify a range of threats to the species. Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Changes to the structure and diversity of aquatic vegetation
- Changes to hydrology and water quality
- Intensification of public access to habitat
- Predation by foxes, cats, dogs, and rats
- Inappropriate fire regimes
- Infection with amphibian chytrid fungus
- Road mortality

Predation of eggs and tadpoles, predation by exotic fish, interaction with cane toads and grazing are also identified as potential threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Green and Golden Bell Frog are discussed below for each identified indirect impact.

CHANGES TO THE STRUCTURE AND DIVERSITY OF AQUATIC VEGETATION

Changes to the structure and diversity of aquatic vegetation from weed invasion is a key threat to the Green and Golden Bell Frog. Weeds are already present within the Strategic Assessment Area. However, urban and transport development has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The species is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occurs adjacent to known populations or habitat, in particular adjacent to the OSO and close to North St Marys along Ropes Creek in GPEC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA. This includes a number of actions, of which the following are the most relevant to the outcome for the Green and Golden Bell Frog:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans

  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk posed to the Green and Golden Bell Frog from invasive weeds. This is because:

- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

CHANGES TO HYDROLOGY AND WATER QUALITY

A reduction in water quality and changes to hydrology are recognised as a principal threat to the species (DEWHA, 2009c). Key issues relate to changes to drainage patterns and stormwater runoff, soil erosion and sedimentation and increased pollutants.

Development under the Plan has the potential to alter water quality and hydrology in areas of known and potential habitat for the Green and Golden Bell Frog. The areas at risk include habitat for the species with Ropes Creek where development of the Western Sydney Freight Line (transport corridor to the east of WSA) intersects an upstream section of the creek.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA and NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the species from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to habitat for the species
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to habitat for the species

INTENSIFICATION OF PUBLIC ACCESS TO HABITAT

Intensification of public access to habitat is identified as a threat to the species. However, populations of the Green and Golden Bell Frog adjacent to or within proximity of proposed development are already subject to this threat as they are located within highly urbanised areas. Implementation of the Plan is unlikely to change the current level of disturbance.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 91.4 ha of potential habitat for the Green and Golden Bell Frog is contained within the three conservation reserves proposed by the Plan
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the species from increased public access to habitat areas as a result of development. This is because:

- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

PREDATION BY CATS AND OTHER PEST ANIMALS

Predation by cats and other pest animals is recognised as a threat to the Green and Golden Bell Frog. New urban development under the Plan is likely to increase the number of domestic cats in the local area. However, areas of habitat within proximity of proposed development already occur within highly urbanised areas. Any increase in the risk of predation from cats on populations of the Green and Golden Bell Frog as a result of the Plan is expected to be minimal.

The Plan also incorporates a range of measures to manage this issue across throughout the nominated areas. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCAs. This includes a number of actions with the most relevant to the outcome for the species being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans

- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
  - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
  - Require appropriate management and control of pest animals relevant to development sites

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes are identified as a potential threat to the Green and Golden Bell Frog (DoE, 2014b).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for the Green and Golden Bell Frog being:
  - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
  - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
  - A process to work with delivery partners to implement the fire management strategy
  - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Green and Golden Bell Frog. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

INFECTION WITH AMPHIBIAN CHYTRID FUNGUS

Amphibian chytrid fungus, which causes the infection known as chytridiomycosis, is likely to impact on populations of the Green and Golden Bell Frog. The threat to the species from chytrid fungus is not well understood, with the risk of extinction from the disease categorised as low to moderate (DEWHA, 2009b; DoEE, 2016). However, the suitability of habitat is influenced by the presence of chytrid fungus.

Chytrid fungus is already present in the Cumberland subregion, although there may be pockets of disease free areas that are inhospitable to the growth of the disease (for example, due to salinity levels or elevated concentrations of trace metals). The potential for dispersing chytridiomycosis in wild frog populations increases with urbanisation around

streams. This comes from growing potential for human interaction, more water flow (urban run-off) and reduced optimal habitat. Increased risks associated with development under the Plan are minimal, however, as habitat areas are already highly urbanised.

The *Cumberland Plain Conservation Plan Guidelines for Infrastructure* contain the following species-specific measure: "For areas where the Green and Golden Bell Frog is confirmed, incorporate best practice site hygiene protocols to manage the potential spread of chytrid fungus". This measure will address the potential impacts of chytrid fungus to the species from development of essential infrastructure on avoided land.

Further, Appendix E of the Plan contains a range of measures to incorporate best practice site hygiene protocols for development on urban capable land and development within the transport corridors across all nominated areas. While the Green and Golden Bell Frog is not specifically identified as a target species for these measures, the species will nonetheless benefit from these controls which will minimise the risk of spread of chytrid fungus.

The Plan further incorporates a range of general measures to manage the risks associated with chytrid fungus. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of chytrid fungus

The package of measures in the Plan is expected to adequately manage the risk associated with chytrid fungus because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

ROAD MORTALITY

Road mortality is identified as a potential threat to the Green and Golden Bell Frog (DoE, 2014b). This is not a novel threat to the species within the Strategic Assessment Area as roads have already been developed in proximity to habitat areas. However, implementation of the Plan will lead to new roads and an increase in the volume of cars on existing roads within nominated areas. The main area of concern is the development of the Outer Sydney Orbital downstream of habitat associated with the Ropes Creek corridor

The Plan includes a species-specific measure (Commitment 3) to avoid and minimise impacts to the Green and Golden Bell Frog and its habitat within certified major transport corridors through detailed planning and design. This includes avoiding areas of potential habitat connectivity within riparian corridors where possible. This measure will minimise the risk of road mortality to the species.

Further, Commitment 6 of the Plan contains the following action (Action 1 d): "identify potential design options for major watercourse crossings to reduce disruption to connectivity and the risk of fauna vehicle strikes".

These measures are considered to adequately address any potential increased threat from road mortality due to implementation of the Plan.

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

There is currently approximately 340.6 ha of potential habitat mapped within protected areas within the area covered by the Plan. This includes potential habitat within:

- Wianamatta Regional Park
- Agnes Banks Nature Reserve

Populations are known to occur in several conservation reserves outside the Cumberland subregion.

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of Green and Golden Bell Frog in the Cumberland subregion. Several commitments are described in more detail the sections above.

The key commitments and actions relevant to the species are:

- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential habitat for Green and Golden Bell Frog in the SCA, as there is approximately 462.3 ha of mapped potential habitat in the SCA for this species
- A species-specific measure (as part of Commitment 3) to avoid and minimise impacts to the Green and Golden Bell Frog and its habitat within certified major transport corridors through detailed planning and design
- Manage pest animals in strategic locations in the Cumberland subregion (Commitment 16) to reduce threats to conservation lands secured within the SCA. This includes preparing a Pest Animal Control Implementation Strategy to guide and co-ordinate delivery of a pest control program
- Support new or existing programs to control key diseases affecting TECs and species in the Cumberland subregion (Commitment 18)

25.11 MELALEUCA DEANEI

25.11.1 SPECIES BACKGROUND

Melaleuca deanei is a flaky-barked shrub with narrow pointed leaves and white flowers which grows to 3 m tall (DoEE, 2018a).

The species flowers in mid-October to December. Produces seeds infrequently and relies on clonal reproduction. Seeds can be held for up to 15 years, until fire, frost or drought triggers their release (DoEE, 2018a).

Longevity of individuals can be 100 years (NSW DECCW, 2010).

M. deanei inhabits ridgetop woodland and wet heath, on sandstone and sandy soils (DoEE, 2018a; OEH, 2019d). The majority of records come from ridgetop woodland (OEH, 2019d). *M. deanei* is associated with sandy loam soils which are low in nutrients (NSW DECCW, 2010).

Records occur primarily in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. Isolated records also occur in Springwood, Wollemi National Park, Yalwal and Central Coast areas. It is known to occur in the Cumberland IBRA subregion (OEH, 2019d). More than 50 per cent of all populations are protected in nature reserves or national parks (NSW DECCW, 2010).

As of 1993, the species was known from 94 populations, of which very few were considered reproductively viable. In 1993, it was estimated that there were 1,000-3,000 individuals of this species though this was likely as a ramet (stem) count (DoEE, 2018a). However, recent genetic research suggests that the species' population size may be much smaller than previous estimates (Douglas, 2019).

Population distribution is fragmented (DoEE, 2018a).

25.11.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

M. deanei is being assessed as a candidate species credit species for Wilton and GMAC. The species has been also identified as a potential SAII entity under the EES guidelines (Principle 4 of the BC Regulation) (OEH, 2017g), as it is a species which is unlikely to respond to management and is therefore irreplaceable.

25.11.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of *M. deanei* in relation to the subject land is shown in Map 25-9.

RECORDS

There are three populations which have been identified within and in proximity to the nominated areas.

One population (population 77) is located adjacent to the confluence of Allens Creek with Stringybark Creek, within Wilton. This population occurs within the boundary of a previously approved development under the EPBC Act (EPBC 2014/7400).

Both of the other populations (population 520 and population 463) occur to the north-east of Campbelltown, within the footprint of the proposed Georges River Koala Reserve.

It is noted that numerous additional records of this species occur in remnant vegetation adjacent to the nominated areas, in areas to the south of Wilton and to the east of Appin, Campbelltown and Macquarie Fields.

POTENTIAL HABITAT

The baseline mapping for this assessment has mapped 2,321.4 ha of known and potential habitat within two nominated areas (GMAC and Wilton). Habitat in these areas is well-connected, and strongly corresponds to the locations of wooded areas in these localities. There is no habitat mapped within GPEC or WSA.

25.11.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM.

10.2.3.1(A) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including *M. deanei*, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

The only records of *M. deanei* within the nominated areas occur within excluded land in Wilton, and subsequently are not located within urban capable land under the Plan.

The baseline mapping for this assessment has mapped 1,750.3 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 1,644.1 ha (93.9 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,545.2 ha was avoided for biodiversity purposes.
- 98.9 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-31.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-31 shows the amounts of habitat within excluded lands for context only.

Table 25-31: Avoidance outcomes for *M. deanei*

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential habitat (ha)	2,321.4	571.1	1,750.3	106.2	1,545.2	98.9	1,644.1

Avoidance of indirect impacts

Potential indirect impacts to *M. deanei* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(B) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Development within the nominated areas will not directly impact on any records or known populations of *M. deanei.*

Potential indirect impacts to *M. deanei* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(C) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

No threshold has been established for *M. deanei.*

10.2.3.1(D) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

There will be no direct impacts to any known populations of *M. deanei* under the Plan.

Approximately 106.2 ha of potential habitat for the species will be lost. This is 6.1 per cent of the potential habitat in the nominated areas (not including excluded lands). The loss of potential habitat occurs within GMAC and Wilton.

The direct impacts of the development are associated with urban development, and primarily impact the fringes of mapped potential habitat corridors within GMAC and Wilton. Impacts in these areas will not result in habitat fragmentation as impacts are located along existing edges of habitat which occur adjacent to cleared areas.

A section of potential habitat within the urban capable land which could be accessed as part of this biodiversity certification process was surveyed and the species was not observed. It is generally considered unlikely that potential habitat in this area contributes to the ongoing survival or viability of the species more broadly.

The direct impacts of the development on *M. deanei* are provided in Table 25-32.

Table 25-32: Direct impacts on *M. deanei*

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Potential habitat (ha)	45.4	60.8	0	0	0	106.2

Indirect impacts

Potential indirect impacts to *M. deanei* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(E) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of potential habitat areas within Wilton and GMAC is unlikely to affect the ecology of *M. deanei* in the locality because:

- There is a low likelihood the species occurs within potential habitat which will be directly impacted under the Plan
- The loss of potential habitat will not affect key life-cycle processes of the species, which regenerates through both seed production and vegetative growth
- Potential habitat will not be fragmented by development

10.2.3.1(F) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the loss of potential habitat areas within Wilton and GMAC will not result in fragmentation of potential habitat nor populations of *M. deanei*.

10.2.3.1(G) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

Known populations within/near the nominated areas include:

- Population 77 within Wilton, which is located within excluded lands
- Population 520 and population 463 which occur to the north-east of Campbelltown, within the footprint of the proposed Georges River Koala Reserve

These populations occur along the eastern boundary of a stronghold region for the species, which ranges between the Holsworthy locality in the north through to the Appin region in the south. It is noted that the Holsworthy Military Reserve (to the north-east of GMAC) it contains 17 per cent of the known population outside formal conservation reserves (NSW DECCW, 2010).

Potential habitat within Wilton and GMAC occurs in the approximate centre of the species' total geographic extent.

10.2.3.1(H) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profile (OEH, 2019d), Recovery Plan (NSW DECCW, 2010) (and other key documents) for *M. deanei* identify a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in key species documents) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes and mechanical methods of bushfire fuel reduction
- Inappropriate habitat disturbance from construction and maintenance of tracks and easements, unrestricted access and rubbish dumping
- Weed invasion

Low fecundity and viability, hybridisation, and trampling/plant damage due to army training exercises have also been identified as key threats. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats within the nominated areas.

There are three known populations of *M. deanei* within or in close proximity to the nominated areas:

- Population 520 and population 463 occurs to the east of GMAC within the footprint of the proposed Georges River Koala Reserve. These populations are not considered at risk of indirect impacts under the Plan due to their distance from urban capable land and the fact that the site will be managed for conservation purposes
- Population 77 occurs within Wilton within the offset site of an existing development approval and is managed in accordance with that approval. Management of the site includes measures to minimise indirect impacts, including fencing to restrict access, and preparation of an environmental management plan to deal with pressures to the population. Overall, population 77 is not considered to be at risk of indirect impacts under the Plan

The following assessments therefore consider the potential impacts of development under the Plan upon mapped potential habitat for *M. deanei.* The areas which are most at risk of impact include mapped habitat within Wilton and the southern portion of GMAC, which occurs close to urban capable lands.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *M. deanei* are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES AND MECHANICAL METHODS OF BUSHFIRE FUEL REDUCTION

Inappropriate fire regimes are an identified threat to *M. deanei* (NSW DECCW, 2010). Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the following mechanisms:

- Increased fire frequency due to arson and accidental lighting of fires

- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

It is additionally noted that mechanical bushfire reduction methods of habitat in close proximity to urban and other kinds of development pose a risk to *M. deanei* (NSW DECCW, 2010).

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for *M. deanei* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *M. deanei*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to *M. deanei* from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *M. deanei* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *M. deanei* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas (it is noted there is 7,466.4 ha for *M. deanei* mapped within the SCA. This includes 1,837.9 ha of potential habitat for *M. deanei* is contained within two of the Plan's proposed reserves)

INAPPROPRIATE HABITAT DISTURBANCE FROM CONSTRUCTION AND MAINTENANCE OF TRACKS AND EASEMENTS, UNRESTRICTED ACCESS AND RUBBISH DUMPING

Impacts relating to construction and maintenance of tracks and easements, unrestricted site access and rubbish dumping have been identified as threats to *M. deanei* (NSW DECCW, 2010). Areas most at risk included areas of mapped potential habitat within Wilton and GMAC.

Appendix E of the Plan includes a species-specific measure to consult with land managers of land containing known populations or habitat for *M. deanei* to mitigate indirect impacts from habitat disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and weed control, and managing rubbish dumping. This measure applies to GMAC and Wilton and will be implemented via consultation with local councils and other public agencies.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 1,837.9 ha of potential habitat for *M. deanei* is contained within two of the Plan's proposed reserves, and two important populations of the species occurs within the Georges River Koala Reserve
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *M. deanei* from inappropriate habitat disturbance as a result of development. This is because:

- A species-specific measure will require consultation with land managers to ensure protection of *M. deanei* from inappropriate habitat disturbance
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

WEED INVASION

Inappropriate fire regimes are an identified threat to *M. deanei* (NSW DECCW, 2010). Areas most at risk of weed invasion due to development under the Plan included areas of mapped potential habitat within Wilton and GMAC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *M. deanei*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies

  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *M. deanei* from the increased risk of weeds associated with development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- There is a commitment (Commitment 15) which will coordinate, enable and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

In 2010, more than 50 per cent of all known occurrences of the species occurred within NSW National Parks. Since 2010, the species has achieved greater protection, as follows (Douglas, 2019):

- Gazettal of the Upper Nepean State Conservation Area has increased protection to two known large populations
- Gazettal of the Dharawal National Park has increased protection of numerous occurrences
- Gazettal of Berowra Valley National Park has increased protection to numerous occurrences. It is noted that, in 2010, the area covered by this National Park contained 17 per cent of the total known sites of the species

There is currently approximately 1,607.3 ha of potential habitat mapped within protected areas within the Strategic Assessment Area.

It is also noted that a, outside of formal conservation reserves, a large population occurs in Holsworthy Military Reserve. This population contains 17 per cent of the known population outside formal conservation reserves (NSW DECCW, 2010).

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of *M. deanei* in the Cumberland subregion. Several commitments are described in more detail the sections above.

Key commitments relevant to the species are:

- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential habitat for *M. deanei* in the SCA, as there is approximately 7,466.4 ha of mapped potential habitat in the SCA for this species
- Manage weeds (Commitment 15) in strategic locations in the Cumberland subregion to reduce threats to conservation lands secured within SCAs. This includes preparing a Weed Control Strategy to guide and co-ordinate delivery of a weed control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
  - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
  - Preparing a Fire Management Strategy to guide and co-ordinate fire management
- Minimise habitat disturbance (Commitments 20 and 26), including a species-specific measure which requires consultation with land managers to ensure protection of *M. deanei* from inappropriate habitat disturbance

25.12 MICROMYRTUS MINUTIFLORA

25.12.1 SPECIES BACKGROUND

Micromyrtus minutiflora is a slender spreading shrub that grows to 2 m high with solitary flowers and white petals (DEWHA, 2008).

The species flowers sporadically from June to March. Response to disturbance (such as fire or mechanical) is uncertain. Regeneration may occur as a result of re-sprouting, or germination of seeds stored within the soil (OEH, 2019i).

M. minutiflora inhabits Scribbly Gum Woodland, Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments (DEWHA, 2008; OEH, 2019i).

The species is endemic to the western parts of the Cumberland subregion in the Richmond-Castlereagh area and has a highly restricted distribution. The distribution overlaps with CRCIF and Castlereagh Scribbly Gum Woodland.

In 2002 there were 11 known populations with approximately 1,800 individuals across the Blacktown, Hawkesbury and Penrith Local Government Areas. In 1997, there were over 1,160 individuals in the Australian Defence Industries site and 500 individuals at Marsden Park site. Populations range from fewer than 50 plants to over 1,000 (DEWHA, 2008).

25.12.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

Micromyrtus minutiflora is being assessed as a candidate species credit species for GPEC and WSA nominated areas.

The species has been identified as a SAII entity in accordance with the requirement of section 10.2.1.4 of the BAM because it has a very highly restricted geographic distribution, which triggers Principle 3 of the BC Regulation.

25.12.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of *M. minutiflora* in relation to the subject land is shown in Map 25-10.

The majority of records and potential habitat for *M. minutiflora* occur to the north of the nominated areas. GPEC and WSA occur within the southern extent of the species stronghold in the Castlereagh and Londonderry areas.

There are several records of the species within GPEC located in the vicinity of Wianamatta Regional Park in the Ropes Crossing area. There are no records of the species within WSA.

There are no records of *M. minutiflora* within the urban capable lands of GPEC and WSA. The important population on the edge of Wianamatta Regional Park in the Ropes Crossing area occurs approximately 1.5 km from the nearest urban capable land.

The species was targeted during surveys within the nominated areas but was not recorded.

Approximately 256.4 ha of potential habitat for *M. minutiflora* has been identified within GPEC and WSA. The majority of potential habitat occurs within the Wianamatta Regional Park in the northern part of GPEC, however surveys confirmed the species was not present within the OSO alignment. A smaller patch of potential habitat has been mapped in Orchard Hills in the middle part of GPEC and around Kemps Creek in WSA. The remaining habitat areas exists mainly as scattered and isolated habitat patches across the eastern half of GPEC.

25.12.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM.

10.2.3.1(A) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including *M. minutiflora*, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

The population of *M. minutiflora* within GPEC occurs outside the urban capable land and has been avoided.

The baseline mapping for this assessment has mapped 69 ha of potential habitat for *M. minutiflora* within the nominated areas (not including excluded lands). Approximately 37.3 ha (54 per cent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 37.1 ha was avoided for biodiversity purposes
- 0.2 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-33.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-33 shows the amounts of habitat within excluded lands for context only.

Table 25-33: Avoidance outcomes for *M. minutiflora*

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential habitat (ha)	256.4	187.4	69	31.7	37.1	0.2	37.3

Avoidance of indirect impacts

Potential indirect impacts to *M. minutiflora* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(B) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Development within GPEC and WSA will not directly impact on any records or known populations of *M. minutiflora.*

Potential indirect impacts to *M. minutiflora* potential habitat due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(C) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

There are currently no impact thresholds for *M. minutiflora.*

10.2.3.1(D) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

A total of 31.7 ha of potential habitat for *M. minutiflora* will be directly impacted by the development. This is 45.9 per cent of the potential habitat in the nominated areas (without excluded lands). The direct impacts of the development are associated with urban development. The direct impacts mainly occur:

- To scattered patches of potential habitat at Orchard Hills in the central part of GPEC, which will be impacted by urban development
- To potential habitat within the alignment of the M7/Ropes Crossing Link Road in northern GPEC
- To potential habitat within the Kemps Creek area in WSA associated with urban development

An area of potential habitat within the Wianamatta Regional Park in the northern part of GPEC is bisected by the corridor for the Outer Sydney Orbital (OSO). Survey confirmed the species was absent with the road corridor, however potential habitat is mapped either side of the OSO and would be fragmented by the proposed development.

The direct impacts of the development on *M. minutiflora* are provided in Table 25-34.

Table 25-34: Direct impacts on *M. minutiflora*

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Potential habitat (ha)	0	0	8.3	10.6	12.8	31.7

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

Impacts to habitat in northern GPEC

The M7/Ropes Crossing Link Road impacts on 4.4 ha of potential habitat along the northern boundary of GPEC. Although not directly impacting on mapped habitat, the OSO corridor will lead to fragmentation of potential habitat within Wianamatta Regional Park, leading to a number of smaller, isolated patches of vegetation. This fragmentation may increase impacts associated with edge effects (primarily weeds) and this has the potential to compromise the suitability of remaining habitat areas directly adjacent to development.

The species was confirmed absent within the OSO corridor during project surveys, and the likelihood that the species occurs within lands adjacent to the corridor is considered low given:

- The area forms part of a Regional Park which is managed by the NSW NPWS and would be well traversed
- The species is relatively easy to identify when it is in flower

This low likelihood of occurrence considerably reduces the risk of impacts to *M. minutiflora* on key life-cycle processes.

Impacts to habitat at Orchard Hills

The loss of potential habitat at Orchard Hills is associated with small, scattered patches of habitat that are currently surrounded by houses and farmland. The extent of cleared land in the area means that impacts are unlikely to increase edge effects to retained habitat areas or further reduce their viability.

Impacts to habitat in WSA

Impacts to potential habitat within WSA are restricted to the Kemps Creek area and are associated with urban capable development. The impacts generally occur on the edges of larger potential habitat polygons, with the habitat surrounded by rural residential development and farmland. The extent of cleared land in the area means that impacts are unlikely to increase edge effects to retained habitat areas or further reduce their viability. It is generally considered unlikely that potential habitat in this area contributes to the ongoing survival or viability of the species more broadly.

Indirect impacts

Potential indirect impacts to *M. minutiflora* due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(e) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of potential habitat within GPEC and WSA is unlikely to affect the ecology of any local population of *M. minutiflora* because the potential for the species to occur is low.

10.2.3.1(f) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the loss of potential habitat within the nominated areas is unlikely to fragment or isolate any local population of *M. minutiflora* because the potential for the species to occur is low.

Surveys of the OSO did not detect *M. minutiflora*, but potential habitat remains either side of the OSO corridor in Wianamatta Regional Park. This mapped potential habitat will be fragmented by the OSO. However, the low likelihood of occurrence of *M. minutiflora* in the area considerably reduces the risk of these impacts.

10.2.3.1(G) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

Potential habitat for *M. minutiflora* within GPEC and WSA occurs within the southern extent of the species stronghold in the Castlereagh and Londonderry areas.

There is one known population within GPEC on the edge of Wianamatta Regional Park near Ropes Crossing. This population is disjunct from the majority of known records which occur approximately 7 km to the north-west and are generally associated with larger, more intact remnants of native vegetation and will not be directly or indirectly impacted by development. This population is generally within the southern geographic extent of the species range, although there are two relatively recent (2014) records of the species further south near Mulgoa.

10.2.3.1(H) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profile for *M. minutiflora* (OEH, 2019i) identifies a range of threats to the species. Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Habitat degradation

The greatest risk areas for these relevant threats are:

- Within the alignment of the M7/Ropes Crossing Link Road in northern GPEC
- Within Wianamatta Regional Park, where the OSO corridor fragments potential habitat
- At Orchard Hills, where urban development fragments potential habitat

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *M. minutiflora* are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

The response of *M. minutiflora* to fire is unknown. However, altered fire regimes are an identified threat (OEH, 2019i) and a 2016 fire in the Wianamatta Nature Reserve (outside of the nominated areas to the north of GPEC) may have substantially affected the species. Increased human activity within the nominated areas increases the risk of fire to habitat areas supporting the species.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for *M. minutiflora* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is

managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk

- Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *M. minutiflora*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

WEED INVASION

M. minutiflora is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban and transport development within GPEC has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

M. minutiflora is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include population 108 that occurs within GPEC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA. This includes a number of actions, of which the following are the most relevant to the outcome for *M. minutiflora*:
  - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
- Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

HABITAT DEGRADATION

Habitat degradation through unrestricted public access and rubbish dumping have been identified as a key threat to *M. minutiflora* (OEH, 2019i). Development within GPEC may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high

biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values

- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

There is currently approximately 2,036.4 ha of potential habitat mapped within protected areas within the area covered by the Plan. This includes potential habitat within:

- Castlereagh Nature Reserve
- Wianamatta Regional Park
- Wianamatta Nature Reserve
- Agnes Banks Nature Reserve
- Windsor Downs Nature Reserve

Four populations occur on public land managed for conservation. They are:

- Castlereagh Nature Reserve – two populations
- Wianamatta Regional Park – one population
- Wianamatta Nature Reserve – one population
- Agnes Banks Nature Reserve – one population

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments and actions that will contribute to the recovery of *M. minutiflora* in the Cumberland subregion. The key commitments and actions relevant to the species are:

- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential habitat for *M. minutiflora* in the SCA, as there is approximately 3,518.4 ha of mapped potential habitat in the SCA for this species
- Manage weeds in strategic locations in the Cumberland subregion (Commitment 15) to reduce threats to conservation lands secured within the SCA. This includes preparing a Weed Control Strategy to guide and co-ordinate delivery of a weed control program
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
    - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
    - Preparing a Fire Management Strategy to guide and co-ordinate fire management

25.13 RAPTORS

This assessment addresses three raptor species together – White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Little Eagle (*Hieraaetus morphnoides*) and Square-tailed Kite (*Lophoictinia isura*).

25.13.1 SPECIES BACKGROUND

LITTLE EAGLE

Little Eagle is a medium-sized bird of prey that occurs throughout the Australian mainland except the most densely forested parts of the Dividing Range escarpment (OEH, 2017i). The species is found throughout NSW, but is more common in the western two-thirds of the state (Saunders and Debus, 2018a).

The species inhabits open eucalypt forest, woodland or open woodland. It also occurs in Sheoak or Acacia woodlands and riparian woodlands of interior NSW (OEH, 2017i).

Little Eagle generally nests in tall living eucalypts (between 5 and 30 m) in open forest, woodland, and remnant woodland within farmland. Nests are generally between 13 and 20 m above ground. They prefer to nest in dense woodland adjacent to open habitat (e.g. grassy woodland) for foraging. Nests are typically:

- In an emergent eucalypt, the tallest in the stand and often with the largest girth
- In woodland patches at least 4.8 ha in size (average 85 ha)
- Mostly within 200 m of the edge of habitat
- More distant from sealed roads (average 838 m) than gravel roads (average 546 m) than tracks (average 304 m)
- At least 38 m from the nearest dwelling (average 457 m)
- At least 1 km from urban development (Saunders and Debus, 2018a)

Little Eagle will forage up to 3 km from the nest, which gives a maximum breeding/foraging territory of 2,800 hectares. Banding data suggest that birds occupy a home range for at least 6-10 years (Saunders and Debus, 2018a).

The species occurs as a single population throughout NSW (OEH, 2017i).

SQUARE-TAILED KITE

Square-tailed Kite is a reddish, medium-sized raptor that occurs along coastal and subcoastal areas from south-western to northern Australia, NSW, Queensland, and Victoria. There are scattered records across NSW (OEH, 2017k).

The species inhabits a variety of forests, including dry woodlands and open forests (OEH, 2017k). Square-tailed Kite prefers timbered watercourses through open or cleared land and the margins between open and timbered country, and can tolerant human disturbance and urban bushland (Saunders and Debus, 2018b).

Nests are generally located along or near watercourses and on the edge of habitat areas, in a fork or on horizontal limbs of a large living trees, and mostly between 15 and 28 m above ground (Saunders and Debus, 2018b).

The species appears to be monogamous as breeding pairs, as they are intolerant of other adults within their breeding territory, and they occupy the same nest site for many years (Saunders and Debus, 2018b).

The species migrates in the summer to south-east NSW to breed, arriving in September and leaving by March (OEH, 2017k). In the Cumberland subregion, breeding has been recorded from July to February (Saunders and Debus, 2018b).

The species occupies large hunting ranges of more than 100 km^2.

WHITE-BELLIED SEA-EAGLE

The White-bellied Sea-Eagle is a large eagle that has long, broad wings and a short, wedge-shaped tail that occurs around the Australian coastline and inland along rivers and wetlands of the Murray Darling Basin. In NSW, it is widespread along the east coast, and along all major inland rivers and waterways (OEH, 2017l).

The species occurs in a variety of habitats, including coastal dunes, tidal flats, grassland, heathland, woodland, and forest close to large bodies of open water including larger rivers, swamps, lakes, and the ocean (OEH, 2017l).

Breeding habitat is constrained to living or dead mature trees within forests or tall woodland within 1 km of rivers, lakes, large dams or creeks, wetlands, and coastlines. Nest are generally located in large emergent eucalypts, often with emergent dead branches or large dead trees nearby, which are used as 'guard roosts' (OEH, 2017l).

25.13.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

The raptors are being assessed as candidate species credit species in terms of breeding habitat for all nominated areas.

The raptors have been identified as potential SAII entities in accordance with the requirement of section 10.2.1.4 of the BAM because of the potential for the development to impact breeding habitat that cannot readily be created at a stewardship site. This SAII assessment addresses direct and indirect impacts on breeding habitat only.

An expert report was prepared for Little Eagle and Square-tailed Kite. Potential breeding habitat for the raptors was mapped on the basis of the expert reports, as well as a KBM, as follows:

- Little Eagle:
  - An expert report for Wilton and GMAC (Saunders and Debus, 2018a) and addendum letter (Saunders, 2020)
  - A KBM for WSA and GPEC
- Square-tailed Kite:
  - An expert report for Wilton and GMAC (Saunders and Debus, 2018b) and addendum letter (Saunders, 2020)
  - A KBM for WSA and GPEC
- White-bellied Sea-Eagle: A KBM for all four nominated areas

The expert reports involved:

- Targeted surveys within the most likely areas of potential breeding and foraging habitat for these species
- Identification of potential breeding and foraging habitat within the nominated areas
- Targeted surveys in potential habitat by the expert as part of preparing the expert report as well as Biosis as part of other targeted surveys for this project (the Biosis surveys were taken into account in preparing the expert report)

The addendum refined the mapping of potential breeding and foraging habitat and clarified the location of such habitat.

25.13.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of the raptors in relation to the subject land is shown in Map 25-11.

RECORDS

Little Eagle

The majority of records of the Little Eagle within the Cumberland subregion are recorded on the Cumberland Plain. This includes 35 records within the nominated areas, or within 5 km of the nominated area boundaries.

Most records are associated with large patches of open woodland that occur within open grassland areas. Some records are found close to the edges of forests along watercourses. A few records were from woodlands associated with wetlands. The records support the conclusion that a mosaic of open woodland and open grassland with scattered trees provides important foraging habitat for the Little Eagle (Saunders and Debus, 2018a).

The expert report concluded that there is a very high likelihood that Little Eagle occurs in the nominated areas at any time of the year and that the nominated areas provide good foraging habitat for the species. There are likely to be 4 to 6 resident pairs resident in Wilton and GMAC, including (Saunders and Debus, 2018a):

- 1 pair in the northern part of GMAC
- 2 pairs in the middle part of GMAC
- 1 pair in the southern part of GMAC
- 1 pair in Wilton

Square-tailed Kite

Square-tailed Kite was seldom recorded in the Cumberland subregion prior to 1990, but the number of records has increased over the last two decades. All records for the Liverpool, Campbelltown and Wollondilly Local Government Areas are more recent than 2000. There are breeding records within the subregion, from near Asquith in 2012, Lane Cove National Park in 2015, and more recently near Penrith, Asquith and South Turramurra (Saunders and Debus, 2018b).

There are 32 records in the nominated areas, including 12 within Wilton and the southern part of GMAC. Another 15 records occur within 5 km of the nominated areas, with 11 occurring just outside the northern part of GMAC. The majority of records are from January to April, which represents the post-breeding dispersal phase (Saunders and Debus, 2018b).

The expert report concluded that there is a very high likelihood that Square-tailed Kite occurs in the nominated areas during the breeding season, and that the nominated areas provide good foraging habitat for the species. There are likely to be 2 to 3 breeding pairs of Square-tailed Kite resident in Wilton and GMAC, including:

- 1 pair centred along the Georges River along the eastern edge of the northern part of GMAC
- 1 pair in the Appin Road area that extends into contiguous forest to the east of the southern part of GMAC
- Possibly 1 pair in the southern part of Wilton

White-bellied Sea-Eagle

There are many records of the White-bellied Sea-Eagle in the Cumberland subregion, although the majority in the Sydney Basin bioregion occur to the east of the subregion along the coast, to the north and south of Sydney.

There are several records of the species in the nominated areas. There is one old record in GPEC and two records in the central part of WSA, including a recent (2017) record. There is a cluster of relatively recent records (2013) within or just outside the central part of GPEC, and several other records in the southern part of GPEC. There are several recent (2018) records just outside the northern part of the GPEC to the east. There are no records in Wilton.

POTENTIAL BREEDING HABITAT

Potential breeding habitat for the raptors has been mapped in all nominated areas.

Potential breeding habitat for Little Eagle and Square-tailed Kite occurs in the urban capable lands of GPEC, GMAC and WSA, and for White-bellied Sea-Eagle, occurs in the urban capable lands of all nominated areas.

Little Eagle

No nests have been recorded in the nominated areas and no evidence of breeding was observed during surveys by ecological consultants or by the authors of the expert report. As the Little Eagle is considered to be resident for at least several consecutive years while nesting, it is likely that if nesting has occurred within the nominated areas it would have been detected. However, suitable nesting habitat is still considered to occur within the nominated areas (Saunders and Debus, 2018a). This view is supported by the occurrence of species records within and around the nominated areas in the breeding season (e.g. a mating pair was observed by Starr et al. (2004) near Camden (Saunders and Debus, 2018a)).

Square-tailed Kite

There is a very high likelihood that Square-tailed Kite occurs within the nominated areas during the breeding season. However, no nests have been recorded in the nominated areas. Breeding was not observed during surveys by the ecological consultants or by the authors of the expert report. As other bird species build similar stick nests it is difficult to identify a Square-tailed Kite nest without the bird being in attendance, which would be required to confirm breeding habitat. The breeding habitat areas indicated in the expert reports (Saunders and Debus, 2018b) are based on the minimum criteria presented in Tables 1 and 2 of the report.

Note that the conclusions in the expert reports are supported by mapping showing 'Breeding and foraging habitat' for Little Eagle and Square-tailed Kite. This habitat is generally restricted to areas outside urban capable lands. Further clarification was sought from the experts and additional refinement of the mapping was completed in June 2020 (Saunders, 2020). The refined mapping was used to define breeding habitat for the species in GMAC and Wilton and calculate impacts consistent with the BAM. KBM mapping was used to identify potential breeding habitat in GPEC and WSA.

25.13.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM.

10.2.3.1(A) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including the raptors, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

Little Eagle

The baseline mapping for this assessment has mapped 2,935.5 ha of potential breeding habitat for Little Eagle within the nominated areas (not including excluded lands). Approximately 2,907.3 ha (99 per cent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,237.5 ha was avoided for biodiversity purposes
- 669.8 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-35.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-35 shows the amounts of habitat within excluded lands for context only.

Table 25-35: Avoidance outcomes for Little Eagle

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential breeding habitat (ha)	4,090.7	1,155.2	2,935.5	28.2	2,237.5	669.8	2,907.3

Square-tailed Kite

The baseline mapping for this assessment has mapped 2,919.2 ha of potential breeding habitat for Square-tailed Kite within the nominated areas (not including excluded lands). Approximately 2,874.6 ha (98.5 per cent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,220.2 ha was avoided for biodiversity purposes
- 654.4 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-36.

Table 25-36: Avoidance outcomes for Square-tailed Kite

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential breeding habitat (ha)	4,198.7	1,279.5	2,919.2	44.6	2,220.2	654.4	2,874.6

White-bellied Sea-Eagle

The baseline mapping for this assessment has mapped 2,432.9 ha of potential breeding habitat for White-bellied Sea-Eagle within the nominated areas (not including excluded lands). Approximately 1,598.9 ha (98.9 per cent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,031.8 ha was avoided for biodiversity purposes
- 567.2 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-37.

Table 25-37: Avoidance outcomes for White-bellied Sea-Eagle in all four nominated areas

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential breeding habitat (ha)	2,432.9	816.3	1,616.6	17.7	1,031.8	567.2	1,598.9

Avoidance of indirect impacts

Potential indirect impacts to the raptors due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(b) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Little Eagle and Square-tailed Kite

There are likely to be 4 to 6 resident pairs of Little Eagle, and 2 to 3 breeding pairs of Square-tailed Kite (that will use the areas for foraging during the breeding season), in Wilton and GMAC.

The expert report found no evidence of breeding of Little Eagle of Square-tailed Kite, as defined by the presence of a bird on a nest, or the presence of pairs of birds in potential habitat, in Wilton or GMAC. Refined mapping completed in June 2020 did map areas of potential breeding habitat in both Wilton and GMAC (Saunders, 2020).

It is uncertain whether Little Eagle or Square-Tailed Kite resides in GPEC or WSA, or the number of resident individuals. Potential breeding habitat occurs in these nominated areas, and relatively recent records occur within or in close proximity to the nominated areas. It is considered likely that the species uses the nominated areas at least for foraging.

White-bellied Sea-Eagle

It is uncertain whether White-bellied Sea-Eagle resides in any of the nominated areas, and if it does occur, the number of potential resident individuals. Potential breeding habitat occurs in each of the nominated areas, particularly Wilton and GMAC, and recent records occur in WSA and particularly within or just outside the central part of GPEC. It is considered likely that the species uses the nominated areas at least for foraging.

10.2.3.1(c) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

There are currently no impact thresholds for the raptors.

10.2.3.1(d) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

The direct impacts of the development on the raptors are provided in Table 25-38. The direct impacts are mainly associated with development of urban capable land within GMAC, and the transport corridors within the nominated areas. For all raptors, the impacts mainly occur:

- In small, scattered areas of habitat across GMAC, which typically impacts the edges of larger, connected areas of vegetation, or small fragmented remnants. The largest impacts within GMAC occur in proximity to Appin
- In Wianamatta Regional Park where the OSO intersects an area of habitat, which will fragment this habitat into two patches and lead to the isolation of one of the patches from the remainder of habitat in the regional park
- In the central part of GPEC where the OSO mostly removes habitat associated with riparian corridors

- To the edges of smaller scattered patches of habitat in WSA that are mainly associated with riparian corridors
- In small, scattered areas within Wilton, which typically affect the edges of larger areas of connected habitat associated with riparian corridors

It is important to note that potential foraging habitat was also mapped within GMAC and Wilton for Little Eagle and Square-tailed Kite (Saunders, 2020). The potential foraging habitat is generally represented by grassed paddocks adjacent to mapped potential breeding habitat and is not considered to be breeding habitat requiring credit calculations under the BAM.

Table 25-38: Direct impacts on potential breeding habitat (ha) for raptors

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Little Eagle	4.8	18.9	0.7	0.6	3.3	28.2
Square-tailed Kite	5	25.2	0.9	0.3	13.3	44.6
White-bellied Sea-Eagle	2.5	7.9	0.9	0.3	6.2	17.7

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

Direct impacts to potential breeding habitat for the raptors are unlikely to affect life cycle processes or impact the viability of any local populations of raptors because:

- Direct impacts to potential breeding habitat for raptors are very small relative to the amount of potential breeding habitat remaining
- Impacts generally occur to the edges of potential breeding habitat that in most cases remains connected to larger patches of habitat associated with gullies and gorges that run down to the Nepean River or along riparian corridors. This reduces the risk that potential breeding habitat becomes isolated from foraging habitat

The development will lead to some fragmentation of potential breeding habitat. This mainly occurs as follows:

- GPEC:
  - In Wianamatta Regional Park where the OSO will fragment habitat into two patches
  - In the central part of the nominated area where the OSO will reduce the size of some habitat patches
- WSA: Along some riparian corridors where the development will reduce the size of patches to some extent

The impacts of habitat fragmentation for these species are considered minor and are unlikely to affect life cycle processes or impact the viability of local populations, because:

- The areas which may be impacted by fragmentation comprise only a small proportion of the total available habitat within the nominated areas
- The mobile nature of the species means that they are considered unlikely to be substantially adversely impacted by the scale of habitat fragmentation which will occur as a result of development under the Plan
- The majority of habitat for these species, including large and well-connected areas of habitat, has been avoided and will be protected under the Plan, which will help to ensure ongoing habitat connectivity into the future

As a result, it is not considered that the development is likely to significantly fragment or isolate the likely resident pairs of Little Eagle and Square-tailed Kite and any population of White-bellied Sea-Eagle in Wilton and GMAC, or fragment or isolate any populations of these species in the WSA or GPEC.

Indirect impacts

Potential indirect impacts to the raptors due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(e) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of potential breeding habitat is unlikely to affect the ecology of any local populations of raptors because direct impacts to potential breeding habitat for raptors are very small relative to the amount of habitat remaining, and the risk of impacts of habitat fragmentation to these species are minimal.

10.2.3.1(f) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the loss of potential breeding habitat is unlikely to fragment or isolate any local populations of raptors because in most cases, impacts mainly occur only to the edges of patches and potential breeding habitat usually remains connected to large areas of habitat or along riparian corridors. Further, the mobile nature of these species reduces their vulnerability to impacts of fragmentation.

10.2.3.1(g) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

There are likely to be 4 to 6 resident pairs of Little Eagle, and 2 to 3 breeding pairs of Square-tailed Kite (that will use the areas for foraging during the breeding season), in Wilton and GMAC. It is uncertain whether White-bellied Sea-Eagle resides in any of the nominated areas, and if it does occur, the number of potential resident individuals.

The importance of these resident pairs to other populations outside the nominated areas is uncertain.

Little Eagle occurs as a single population throughout NSW (OEH, 2017i), while Square-tailed Kite appears to be monogamous as breeding pairs, as they are intolerant of other adults within their breeding territory, and they occupy the same nest site for many years (Saunders and Debus, 2018b).

The expert report found no evidence of breeding of Little Eagle or Square-tailed Kite, as defined by the presence of a bird on a nest, or the presence of pairs of birds in potential habitat, in Wilton or GMAC. If breeding does not occur within the nominated areas, it is likely that these species breed outside the nominated areas and use the nominated areas for foraging.

10.2.3.1(h) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profiles for the three species identify a range of threats. Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Non-target poisoning during pest animal control
- Habitat disturbance

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the species are discussed below for each identified indirect impact.

NON-TARGET POISONING DURING PEST ANIMAL CONTROL

Accidental poisoning during pest animal control is recognised as a threat to the species. Poisoning of pest animals may occur during implementation of the Plan as part of the Pest Animal Control Implementation Strategy (Commitment 16).

To mitigate the risk to the three raptor species, the Plan includes a specific commitment and action to *"Ensure that the Pest Animal Control Implementation Strategy specifies the use of pest control techniques that will reduce the risk of secondary poisoning from Pindone or second-generation rodenticides"* (Commitment 16, Action 3)

This measure is considered adequate to address the threat to the species.

HABITAT DISTURBANCE

Habitat disturbance (particularly to nest sites) is recognised as a threat to the species. Habitat disturbance can occur due to a range of mechanisms including:

- Uncontrolled access to areas of high biodiversity
- Inappropriate land management practices

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Retaining large trees (including dead trees) (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction (under Commitment 5)
- Establishing ecological setbacks (500m circular setback from where nests are located in undisturbed bushland or 250m for nests adjacent to existing development) for raptor nests to provide a buffer to adjacent development
- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

An estimate of the potential breeding habitat for raptors in protected lands in the area covered by the Plan is:

- Little Eagle: 297.8 ha
- Square-tailed Kite: 330 ha
- White-bellied Sea-Eagle: 389.4 ha

Each of the raptors has been recorded within several of the following protected lands within and outside the Cumberland subregion, including:

- Wianamatta Nature Reserve
- Dharawal National Park
- Dharug National Park
- Scheyville National Park
- Cattai National Park
- Yengo National Park
- Blue Mountains National Park
- Dharawal National Park
- Royal National Park
- Castlereagh Nature Reserve
- Windsor Downs Nature Reserve

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of the raptors in the Cumberland subregion. Several commitments are described in more detail the sections above.

The key commitments and actions relevant to the species are:

- Species-specific commitments under Commitment 5 to retain large trees (≥ 50cm DBH) during precinct planning where possible and establish ecological setbacks for raptor nests to provide a buffer to adjacent development
- A specific measure in Appendix E of the Plan to establish ecological setbacks (500m circular setback from where nests are located in undisturbed bushland or 250m for nests adjacent to existing development) for raptor nests to provide a buffer to adjacent development
- Ensuring that the Pest Animal Control Implementation Strategy specifies the use of pest control techniques that will reduce the risk of secondary poisoning from Pindone or second-generation rodenticides (Commitment 16)
- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential breeding habitat for raptors in the SCA, as there is 17,566.5 ha, 17,322.6 ha, and 13,699.7 ha of mapped potential breeding habitat in the SCA for the Little Eagle, Square-tailed Kite and White-bellied Sea Eagle respectively

25.14 PSEUDOPHRYNE AUSTRALIS

25.14.1 SPECIES BACKGROUND

Red-crowned Toadlet (*Pseudophryne australis*) is a small frog that is dark brown to black, with distinctive reddish-orange patches. It is a relatively long-lived species (up to 8 to 10 years) (OEH, 2019j).

The species inhabits periodically wet drainage lines below sandstone ridges within open forests, mostly at the interface of Hawkesbury sandstone and Wianamatta and Narrabeen shale (OEH, 2019j).

The Red-crowned Toadlet appears to be largely restricted to the immediate vicinity of suitable breeding habitat. Breeding habitat comprises dense vegetation and debris beside ephemeral creeks and gutters (OEH, 2019j). The species deposits eggs in terrestrial nests beneath rocks and logs or in leaf litter, and relies on rainfall to wash the partially developed tadpoles into ephemeral creeks for completion of the reproductive cycle (NSW Scientific Committee, 2002).

Outside the breeding period, the species disperses to refuge areas close to breeding sites, under rocks and amongst masses of dense vegetation or thick piles of leaf litter generally on sandstone ridges (OEH, 2019j).

The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains (OEH, 2019j).

Records for the species are widespread surrounding the Cumberland subregion, but few records occur in the subregion.

25.14.2 ASSESSMENT UNDER THE STRATEGIC BIODIVERSITY CERTIFICATION

The Red-crowned Toadlet is being assessed as a candidate species credit species for GPEC, GMAC, and Wilton.

The species has been identified as a potential SAII entity in accordance with the requirement of section 10.2.1.4 of the BAM because of its very high susceptibility to the disease chytrid fungus, which triggers Principle 4 of the BC Regulation.

25.14.3 OCCURRENCE IN RELATION TO THE SUBJECT LAND

The occurrence of Red-crowned Toadlet in relation to the subject land is shown in Map 25-12.

There are no records for the Red-crowned Toadlet within the nominated areas. The closest records occur within a few kilometres of GPEC, GMAC, and Wilton.

Approximately 1,082 hectares of potential habitat for Red-crowned Toadlet has been identified within the nominated areas. This occurs in Wilton and GMAC. No potential habitat was mapped within GPEC and WSA.

Potential habitat in Wilton and GMAC generally occurs in scattered patches within the vicinity of gorges and gullies that occur mainly around the edges of the nominated areas. The vast majority of potential habitat in GMAC is restricted to the southern part of the nominated area, with only one small patch of habitat occurring in the northern part.

25.14.4 IMPACT ASSESSMENT

The following assessment addresses the provisions set out in section 10.2.3 of the BAM.

10.2.3.1(A) THE ACTION AND MEASURES TAKEN TO AVOID DIRECT AND INDIRECT IMPACTS

Avoidance and minimisation of impacts to biodiversity values, including Red-crowned Toadlet, was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of direct impacts

No known populations of Red-crowned Toadlet occur within GMAC and Wilton. Avoidance of impacts to populations was therefore not a relevant consideration for this species.

The baseline mapping for this assessment has mapped 869 ha of potential habitat for Red-crowned Toadlet within the nominated areas (not including excluded lands). Approximately 859.7 ha (98.9 per cent) of this was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 645.1 ha was avoided for biodiversity purposes
- 214.6 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 25-39.

It is important to note that the avoidance calculations in the table including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands. Table 25-39 shows the amounts of habitat within excluded lands for context only.

Table 25-39: Avoidance outcomes for Red-crowned Toadlet

Avoidance of:	Total in nominated areas	Total in excluded lands	Total without excluded lands	Directly impacted	Avoided for biodiversity purposes	Avoided for other purposes	Total avoidance
Potential habitat (ha)	1,082	213	869	9.3	645.1	214.6	859.7

Avoidance of indirect impacts

Potential indirect impacts to Red-crowned Toadlet due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(B) THE SIZE OF THE LOCAL POPULATION DIRECTLY AND INDIRECTLY IMPACTED BY THE DEVELOPMENT

Development within GMAC and Wilton will not directly impact any known populations of Red-crowned Toadlet.

10.2.3.1(C) THE EXTENT TO WHICH THE IMPACT EXCEEDS ANY THRESHOLD FOR THE POTENTIAL ENTITY

There are currently no impact thresholds for Red-crowned Toadlet.

10.2.3.1(D) THE LIKELY IMPACT (INCLUDING DIRECT AND INDIRECT) THAT THE DEVELOPMENT, CLEARING OR BIODIVERSITY CERTIFICATION WILL HAVE ON THE HABITAT OF THE LOCAL POPULATION

Direct impacts

A total of 9.3 ha of potential habitat for Red-crowned Toadlet will be directly impacted by the development. This is 1.1 per cent of the potential habitat in the nominated areas (without excluded lands). The direct impacts of the development

are associated with urban development. The direct impacts mainly occur at the very edges of potential habitat associated with gorges and gullies that run down to the Nepean River, in the following locations:

- Scattered areas of Wilton
- Southern part of GMAC

The direct impacts of the development on Red-crowned Toadlet are provided in Table 25-40.

Table 25-40: Direct impacts on Red-crowned Toadlet

Impacts to:	Wilton*	GMAC*	WSA*	GPEC*	Transport corridors#	Total
Potential habitat (ha)	2.3	7	0	0	0	9.3

* Impacts from urban development only within each nominated area

Impacts from transport corridors across all nominated areas

The impacts to the areas of potential habitat within Wilton and GMAC are unlikely to impact the ongoing survival or viability of the Red-crowned Toadlet in the local area because:

- Only a very small proportion (1.1 per cent) of this potential habitat is directly impacted. The vast majority of potential habitat has been avoided for biodiversity or other purposes
- There are no records or known populations of the species in the area. While many records of the species occur surrounding the Cumberland subregion, the species is generally not known from the subregion
- The impacts are unlikely to cause fragmentation or isolation of habitat because, where impacts occur, only the edges of potential habitat at the tops of gorges and gullies are impacted
- The corridors of potential habitat that exist along gorges and gullies are maintained

Indirect impacts

Potential indirect impacts to Red-crowned Toadlet due to the development, including mitigation measures under the Plan to avoid and manage these impacts, are assessed in subsection (h).

10.2.3.1(E) THE LIKELY IMPACT ON THE ECOLOGY OF THE LOCAL POPULATION

As discussed in response to subsection (d) above, the loss of potential habitat within Wilton and GMAC is unlikely to affect the ecology of any local population of Red-crowned Toadlet because:

- Only a very small proportion (1.1 per cent) of this potential habitat is directly impacted
- There are no records or known populations of the species in the locality and the species is generally not known from the subregion, reducing the risk that breeding habitat occurs in the locality

10.2.3.1(F) A DESCRIPTION OF THE EXTENT TO WHICH THE LOCAL POPULATION WILL BECOME FRAGMENTED OR ISOLATED

As discussed in response to subsection (d) above, the loss of potential habitat within Wilton and GMAC is unlikely to fragment and isolate any local population because impacts occur only to the very edges of potential habitat and the corridors of potential habitat that exist along gorges and gullies are maintained.

10.2.3.1(G) THE RELATIONSHIP OF THE LOCAL POPULATION TO OTHER POPULATION/POPULATIONS OF THE SPECIES

Development within Wilton and GMAC will not directly impact any records or known populations of Red-crowned Toadlet. No populations are known from these nominated areas.

Potential habitat within Wilton and GMAC is not at the limit of the species range. Records for the species are widespread surrounding the Cumberland subregion.

10.2.3.1(H) THE EXTENT TO WHICH THE DEVELOPMENT WILL LEAD TO AN INCREASE IN THREATS AND INDIRECT IMPACTS, INCLUDING IMPACTS FROM INVASIVE FLORA AND FAUNA, THAT MAY IN TURN LEAD TO A DECREASE IN THE VIABILITY OF THE LOCAL POPULATION

The BioNet profile for the Red-crowned Toadlet identifies a range of threats to the species (OEH, 2019j). Where these threats are present in the nominated areas and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential threats or indirect impacts are considered relevant to implementation of the Plan:

- Reduction in water quality
- Inappropriate fire regimes
- Habitat disturbance including collection of bush rock and recreational activities
- Infection with amphibian chytrid fungus

The greatest risk areas for these relevant threats are at the edges of potential habitat associated with gorges and gullies that run down to the Nepean River in the northern part of Wilton, and the western part of GMAC.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Red-crowned Toadlet are discussed below for each identified indirect impact.

REDUCTION IN WATER QUALITY

A reduction in water quality and changes to hydrology are recognised as a principal threat to the species (OEH, 2019j). Key issues relate to increased pollutants in runoff from developed areas.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA and NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the species from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed and operated in a way that avoids and minimises any potential impacts to habitat for the species
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to habitat for the species

INAPPROPRIATE FIRE REGIMES

High frequency fire is identified as a potential threat to the Red-crowned Toadlet (OEH, 2019j).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations in the Cumberland subregion. This includes a number of actions with the most relevant to the outcome for the Red-crowned Toadlet being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Red-crowned Toadlet. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

HABITAT DISTURBANCE INCLUDING COLLECTION OF BUSH ROCK AND RECREATIONAL ACTIVITIES

Inappropriate habitat disturbance has been identified as a threat to the Red-crowned Toadlet (OEH, 2019j).

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program

- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the Red-crowned Toadlet from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

INFECTION WITH AMPHIBIAN CHYTRID FUNGUS

Amphibian chytrid fungus, which causes the infection known as chytridiomycosis, is recognised as a threat to the Red-crowned Toadlet (OEH, 2019j).

Chytrid fungus is already present in the Cumberland subregion, although there may be pockets of disease free areas that are inhospitable to the growth of the disease (for example, due to salinity levels or elevated concentrations of trace metals).

The Plan incorporates a range of measures to manage the risks associated with the spread of infection/disease. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion (this measure specifically relates to chytrid fungus)
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Development controls to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures to protect the environment during construction, including best practice site hygiene protocols to minimise the spread of disease

The package of measures in the Plan is expected to adequately manage the risk to potential habitat from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

10.3.2.1(I) AN ESTIMATE OF THE AREA, OR NUMBER OF POPULATIONS AND SIZE OF POPULATIONS THAT IS IN THE RESERVE SYSTEM IN NSW, THE IBRA REGION AND THE IBRA SUBREGION

There is currently approximately 24.9 ha of potential habitat for the Red-crowned Toadlet mapped within protected areas in the area covered by the Plan. This comprises potential habitat within the Upper Nepean State Conservation Area.

Populations are known from many reserves managed for conservation outside the Cumberland subregion, including:

- Nattai National Park
- Blue Mountains National Park
- Wollemi National Park
- Dharawal National Park
- Royal National Park
- Berowra Valley National Park

10.3.2.1(J) THE MEASURES PROPOSED TO CONTRIBUTE TO THE RECOVERY OF THE SPECIES IN THE IBRA SUBREGION

The Plan includes a range of commitments that will contribute to the recovery of Red-crowned Toadlet in the Cumberland subregion. Several commitments are described in more detail the sections above.

The key commitments and actions relevant to the species are:

- Secure a minimum of 5,325 ha of native vegetation in conservation lands within the SCA (Commitment 8). Offset targets to secure PCTs (see Chapter 8) are likely to result in securing of additional potential habitat for Red-crowned Toadlet in the SCA, as there is approximately 8,400.4 ha of mapped potential habitat in the SCA for this species
- Support new or existing programs to control key diseases affecting TECs and species in the Cumberland subregion (Commitment 18)
- Manage fire in strategic locations in the Cumberland subregion (Commitment 17) to support the maintenance of biodiversity values on land secured within the SCA. This includes:
    - Consulting with Rural Fire Service, NSW NPWS, and EES to identify fire management priorities, including fire sensitive species and ecological communities
    - Preparing a Fire Management Strategy to guide and co-ordinate fire management

26 Impact summary

The BCAR must include the number and classes of biodiversity credits that would be required to be retired if the offset rules under the BC Act applied (clause 6.9(c) BC Regulation).

This Chapter identifies:

- Impacts on native vegetation (PCTs) and species requiring offsets and the native vegetation not requiring offsets
- Areas not requiring assessment in accordance with section 10 of the BAM
- Biodiversity credits that would be required to be retired if the offset rules under the BC Act applied

It is important to note that the number and classes of biodiversity credits needed to offset the impacts of the development are not required to be retired under a strategic biodiversity certification (see Part 1). However, the NSW Environment Minister must be satisfied that the 'approved conservation measures' under the Plan adequately address the likely impacts on biodiversity values. The Minister will have regard to the BCAR in making this decision.

The Plan has had regard to the credit output of the BAM in determining the commitments under the conservation program. The adequacy of the commitments in offsetting the impacts of the development are evaluated in Part 7.

26.1 IMPACTS REQUIRING OFFSETS

Table 26-1 and Table 26-3 identify the impacts on native vegetation and species that require offsets.

Map 26-1 and Map 26-2 provide maps of impacts on native vegetation and species that require offsets and impacts on native vegetation and species that do not require offsets.

26.1.1 NATIVE VEGETATION REQUIRING OFFSETS

Section 10.3.1 of the BAM specifies that an offset is required for impacts on native vegetation where the vegetation integrity score is:

- ≥15 where the PCT is representative of an endangered or critically endangered ecological community
- ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community
- ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat

The PCTs/vegetation zones requiring offsets are provided in Table 26-1.

The PCT/vegetation zones not requiring offsets are provided in Table 26-2.

Table 26-1: PCTs/vegetation zones requiring offsets

PCT	Condition
724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact
	Thinned
	Scattered Trees
725 - Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Intact
	Thinned
	Scattered Trees
781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Thinned
830 - Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Intact

PCT	Condition
	Thinned
835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact
	Thinned
	Scattered Trees
849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact
	Thinned
	Scattered Trees
	DNG
850 - Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Intact
	Thinned
	Scattered Trees
	DNG
1395 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Intact
	Thinned
	Scattered Trees
	DNG
1800 - Swamp Oak open forest on river-flats of the Cumberland Plain and Hunter valley	Intact
	Thinned
	Scattered Trees

Table 26-2: PCTs/vegetation zones not requiring offsets

PCT	Condition
835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Non-offsettable grassland
849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Non-offsettable grassland
850 - Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Non-offsettable grassland
1395 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Non-offsettable grassland

26.1.2 SPECIES REQUIRING OFFSETS

The species credit species requiring offsets are provided in Table 26-3.

Table 26-3: Species credit species requiring offsets

Species	Common Name
Acacia bynoeana	Bynoe's Wattle
Acacia pubescens	Downy Wattle
Allocasuarina glareicola	-
Callocephalon fimbriatum	Gang-gang Cockatoo
Calyptorhynchus lathami	Glossy Black Cockatoo
Cercartetus nanus	Eastern Pygmy-possum
Chalinolobus dwyeri	Large-eared Pied Bat
Dillwynia tenuifolia	-
Epacris purpurascens var. *purpurascens*	-
Grevillea juniperina subsp. *juniperina*	-
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea
Haliaeetus leucogaster	White-bellied Sea-Eagle
Heleioporus australiacus	Giant Burrowing Frog
Hibbertia fumana	-
Hibbertia puberula	-
Hieraaetus morphnoides	Little Eagle
Lathamus discolor	Swift Parrot
Litoria aurea	Green and Golden Bell Frog
Lophoictinia isura	Square-tailed Kite
Marsdenia viridiflora subsp. *viridiflora* - endangered population	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas
Maundia triglochinoides	-
Melaleuca deanei	Deane's Paperbark
Meridolum corneovirens	Cumberland Plain Land Snail
Micromyrtus minutiflora	*Micromyrtus minutiflora*
Myotis macropus	Southern Myotis
Ninox strenua	Powerful Owl
Persicaria elatior	Tall Knotweed
Persoonia bargoensis	Bargo Geebung
Persoonia nutans	Nodding Geebung
Petaurus norfolcensis	Squirrel Glider

Species	Common Name
Phascolarctos cinereus	Koala
Pimelea curviflora var. *curviflora*	-
Pimelea spicata	Spiked Rice-flower
Pomaderris brunnea	Brown Pomaderris
Pseudophryne australis	Red-crowned Toadlet
Pterostylis saxicola	Sydney Plains Greenhood
Pultenaea parviflora	-
Pultenaea pedunculata	Matted Bush-pea
Tyto novaehollandiae	Masked Owl

26.1.3 PRESCRIBED IMPACTS REQUIRING OFFSETS

The BAM does not calculate biodiversity credits to offset prescribed impacts, and additional offsets may be proposed should mitigation measures or adaptative management not be considered adequate to avoid prescribed impacts.

Relevant prescribed impacts are assessed in detail in Chapter 24, including the mitigation measures proposed to address these impacts. The commitments and mitigation measures in the Plan are expected to adequately avoid and mitigate prescribed impacts and no additional offsets for prescribed impacts are considered necessary. A summary of the justification for not requiring offsets for each prescribed impact is provided in Table 26-4.

Table 26-4: The need for offsets for prescribed impacts

Prescribed impact type	Potential direct impacts	Potential indirect impacts	Requirement for offsets	Justification
Karst, caves, crevices, cliffs	Removal or destruction (e.g. cracking or collapse) of habitat	Recreational use/ disturbance Noise or light disturbance	No	Impacts unlikely to occur
Rocks	Removal of habitat (rocks)		No	Impacts unlikely to occur
Human-made structures	Removal of habitat (structures)	Human disturbance Noise or light disturbance	**Microbats** No **Green and Golden Bell Frog** No	**Microbats** The Plan includes mitigation measures to address risks to microbat species associated with impacts to human-made structures, including preconstruction surveys and artificial breeding and roosting habitat. These mitigation measures are considered adequate to compensate for the loss of roosting and potential breeding habitat. This type of habitat loss will be a long-term process and commensurate roosting opportunities will remain available to microbat populations **Green and Golden Bell Frog** Impacts are unlikely to occur to this species– impacted human made structures supporting potential habitat for the species only represent low quality potential movement corridors through suburbia
Non-native vegetation	Removal of habitat (non-native vegetation)	Recreational use/disturbance Weed invasion Spread of plant/animal disease Pest animals/predation/ competition Soil erosion/sedimentation Urban run-off (water quality)	**Native flora** No **Native fauna** No	**Native flora** Impacts to flora species associated with non-native vegetation are largely a result of GIS mapping inconsistencies between expert species polygons and native vegetation mapping prepared for this project, which have resulted in many small 'slivers' of mapped habitat over-lapping into non-native vegetation polygons One area of habitat associated with non-native vegetation for *Hibbertia fumana* and *Hibbertia puberula,* comprising a total of 1.05 hectares, occurs in a materials storage yard and has undergone complete clearance and soil re-profiling and does not support habitat for either species. The remainder of non-native vegetation impacts occur as small sliver polygons ≤0.01 ha in area Impacts to *Pimelea spicata* are also mostly associated with small slivers created from differences in GIS mapping methods with 274 of the 287 impacted polygons being ≤0.1 ha in area. The remaining larger areas of mapped habitat

Prescribed impact type	Potential direct impacts	Potential indirect impacts	Requirement for offsets	Justification
				are associated with areas of dense African Olive infestations in the Menangle area, and areas of highly disturbed vegetation generally showing signs of soil compaction, including residential yards and dwellings (buildings) None of the impacts to *Hibbertia fumana, Hibbertia puberula* or *Pimelea spicata* associated with non-native vegetation are considered to need additional offsets due to the very low condition of the potential habitat impacted **Native fauna** Level of direct and indirect impacts to Grey-headed Flying-fox, microbats, native birds, Spotted-tail Quoll and Green and Golden Bell Frog associated with the removal of habitat represented by non-native vegetation is minor in nature. This is due to exotic vegetation representing only a fraction of the total impacted habitat for each species and generally being of only marginal habitat value for most of these species. Furthermore, the level of impact is also minor when compared to the amount of non-native vegetation habitat and higher quality native vegetation habitat that will be avoided or not impacted by the development within the Plan area. Significant offsets will be secured as a result of impacts to native vegetation and associated habitats
Habitat connectivity/ movement	N/A	Reduction in habitat connectivity	No	Most key areas of habitat connectivity within the nominated areas have been avoided and will not be impacted The Plan includes a range of commitments and mitigation measures to address potential impacts on habitat connectivity, including for Koala. These measures are considered adequate to address these impacts
Water bodies/ hydrological processes	Removal of habitat (water bodies)	Change in water flows/quantity Urban run-off (water quality)	**Species associated with waterbodies (except Green and Golden Bell Frog)** No **Species associated with waterbodies - Green and Golden Bell Frog**	**Species associated with waterbodies (except Green and Golden Bell Frog)** Waterbodies directly impacted by the development provide only marginal forage habitat to Southern Myotis and water birds, with higher order streams and larger wetlands/waterbodies avoided. Only very small amounts of potential habitat for White-bellied Sea Eagle containing water bodies are being impacted relative to suitable habitat remaining in the subregion **Species associated with waterbodies - Green and Golden Bell Frog** While the waterbody impacted at St Marys Leagues Club has the potential to provide breeding habitat for any population of Green and Golden Bell Frog

Prescribed impact type	Potential direct impacts	Potential indirect impacts	Requirement for offsets	Justification
			No **Species and TECs potentially affected by hydrological processes** No	that may occur along Ropes Creek, the population was not recorded during recent targeted surveys (see Supporting Document I) **Species and TECs potentially affected by hydrological processes** The Plan includes a range of general mitigation measures and several commitments or actions to address potential impacts to species and TECs associated with changes to hydrological processes. These measures are considered adequate to address these impacts
Vehicle strikes	Death of species individuals	N/A	No	The likelihood of vehicle strike is considered low for most species. The Plan includes a range of commitments and mitigation measures to address potential impacts associated with vehicle strikes on Koala and commitments to avoid and minimise impacts to areas of habitat connectivity during transport corridor design relevant to other species. These measures are considered adequate to address these potential impacts

26.2 IMPACTS NOT REQUIRING FURTHER ASSESSMENT

Areas that do not require assessment in accordance with section 10. 4 of the BAM include:

- Urban native/exotic vegetation
- Non-offsettable grassland
- Cleared land and existing building

26.3 BIODIVERSITY CREDIT CALCULATIONS

The biodiversity credit reports are provided at Supporting Document E.

26.3.1 ECOSYSTEM CREDITS

Table 26-5 to Table 26-8 identify the area of impact and associated number of biodiversity credits for each impacted PCT within each nominated area that would be required to be retired if the offset rules applied under the BC Act.

The total number of ecosystem credits that would be required to be retired to offset the impact of the proposed development on PCTs is 40,082 credits.

As noted, the number and classes of biodiversity credits needed to offset the impacts of the development are not required to be retired under a strategic biodiversity certification (see Part 1). The adequacy of the commitments in offsetting the impacts of the development are evaluated in Part 7.

Table 26-5: Ecosystem credits - Wilton

Vegetation zone	Vegetation integrity loss	Area (ha)	Ecosystem credits
849_Intact	53.9	1.6	53
849_Thinned	42.3	23.4	617
849_Scattered_trees	18.3	23.8	271
849_DNG	24.1	148.7	2,237
850_Scattered_trees	38.1	0.9	22
850_DNG	25.7	159.6	2,559
1395_Intact	72.9	11.0	499
1395_Thinned	63.9	70.8	2,830
1395_Scattered_trees	30.0	17.9	336
1395_DNG	28.4	171.2	3,033
	Total	**628.8**	**12,457**

Table 26-6: Ecosystem credits - GMAC

Vegetation zone name	Vegetation integrity loss	Area (ha)	Ecosystem credits
830_Intact	48.3	0.04	1
830_Thinned	20.1	0.01	1
835_Intact	76.6	1.3	49
835_Thinned	57.1	7.2	207
835_Scattered_trees	68.7	0.2	6
849_Intact	53.9	10.8	362
849_Thinned	42.3	37.4	988

Vegetation zone name	Vegetation integrity loss	Area (ha)	Ecosystem credits
849_Scattered_trees	18.3	26.3	301
849_DNG	24.1	28.2	425
850_Intact	58.1	4.0	147
850_Thinned	41.9	21.8	570
850_Scattered_trees	38.1	6.9	163
850_DNG	25.7	12.4	198
1395_Intact	72.9	34.8	1,585
1395_Thinned	63.9	74.7	2,986
1395_Scattered_trees	30.0	23.1	434
1395_DNG	28.4	56.3	997
Total		**345.4**	**9,420**

Table 26-7: Ecosystem credits - WSA

Vegetation zone name	Vegetation integrity loss	Area (ha)	Ecosystem credits
724_Thinned	36.2	44.4	804
724_Scattered_trees	20.5	2.0	20
725_Intact	49.2	0.8	20
725_Thinned	43.3	8.6	187
725_Scattered_trees	19.6	2.9	29
781_Thinned	62.5	1.9	61
835_Intact	76.6	0.6	21
835_Thinned	57.1	29.8	850
835_Scattered_trees	68.7	19.3	662
849_Intact	53.9	10.9	367
849_Thinned	42.3	157.6	4,166
849_Scattered_trees	18.3	66.5	759
849_DNG	24.1	41.5	625
850_Thinned	41.9	5.8	151
850_Scattered_trees	38.1	1.6	38
850_DNG	25.7	0.2	3
1800_Intact	43.2	0.7	14
1800_Thinned	46.6	15.0	350
1800_Scattered_trees	41.2	1.6	32
Total		**411.5**	**9,159**

Table 26-8: Ecosystem credits – GPEC

Vegetation zone name	Vegetation integrity loss	Area (ha)	Ecosystem credits
724_Intact	61.7	7.2	223
724_Thinned	36.3	30.9	561
724_Scattered_trees	20.5	23.8	244
725_Intact	49.2	15.2	373
725_Thinned	43.3	10.1	218
781_Thinned	62.5	2.3	70
835_Intact	76.6	12.0	461
835_Thinned	57.1	113.0	3,228
835_Scattered_trees	68.7	2.7	92
849_Intact	53.9	4.3	143
849_Thinned	42.3	83.4	2,204
849_Scattered_trees	18.3	4.1	46
849_DNG	24.1	8.9	133
850_Thinned	41.9	16.1	421
850_Scattered_trees	38.1	2.2	51
850_DNG	25.7	23.0	369
1800_Thinned	46.6	9.0	209
	Total	**368.0**	**9,046**

26.3.2 SPECIES CREDITS

Table 26-9 to Table 26-12 identifies the area of impact and associated number of biodiversity credits for each impacted species credit species within each nominated area that would be required to be retired if the offset rules applied under the BC Act.

The total number of species credits that would be required to be retired to offset the impact of the proposed development on species credit species is 164,103 credits.

METHOD FOR CALCULATING SPECIES CREDITS FOR EPACRIS PURPURASCENS VAR. PURPURASCENS

Epacris purpurascens var. *purpurascens* is identified under the BAM as a species where the unit of measure used to calculate credits is a count of individuals rather than area of habitat.

The consulting team developed a method to address this requirement. The method uses BioNet records for the species in the locality of the nominated areas to derive an estimate of the number of individuals per hectare.

The steps involved in the method were:

- All BioNet records of the species that occur within 20kms of modelled habitat were selected to allow for consideration of populations in the locality of the nominated areas. Records used were sourced from "As Held BioNet Data" (at May 2021). A total of 314 records were considered, once duplicates had been removed
- To group individual records into populations, and to provide an estimated area within which the record occurs, each BioNet record was buffered by 56.42 m (radius) to create 1ha buffers surrounding each point
- Buffer areas were then combined (with overlapping areas dissolved) to ascertain an area value for each group of records. A total of 108 buffer areas (populations) were created, ranging in area from 1ha to 6.7 ha

- BioNet records were interrogated to determine the number of individual plants each record represents. Where no counts were provided the number of individuals was assumed to be one. Numbers of individuals per BioNet record ranged from 1 to 25,000. When these were provided as a range, the mid-point of the range was used
- The total individuals present within each buffer area (based on all BioNet records within each buffer area) were then summed to determine the number of individuals per population. The total individuals per population was divided by the total area of the buffer to ascertain the individuals per hectare estimate
- Individuals per hectare values were ranked and the median value of 8 individuals per hectare was selected. The median value is considered to be more suitable than the mean to return the central tendency for a skewed number distribution such as this dataset. The data ranges from 1 individual per hectare to 27,500 individuals per hectare, with 94 of the 108 total entries returning less than 1,000 individuals per hectare

Based on the median value of 8 stems per hectare, the total estimated impacts to *Epacris purpurascens* var. *purpurascens* across the nominated areas 1,044 stems (across 87 hectares of modelled potential habitat).

Table 26-9: Species credits - Wilton

Species	Area (ha)	No. of species credits
Bynoe's Wattle (*Acacia bynoeana*)	240.4	4,695
Downy Wattle (*Acacia pubescens*)	428.3	7,268
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	0.6	20
Glossy Black Cockatoo (*Calyptorhynchus lathami*)	1.4	51
Eastern Pygmy-possum (*Cercartetus nanus*)	7.0	241
Large-eared Pied Bat (*Chalinolobus dwyeri*)	106.8	4,799
Epacris purpurascens var. *purpurascens*	315^	473
Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)	2.6	84
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	2.5	90
Giant Burrowing Frog (*Heleioporus australiacus*)	0.3	9
Hibbertia fumana	28.4	1,084
Hibbertia puberula	27.7	701
Little Eagle (*Hieraaetus morphnoides*)	4.8	114
Square-tailed Kite (*Lophoictinia isura*)	5.0	118
Deane's Paperbark (*Melaleuca deanei*)	45.4	1,936
Cumberland Plain Land Snail (*Meridolum corneovirens*)	88.5	2,704
Southern Myotis (*Myotis macropus*)	83.0	2,104
Bargo Geebung (*Persoonia bargoensis*)	37.1	1,170
Squirrel Glider (*Petaurus norfolcensis*)	58.1	1,696
Koala (*Phascolarctos cinereus*)	106.9	3,185
Spiked Rice-flower (*Pimelea spicata*)	387.7	4,014
Brown Pomaderris (*Pomaderris brunnea*)	17.0	552
Red-crowned Toadlet (*Pseudophryne australis*)	2.3	63
Sydney Plains Greenhood (*Pterostylis saxicola*)	11.2	394
Matted Bush-pea (*Pultenaea pedunculata*)	24.1	667
Masked Owl (*Tyto novaehollandiae*)	<0.1	1
Total	**1,717.1**	**38,233**

^ Count of individuals – not included in area total

Table 26-10: Species credits – GMAC

Species	Area (ha)	No. of species credits
Bynoe's Wattle (*Acacia bynoeana*)	158.8	3,965
Downy Wattle (*Acacia pubescens*)	266.3	5,947
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	3.1	100
Glossy Black Cockatoo (*Calyptorhynchus lathami*)	7.5	275
Eastern Pygmy-possum (*Cercartetus nanus*)	35.2	1,237
Large-eared Pied Bat (*Chalinolobus dwyeri*)	173.8	7,763
Epacris purpurascens var. *purpurascens*	427^	641
Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)	2.3	74
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	8.1	290
Giant Burrowing Frog (*Heleioporus australiacus*)	0.3	8
Hibbertia fumana	7.1	334
Hibbertia puberula	7.1	224
Little Eagle (*Hieraaetus morphnoides*)	18.8	452
Square-tailed Kite (*Lophoictinia isura*)	25.2	615
Marsdenia viridiflora subsp. *viridiflora* - endangered population	32.9	864
Deane's Paperbark (*Melaleuca deanei*)	60.9	2,728
Cumberland Plain Land Snail (*Meridolum corneovirens*)	155.0	4,472
Southern Myotis (*Myotis macropus*)	134.2	3,236
Bargo Geebung (*Persoonia bargoensis*)	46.4	1,478
Squirrel Glider (*Petaurus norfolcensis*)	106.5	3,010
Koala (*Phascolarctos cinereus*)	135.3	4,122
Spiked Rice-flower (*Pimelea spicata*)	61.1	932
Brown Pomaderris (*Pomaderris brunnea*)	22.0	732
Red-crowned Toadlet (*Pseudophryne australis*)	7.0	192
Sydney Plains Greenhood (*Pterostylis saxicola*)	35.0	1,202
Matted Bush-pea (*Pultenaea pedunculata*)	26.3	715
Masked Owl (*Tyto novaehollandiae*)	0.1	4
Total	**1,536.3**	**45,612**

^ Count of individuals – not included in area total

Table 26-11: Species credits – WSA

Species	Area (ha)	No. of species credits
Bynoe's Wattle (*Acacia bynoeana*)	12.3	235
Downy Wattle (*Acacia pubescens*)	356.6	6,708
Eastern Pygmy-possum (*Cercartetus nanus*)	11.1	304
Dillwynia tenuifolia	74.8	1,106
Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*)	286.2	3,978

Species	Area (ha)	No. of species credits
Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)	7.1	138
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	1.3	36
Hibbertia fumana	6.0	135
Hibbertia puberula	6.0	92
Little Eagle (*Hieraaetus morphnoides*)	1.4	29
Square-tailed Kite (*Lophoictinia isura*)	1.3	27
Marsdenia viridiflora subsp. *viridiflora* - endangered population	225.4	4,895
Maundia triglochinoides	13.2	325
Cumberland Plain Land Snail (*Meridolum corneovirens*)	237.8	5,184
Micromyrtus minutiflora	16.6	462
Southern Myotis (*Myotis macropus*)	324.8	6,589
Powerful Owl (*Ninox strenua*)	0.1	2
Tall Knotweed (*Persicaria elatior*)	2.4	65
Nodding Geebung (*Persoonia nutans*)	58.7	1,060
Spiked Rice-flower (*Pimelea spicata*)	300.1	3,874
Pultenaea parviflora	48.7	907
Matted Bush-pea (*Pultenaea pedunculata*)	87.1	1,446
Total	**2,079**	**37,597**

Table 26-12: Species credits – GPEC

Species	Area (ha)	No. of species credits
Bynoe's Wattle (*Acacia bynoeana)*)	22.8	538
Downy Wattle (*Acacia pubescens*)	270.6	6,183
Allocasuarina glareicola	17.4	489
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	<0.1	3
Eastern Pygmy-possum (*Cercartetus nanus*)	13.8	482
Large-eared Pied Bat (*Chalinolobus dwyeri*)	0.9	29
Dillwynia tenuifolia	99.0	1,844
Juniper-leaved Grevillea *(Grevillea juniperina* subsp. *juniperina*)	181.4	2,791
Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)	4.00	74
White-bellied Sea-Eagle *(Haliaeetus leucogaster*)	5.9	224
Hibbertia fumana	31.5	1,012
Hibbertia puberula	36.2	743
Little Eagle (*Hieraaetus morphnoides*)	3.2	68
Swift Parrot (*Lathamus discolor*)	26	534
Green and Golden Bell Frog (*Litoria aurea*)	7.7	100
Square-tailed Kite (*Lophoictinia isura*)	13.1	316
Marsdenia viridiflora subsp. *viridiflora* - endangered population	167.3	4,046

Species	Area (ha)	No. of species credits
Maundia triglochinoides	9.4	227
Cumberland Plain Land Snail (*Meridolum corneovirens*)	238.8	5,939
Micromyrtus minutiflora (*Micromyrtus minutiflora*)	15.2	427
Southern Myotis (*Myotis macropus*)	217.3	5,246
Tall Knotweed (*Persicaria elatior*)	47.5	1,330
Nodding Geebung *(Persoonia nutans)*	83.4	1,541
Squirrel Glider (*Petaurus norfolcensis*)	136.7	3,180
Pimelea curviflora var. *curviflora*	52.5	1,142
Spiked Rice-flower (*Pimelea spicata*)	114.1	1,651
Sydney Plains Greenhood (*Pterostylis saxicola*)	0.9	20
Pultenaea parviflora	56.8	1,250
Matted Bush-pea (*Pultenaea pedunculata*)	71.1	1,217
Masked Owl (*Tyto novaehollandiae*)	0.5	15
Total	**1,945**	**42,661**

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Environmental consulting

2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 6A: STRATEGIC ASSESSMENT REPORT

CHAPTER 27 – INTRODUCTION

CHAPTER 28 – DESCRIPTION OF THE PROTECTED MATTERS AFFECTED BY THE PLAN

CHAPTER 29 – THREATENED FLORA IMPACT ASSESSMENT

CHAPTER 30 – THREATENED FAUNA IMPACT ASSESSMENT

CHAPTER 31 – THREATENED ECOLOGICAL COMMUNITIES IMPACT ASSESSMENT

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	Callan Wharfe, James Shepherd, Rebecca Dwyer, Renae Baker (Biosis) Heather Tolley, Natasha Buckingham, Peter Hemphill, Stephanie Binks (Open Lines) Darren James (DAJ Environmental)
CONTENT:	Natasha Buckingham, Kimberly Spragg, Stephanie Binks, Heidi Birkby, Christa Shen, Tom Holden, Heather Tolley, Peter Hemphill (Open Lines) Darren James (DAJ Environmental)
REVIEWED BY:	
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DATE:	2021

Part 6A Contents

Part 6A List of Figures

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27 Introduction

Parts 6a and 6b of the Cumberland Plain Assessment Report present the impact assessment for relevant matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

27.1 SCOPE OF THE EPBC ACT ASSESSMENT

As outlined in Chapter 1, the scope of the EPBC Act assessment includes:

- Urban and industrial development within urban capable land in nominated areas
- Infrastructure within urban capable land in nominated areas, as well as 'essential' infrastructure in limited cases within avoided lands in the nominated areas
- Intensive plant agriculture within the agribusiness precinct in the Western Sydney Aerotropolis (WSA)
- Western Sydney Major Infrastructure Corridors (transport corridors) within and outside nominated areas

Chapter 7 in Part 2 of the report provides details about these development types and locations.

27.2 STRUCTURE AND APPROACH TO PARTS 6A AND 6B

Part 6a (this document) includes:

- Chapter 27: Introduction (this chapter)
- Chapter 28: Description of the protected matters affected by the Plan
- Chapter 29: Listed threatened flora species
- Chapter 30: Listed threatened fauna species
- Chapter 31: Listed threatened ecological communities

Part 6b includes:

- Chapter 32: Listed migratory species
- Chapter 33: Ramsar wetlands
- Chapter 34: World and National Heritage
- Chapter 35: Areas of Commonwealth land
- Chapter 36: Analysis of the transport program
- Chapter 37: Analysis of the urban and industrial program
- Chapter 38: Cumulative impact assessment

Chapters in these Parts address the Terms of Reference for the assessment as they relate to specific protected matters. Parts 1, 2, 3, 4, and 7 of the report also address components of the Terms of Reference and must be read in conjunction with Parts 6a and 6b for a complete understanding of the project. Section 4.2.2 (in Chapter 4 of Part 1) sets out the Terms of Reference in full and identifies where they have been addressed throughout the report.

Given the size and complexity of the assessment report, each chapter in Parts 6a and 6b attempts to provide a stand-alone analysis of the relevant issues. However, to avoid excessive repetition each chapter includes cross references to other relevant sections of the report and supporting documents where it is appropriate to do so. For example, details about the baseline data used in the assessment are provided in Part 3 of the report.

Each chapter provides:

- An introduction that sets out the assessment approach for those protected matters
- Descriptions of the relevant protected matters
- Analysis of:
    - How impacts have been avoided
    - Any direct impacts and offsets

  - Potential indirect impacts and mitigation measures
  - An evaluation of the outcomes for each protected matter against the relevant requirements of the EPBC Act and Terms of Reference
- Where appropriate, detailed attachments for any specific technical information that is best presented separately and out of the main text
- Maps of the protected matters (e.g. habitat and records for threatened species). In some cases, these are presented within chapters and in others are presented as separate files which can be viewed as layered PDFs. Layered PDFs enable more information to be presented on maps and allow viewers to turn layers on and off as they interrogate the information

Reference lists are provided at the end of both Part 6a and 6b.

28 Description of the protected matters affected by the Plan

This Chapter describes the protected matters likely to be affected by the Plan by:

- Providing a high-level description of the existing environment within the Strategic Assessment Area
- Identifying the relevant matters for assessment under the EPBC Act

28.1 EXISTING ENVIRONMENT

As required by Clause 3.1 of the Terms of Reference:

> *The Report must describe the nature of the environment within the Strategic Assessment Area, and other areas outside the Strategic Assessment Area that may be impacted by actions taken under the Plan. This must include (at a minimum):*
>
> 1. *A description of historical and current land use*
> 2. *The extent and quality of native vegetation present including detailed mapping of ecological communities and habitat for threatened species listed under the EPBC Act*
> 3. *The nature of the environment, including ecosystem processes and threatening processes*
> 4. *A description of the landscape context for key environmental matters, including connectivity, habitat fragmentation and ecological processes*
> 5. *A spatial map of areas that are already protected for environmental purposes, including Bio-banking and Biodiversity Stewardship sites*

This section broadly addresses these requirements. For the Strategic Assessment Area, it provides:

- A discussion of historical and existing land uses
- An overview of native vegetation
- A description of ecological processes
- A description of threatening processes
- Information about currently protected areas

Detailed information about threatened ecological communities (TECs) and species (e.g. mapping of individual species habitat) as well as relevant protected matters that sit outside the Strategic Assessment Area is provided elsewhere in this report.

28.1.1 HISTORICAL AND EXISTING LAND USES

The Strategic Assessment Area occurs primarily within the Cumberland IBRA subregion of Western Sydney (Cumberland subregion). The Cumberland subregion is a broad geographic basin that is bounded by the Hornsby Plateau in the north, the base of the Blue Mountains in the west, the Woronora plateau in the south, and the centre of Sydney to the east. It has an area of approximately 275,000 hectares, rising gradually from the flat low-lying areas at sea level in the east to an altitude of around 350 metres on the margins to the north and south.

The Strategic Assessment Area has been greatly affected by historical and ongoing land use pressures. Its gentle undulating plains and fertile soils mean it has been a focus of agriculture and occupation both before and after European settlement (DECCW, 2011).

Before European settlement it had extensive grassy woodlands and abundant fauna. Hundreds of records of Aboriginal sites have been found across the subregion, suggesting it was an important area for Aboriginal people. Records indicate Aboriginal occupation of the Sydney region for at least 20,000 years, and possibly 40,000 years (Nanson, Young et al., 1987; Stockdon, 2009; Stockton & Holland, 1974). There also is evidence of Aboriginal people using fire to manage the landscape to establish mosaics of forest and grassland in a way that facilitated hunting of kangaroos (Gammage, 2011).

Since European settlement the Strategic Assessment Area has been used for agriculture and more recently for urban development. Agriculture was established by European settlers in 1792, and since the mid-1900s most of the area has been subject to grazing or cultivation (Tozer, 2003). Fire and clearing have been used extensively to support this.

In the second half of 1900s, Sydney's growth accelerated and residential, commercial and industrial areas expanded further into the Cumberland subregion (Benson & Howell, 1990). At 2019, the Cumberland subregion is expected to support 44 per cent of Sydney's population (DECCW, 2011). The need to accommodate and provide services for the increasing urban population has put pressure on existing agriculture. The Sydney Metropolitan Area is predicted to reach 6 million by 2036. (DECCW, 2011). One recent study projected that on the current trajectory, by 2031 total food production in the Basin may reduce by 60 per cent, including 90 per cent of fresh vegetable production (Institute for Sustainable Futures, 2016).

28.1.2 NATIVE VEGETATION

The native vegetation in the Cumberland subregion is diverse and very different to the surrounding areas. It supports a variety of flora and fauna, including a range of migratory and threatened species. As a result of historical and ongoing patterns of use, the Cumberland subregion and its biodiversity have suffered significant disturbance and it is thought to be one of the most threatened regions in NSW (DEC, 2005b). Many of the ecological communities and the fauna and flora they support are listed as threatened under both NSW and Commonwealth environmental legislation. Approximately 8 per cent of the remaining bushland is protected in reserves (DECCW, 2011).

Areas of remaining native vegetation (see Figure 28-1) are often of high conservation value as they may contain the only remaining habitat for ecological communities and species that rely on the Cumberland subregion for survival.

Native vegetation remaining in the Strategic Assessment Area comprises 39 different PCTs which represent 19 vegetation classes within 10 vegetation formations.

In 2010 only 13 per cent of the pre-1750 extent of the region's vegetation remained as intact, with an additional 12 per cent occurring as scattered trees in disturbed areas (DECCW, 2011). What remains is often highly fragmented. An estimated 2,446 individual native vegetation remnants remain, and the 81 largest patches (containing >50 ha) represent 51 per cent of the remaining native vegetation across the Cumberland subregion (DECCW, 2011).

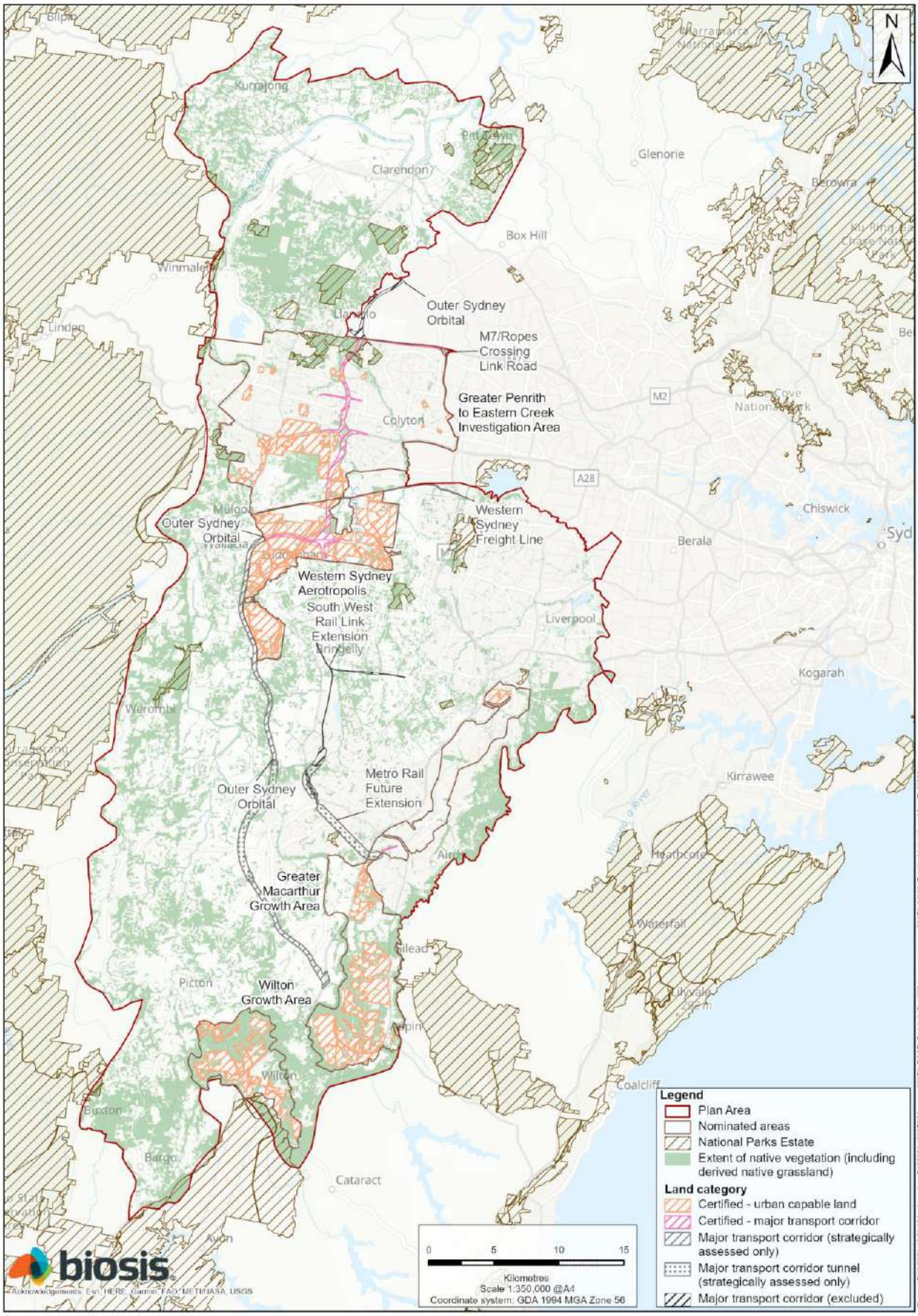

Figure 28-1: Extent of native vegetation in the Strategic Assessment Area

28.1.3 ECOLOGICAL PROCESSES

The ecological processes in an area determine the species composition, habitat structure, and ecological health of sites and landscapes. They include biological, physical, and chemical processes such as natural disturbance, hydrology, nutrient cycling, flora and fauna interactions, population dynamics, and evolution (US EPA, 1999).

There are several ecological processes that are particularly relevant to consideration of the Plan and its contribution to the Cumberland subregion. They are:

- Habitat connectivity and fragmentation
- Fire regimes
- Soil nutrient cycling
- Hydrology

HABITAT CONNECTIVITY AND FRAGMENTATION

Habitat connectivity refers to the degree of connectedness of areas of habitat. Habitat connectivity can include:

- Corridors of vegetation linking other areas of habitat
- Isolated patches of habitat that provide 'stepping stones' between other areas of habitat
- Habitat features (such as large trees with hollows) scattered within areas of non-habitat (e.g. urban land) that provide habtiat connectivity between intact areas of habitat

Habitat connectivity is important for biodiversity as it allows the linkage of habitats, species, communities, and ecological processes. In undisturbed areas connectivity is high, and as development increases, fragmentation occurs.

Larger patches of vegetation are often more diverse and less susceptible to 'edge effects.' Edge effects are an indirect impact of habitat fragmentation. New environmental conditions at edges can promote growth of invasive species and weeds which can compete with native flora and fauna. Altered conditions can also reduce the health of important habitat features such as hollow-bearing trees. Changes in connectivity can allow invasion of pest fauna specialising in edge habitats which may alter the behaviour of resident animals and make them at risk of higher levels of predation.

The Cumberland subregion is highly fragmented, and connectivity is already compromised to the point that many of the species that previously occurred there are no longer present (DECCW, 2011). However, it is still very important for species such as Koala, woodland birds, and a range of flora. Once clearing levels exceed 70 per cent of the landscape, biodiversity loss from fragmentation increases (DECCW, 2011). This threshold has been passed already in the Cumberland subregion (DECCW, 2011).

Significant conservation planning has occurred in the Cumberland subregion over the last decade which has examined habitat connectivity. Following the Cumberland Plain Recovery Plan (DECCW, 2011), EES prepared the Biodiversity Investment Opportunities Map (BIO Map) (OEH, 2015), to ensure that conservation funding within the subregion is targeted towards areas of greatest strategic benefit.

BIO Map identifies Priority Investment Areas (PIAs) where the protection and management of native vegetation is likely to maximise benefits to biodiversity within the subregion. The PIAs comprise:

- Core areas: large areas of native vegetation and habitat where management will be of greatest benefit to the conservation of biodiversity values. These areas represent the habitat in the Cumberland subregion most likely to support species persistence and interactions between species and landscape-scale ecological processes
- Regional biodiversity corridors: linear areas that link core areas and play a crucial role in maintaining connections between species populations that would otherwise be isolated and at greater risk of local extinction

BIO Map identifies a total of 87 core areas and 27 regional biodiversity corridors within the Cumberland subregion. The core areas comprise a total of 24,196.8 ha and the corridors a total of 17,927.5 ha.

Habitat connectivity within the Plan area was mapped by:

- Identifying BIO Map regional corridors and core areas (OEH, 2015). BIO Map corridors/core areas are likely to be the most important areas of habitat connectivity in the nominated areas for the majority of species. EES had only identified BIO Map corridors within the boundaries of the Cumberland subregion. To undertake the mapping for

the small parts of the nominated areas outside the Cumberland subregion the Priority Conservation Lands layer (DECCW, 2010b) or the native vegetation map (see Chapter 19) was used to extend the BIO Map corridor mapping

- Identifying local corridors using the native vegetation mapping to identify connected patches of native vegetation. This was done visually in GIS, with only contiguous patches identified as being connected
- Identify any remaining native vegetation not within a regional corridor or local corridor as:
    - Connected – within 100 m of another patch of woody vegetation
    - Isolated – greater than 100 m from another patch of woody vegetation

Key areas of habitat connectivity in the nominated areas are shown in Map 28-1.

FIRE

Fire has been shown to be important in maintaining native species richness in remnant grasslands in south-eastern Australia (Lunt & Morgan, 2002; Lunt, Prober et al., 2012).

Fire regimes in the Cumberland subregion were established over hundreds of years and fire plays an important role in shaping the landscape and vegetation. The fire regimes of the subregion have been significantly altered over time due to urbanisation. In and around urban areas, fire is primarily used to manage fire risk to property from surrounding vegetation. This results in either more frequent fires than would occur naturally (through hazard reduction burns), or alternatively the total exclusion of fire. Both situations represent a deviation from natural fire patterns, and this impacts fire-dependent vegetation communities.

Fire regimes are characterised by their frequency, seasonality, and intensity. Different ecological communities have different recommended fire intervals. For example, the suggested minimum fire interval for Cumberland Plain Woodland is five years and the maximum fire interval is 12 years (DECCW, 2011). For other communities, including Moist Shale Woodland and Western Sydney Dry Rainforest, burning is not recommended at all (DECCW, 2011). In general, grassy woodlands require a higher fire frequency than shrubby woodlands (DECCW, 2011).

Particularly relevant to restoration efforts, fire can be used to increase the native species richness in previously cleared Cumberland Plain Woodland derived grasslands (Morris, de Barse et al., 2016).

SOIL NUTRIENT CYCLING

Soil nutrient cycling is another important ecological process that contributes to the healthy functioning of vegetation communities and species habitats on the Cumberland subregion. It does this through storing water and carbon and transforming waste and nutrients.

Natural soil nutrient cycling processes have been negatively affected in several ways through urbanisation and agricultural practices. Grazing has led to soil compaction, which hinders the re-establishment of a diverse native understorey, and makes soil more susceptible to erosion.

The soils of Cumberland Plain woodland communities have been shown to be subject to nutrient loading from fertilisers from previous agricultural use, deposition of livestock dung, rubbish dumping and stormwater runoff from urban areas (NSW Scientific Committee, 2009). The soils of other vegetation communities within the Cumberland subregion would have likely also been subject to similar nutrient loading.

The effects of agriculture and urbanisation on soils of the Cumberland subregion have promoted invasion by exotic species, displacing native species (Hill, Tung et al., 2005). Areas that have been cleared and grazed are now dominated by exotics (mainly perennial grasses), which make up two thirds of the canopy cover and up to half of species richness (Hill, Tung et al., 2005). This is partly due to elevated levels of soil nitrogen (which is found in fertilisers) that creates conditions which favour that exotic species over native species.

Understanding soil nutrient cycling is relevant for restoration efforts. A study examining barriers to restoring Cumberland Plain Woodland on previously cleared areas found that adding carbon to the soil and/or fire, when combined with native seed addition, increased the abundance and species richness of native species relative to exotic species (Morrie & de Barse, 2013). Adding carbon to the soil reduces the nitrate levels in the soil and increases soil microbes, creating conditions that allow natives to be more competitive with exotic species.

HYDROLOGY

The Strategic Assessment Area occurs within two catchments and is traversed by a number of major rivers and a wide range of smaller waterways (see Figure 28-2). The two catchments are:

- Botany Bay
- Hawkesbury-Nepean

Development and agricultural practices over the years have reduced riparian vegetation and impacted the hydrology of the catchments. During heavy rain water moves more quickly off surfaces which leads to flooding, erosion, and sedimentation and can contribute to reduced water quality (DEC, 2005b). For plants and animals dependent on flood flows to trigger critical life cycle events, changes to hydrology could impact their viability.

Botany Bay catchment

Parts of Greater Macarthur Growth Area (GMAC) occur within the Georges River sub-catchment of the Botany Bay catchment. The Georges River ultimately flows directly into Botany Bay and the waters surrounding Towra Point Ramsar site (outside the Strategic Assessment Area).

The water quality of the Georges River varies depending upon the degree of development within each sub-catchment of the river. The water quality in the vicinity of GMAC ranges from poor (within the Bunbury-Curran Creek sub-catchment) to good (the Mid Georges River sub-catchment) (GRCCC, 2017). Large areas of the upper reaches of the catchment are vegetated, which provides protection from activities that reduce water quality.

Hawkesbury-Nepean catchment

The majority of the Strategic Assessment Area occurs within the Hawkesbury-Nepean catchment. The catchment is one of the longest coastal catchments in NSW, stretching from Broken Bay in the north to Goulburn in the south with the Hawkesbury-Nepean river flowing for 470 km and draining more than 22,000 km^2 of land (Western Sydney University, 2016).

The Nepean River flows south to north through the Strategic Assessment Area to near the point that it becomes the Hawkesbury River where it junctions to the Grose River. Wianamatta (South Creek) is another major waterway running through Western Sydney Aerotropolis (WSA) and Greater Penrith to Eastern Creek Investigation Area (GPEC). Many of the waterways in the Strategic Assessment Area have extensive floodplains (GES, 2018).

Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by the negative effects of historical land uses (e.g. clearing, urbanisation) (GES, 2018).

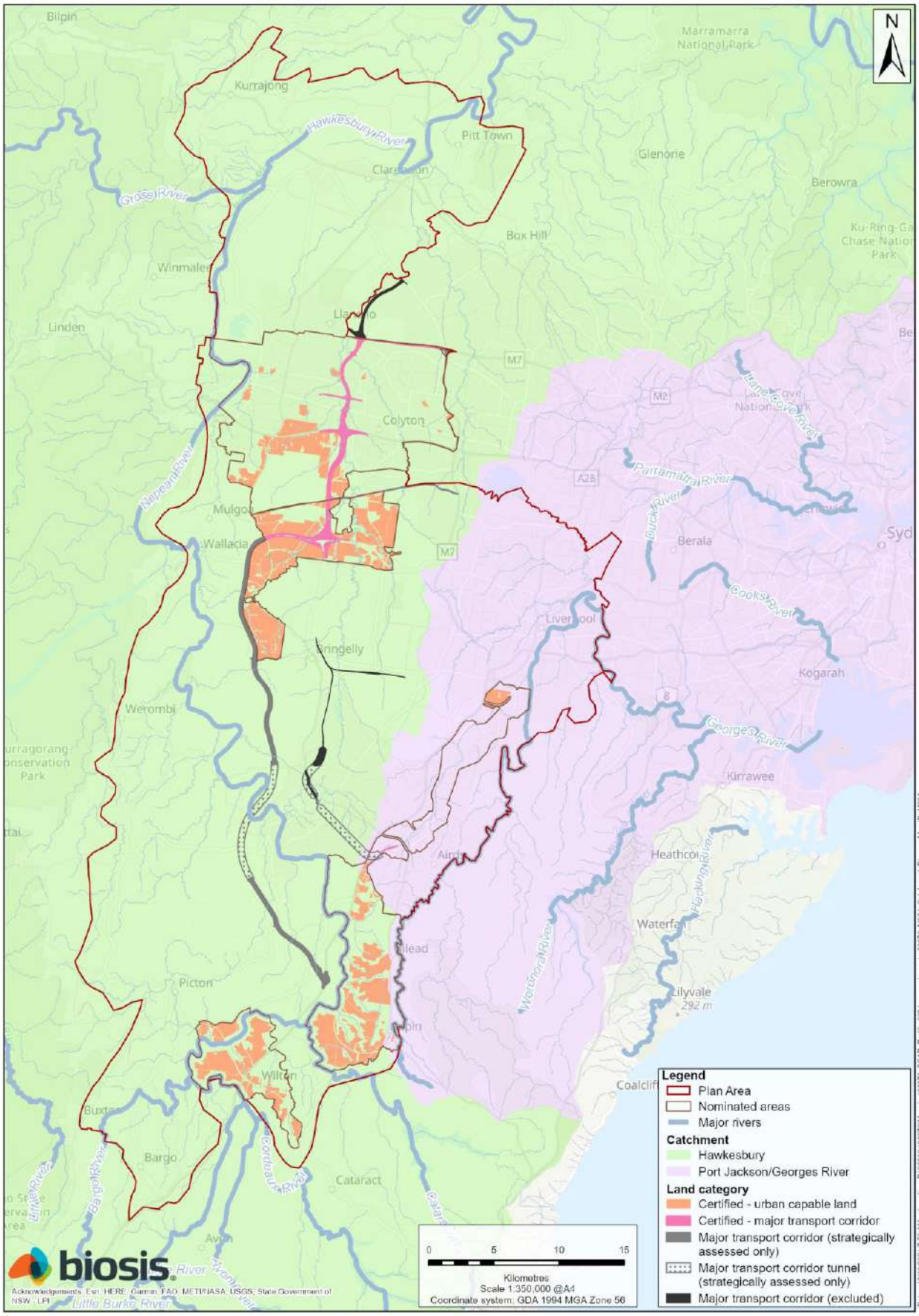

Figure 28-2: Major rivers of the Strategic Assessment Area

28.1.4 THREATENING PROCESSES

A process is defined as a threatening process under the EPBC Act if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

The EPBC Act enables the listing of key threatening processes. A threatening process may be added to the list of key threatening processes in several circumstances, including where it could cause a native species or an ecological community to become eligible for listing under the EPBC Act as threatened.

The key threatening processes in the Cumberland subregion fall into the following categories:

- Habitat loss
- Climate change
- Weeds
- Pest animals
- Fire
- Disease

HABITAT LOSS

Habitat loss is one of the key threats to the biodiversity of the Cumberland subregion (DECCW, 2011). Further clearing of native vegetation places more pressure on already over-cleared landscapes and leads to increasingly isolated and small remnants that are more susceptible to degradation, provide less habitat and support fewer species (DECCW, 2011).

The EPBC Act lists 'land clearance' under this category.

CLIMATE CHANGE

Climate change is a key threat to the biodiversity of the Cumberland subregion (DECCW, 2011). The nature and extent of the threat is difficult to quantify, but may include (DECCW, 2010a):

- Reductions in the geographic range of species
- Changes to the timing of species' lifecycle events
- Changes in population dynamics and survival
- Changes in the location of species' habitats
- Increases in the risk of extinction for species that are already vulnerable
- Increased opportunity for range expansion of invasive species
- Changes in the structure and composition of ecosystems and communities
- Increased likelihood of extreme weather events and fire
- Changes in coastal and estuarine habitat due to rising sea levels

The EPBC Act lists 'loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' under this category.

WEED INVASION

Weed invasion is an ongoing threat to the remaining vegetation in the Cumberland subregion. In particular, African Olive, African Lovegrass, and Bridal Creeper have established themselves widely, are very competitive and can dominate native understory species (DECCW, 2011; Tozer, 2003).

Key threatening processes listed under the EPBC Act in this category include:

- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- Novel biota and their impact on biodiversity

Several threatening processes relevant to the subregion are also listed under the *Biodiversity Conservation Act 2016* (BC Act) in this category, including:

- Invasion of native plant communities by African Olive
- Invasion, establishment and spread of Lantana
- Invasion of native plant communities by exotic perennial grasses

PEST ANIMALS

Pest animals are a key threat to native fauna species and native vegetation in the Cumberland subregion, including threatened ecological communities such as Cumberland Plain Woodland (DIPNR, 2003). Grazing by pest animals has prevented the recovery and regeneration of native species (DIPNR, 2003).

KTPs listed under the EPBC Act in this category include:

- Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)
- Competition and land degradation by rabbits
- Competition and land degradation by unmanaged goats
- Predation by European red fox
- Predation by feral cats
- Predation, habitat degradation, competition, and disease transmission by feral pigs
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*)

FIRE

Inappropriate fire regimes are a key issue for biodiversity, particularly ecological communities, in the Cumberland subregion. Frequent fire from arson is a major problem and has resulted in a significant change to ecological communities in the subregion, which have evolved and been selected by pre-European practices to be dependent on a certain fire regime (DECCW, 2011).

High frequency fire and inappropriate fire regimes have been identified as threats to a number of species and ecological communities in the Cumberland subregion, including Cumberland Plain Woodland (NSW Scientific Committee, 2000).

No key threatening processes listed under the EPBC Act are included in this category.

The BC Act lists 'high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' as a threatening process under this category.

DISEASE

KTPs listed under the EPBC Act in this category include:

- Dieback caused by the root-rot fungus *Phytophthora cinnamomi*
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis
- Novel biota and their impact on biodiversity
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species

Phytophthora has the potential to affect several ecological communities in the Cumberland subregion, including Castlereagh Scribbly Gum and Agnes Banks Woodland, Cumberland Plain Woodland and Shale Sandstone Transition Forest (DoEE, 2018g).

Several frog species are under threat from the impacts of chytrid fungus in the subregion, including Green and Golden Bell Frog and Giant Burrowing Frog (DoEE, 2016b).

Although not listed under the EPBC Act, psyllid-induced dieback of grey box in the Cumberland subregion has been observed. Specifically a native lace lerp species, or psyllid (*Cardiaspina* sp.) has been found to cause defoliation, canopy dieback and tree mortality on *E. moluccana* (NSW Environmental Trust, 2016). The canopy loss removes patches from being within the EPBC-listed state as it is dependent on the presence of a minimum foliage density.

28.1.5 CURRENTLY PROTECTED AREAS

There are a range of currently protected lands within the Strategic Assessment Area (see Figure 28-3). These comprise:

- Land within the National Parks estate
- Land that is in the process of being incorporated into the National Parks estate
- Existing offset sites
- Existing Biobank and Biodiversity Stewardship sites

The total area of protected lands within the Strategic Assessment Area is 8,981 hectares.

Existing offset sites, BioBank, and Biodiversity Stewardship sites have not been shown in Figure 28-3 due to privacy reasons.

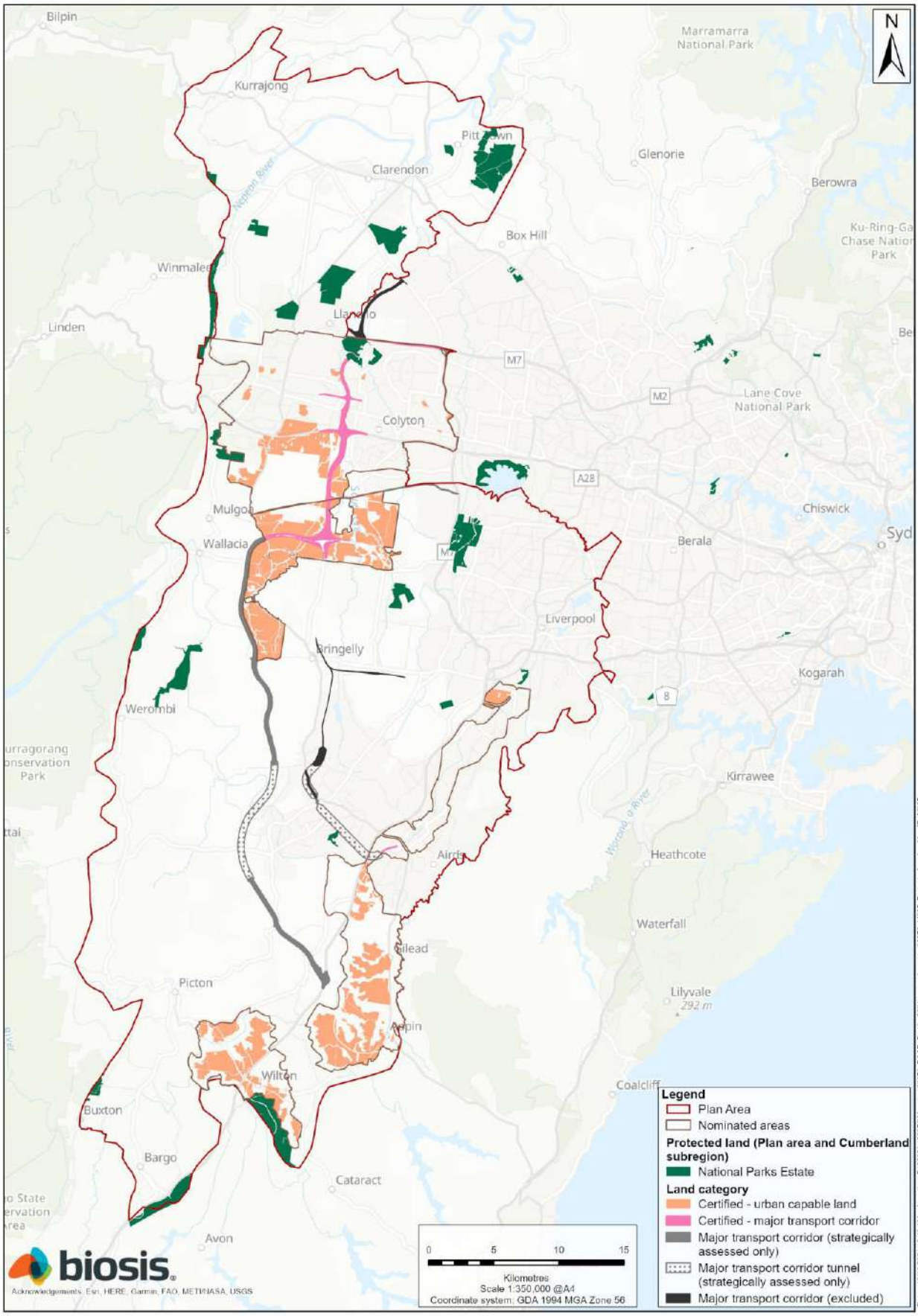

Figure 28-3: Currently protected lands within the Strategic Assessment Area

28.2 RELEVANT PROTECTED MATTERS

As required by Clause 3.2 of the Terms of Reference:

> *The Report must identify and describe each protected matter that may be impacted directly, indirectly, and cumulatively by actions taken under the Plan…*

A method to identify these matters was applied (see Section 11.1.2 in Part 3 of the report). This was based on applying a set of criteria and using expert input to assign the full list of potential matters for the Strategic Assessment Area into one of two categories:

- Category 1: matter needs detailed assessment. These matters are reliant on the Cumberland subregion, have some potential to be impacted (directly, indirectly, or cumulatively), and are addressed in detail in the Assessment Report
- Category 2: assessment of the matter is completed, and no further analysis is required. These matters are not reliant on the Cumberland subregion, are subject to no or very low risk of impacts (directly, indirectly, or cumulatively), and are not addressed further in the Assessment Report

This work identified the following groups of protected matters as being relevant to the assessment:

- Listed threatened species (see Section 28.2.1)
- Listed threatened ecological communities (see Section 28.2.2)
- Listed migratory species (see Section 28.2.3)
- Finalised Priority Assessment List (FPAL) (see Section 28.2.4)
- Wetlands of international importance (Ramsar wetlands) (see Section 28.2.5)
- World and National Heritage (see Section 28.2.6)
- Commonwealth land (see Section 28.2.7)

Detailed impact assessments have been undertaken for Category 1 protected matters, which are highlighted in blue in the following tables.

28.2.1 THREATENED SPECIES

The following threatened species were assigned to Category 1 for detailed assessment in the report:

- 20 threatened fauna species (see Table 28-1)
- 23 threatened flora species (see Table 28-2)

Detailed impact assessments for Category 1 threatened species are presented in Chapter 29 (flora species) and Chapter 30 (fauna species).

Note that Table 28-1 and Table 28-2 include statistics on important populations, records and distribution of species within the Cumberland subregion. The purpose of these statistics is to give a broad indication of how important the Cumberland subregion is likely to be for the species, or if the species predominantly occurs elsewhere. These statistics are based on data that was assessed in 2019 for this project. Since this time, further records of species have been recorded, and the number of important populations for some species has changed. However, these changes are generally minor, and do not change the understanding of the species' general distribution and habitat use in the Cumberland subregion, compared to other habitat across their wider distribution. Therefore, the statistics presented in Table 28-1 and Table 28-2 are based on the original analysis of data used for this project, and do not incorporate subsequent data updates.

Following the public exhibition period, and in preparation for submission of this report, the list of flora and fauna species presented in Table 28-1 and Table 28-2 were reviewed to check whether new information had become available since the initial assessment period which would cause a species to require a more detailed assessment. There were no additions of new Category 1 species as a result of this assessment.

Table 28-1: Threatened fauna

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
BIRDS						
Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Critically Endangered	1, 1.36%, 0.63%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	1, 3.97%, 0.42%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Calidris canutus	Red Knot, Knot	Endangered; Migratory; FPAL	Not Listed	1, 0.34%, 0	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Calidris ferruginea	Curlew Sandpiper	Critically Endangered; Migratory; FPAL	Not Listed	1, 0.08%, 0.03%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Calidris tenuirostris	Great Knot	Critically Endangered; Migratory; FPAL	Vulnerable	0, 0, 0.08%	Category 2	The species has a broad Australian distribution and NSW does not contain any important sites for the species. It is unlikely to occur in the Strategic Assessment Area
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Vulnerable; Migratory; FPAL	Vulnerable	1, 0.63%, 0.11%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Charadrius mongolus	Lesser Sand Plover, Mongolian Plover	Endangered; Migratory	Not Listed	0, 0, 0.06%	Category 2	The species has a widespread Australian distribution, and no records occur in the Strategic Assessment Area. It is unlikely to occur in the Strategic Assessment Area
Dasyornis brachypterus	Eastern Bristlebird	Endangered	Endangered	0, 0, 1.3%	Category 2	The species does not occur on the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Diomedea antipodensis	Antipodean Albatross	Vulnerable	Vulnerable	0, 0, 0	Category 2	The species is endemic to New Zealand and forages in open water off the coast of NSW. It is unlikely to occur in the Strategic Assessment Area
Diomedea antipodensis gibsoni	Gibson's Albatross	Vulnerable	Vulnerable	0, 0, 0	Category 2	The species is a non-breeding visitor to Australian waters. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Diomedea epomophora	Southern Royal Albatross	Vulnerable; Migratory	Not Listed	0, 0, 0	Category 2	The species forages in open water off the east, west and south Australian coast. It is unlikely to occur in the Strategic Assessment Area
Diomedea exulans	Wandering Albatross	Vulnerable; Migratory	Endangered	0, 0, 0	Category 2	The species forages in open water from Fremantle in WA around southern Australia to the Whitsunday Islands in Queensland. It is unlikely to occur in the Strategic Assessment Area
Diomedea sanfordi	Northern Royal Albatross	Endangered	Not Listed	0, 0, 0	Category 2	The species has a broad distribution across the Southern Ocean. It forages in waters off Tasmania and South Australia, and less frequently in NSW waters. It is unlikely to occur in the Strategic Assessment Area
Grantiella picta	Painted Honeyeater	Vulnerable	Vulnerable	0, 0.18%, 0.16%	Category 2	The species has a broad but sparse distribution from south-east Australia to the Northern Territory that is associated with the fruiting of mistletoe. It is unlikely to be reliant on the Strategic Assessment Area
Hirundapus caudacutus	White-throated Needletail	Vulnerable; Migratory	Not Listed	0, 2.43%, 0.38	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Lathamus discolor	Swift Parrot	Critically Endangered	Endangered	1, 9.49%, 0.41%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Limosa lapponica baueri	Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit	Vulnerable; Migratory; FPAL	Not Listed	1, 0, 0.06%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri)	Critically Endangered; Migratory; FPAL	Not Listed	0, 0, 0.06%	Category 2	The species occurs predominately in Western Australia and is not considered likely to occur in the Strategic Assessment Area
Macronectes giganteus	Southern Giant-Petrel, Southern Giant Petrel	Endangered; Migratory	Endangered	0, 0, 0	Category 2	The species is a pelagic bird with a range as far as northern Queensland. It does not occur in the Strategic Assessment Area and is unlikely to be reliant on the area
Macronectes halli	Northern Giant Petrel	Vulnerable; Migratory	Vulnerable	0, 0, 0	Category 2	The species is a pelagic bird with an Australian distribution from Freemantle in WA to Sydney in NSW. No records occur in the Strategic Assessment Area, and it is unlikely to be reliant on the area
Neophema chrysogaster	Orange-bellied Parrot	Critically Endangered	Critically Endangered	0, 0, 0.09%	Category 2	The species is associated with saltmarsh and foredune vegetation communities either on coastlines or coastal lagoons. No records occur in the Strategic Assessment Area, and it is unlikely to be reliant on the area
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Critically Endangered; Migratory; FPAL	Not Listed	1, 0, 0.05%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Pachyptila turtur	Fairy Prion	Vulnerable	Not Listed	0, 0, 0	Category 2	The species has a circumpolar distribution and is known from areas in the vicinity to Macquarie Island, and Bishop and Clerk Island. No records occur in the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area due to the lack of suitable habitat

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Pachyptila turtur subantarctica	Fairy Prion (southern)	Vulnerable	Not Listed	0, 0, 0	Category 2	The species has a circumpolar distribution and is known from areas in the vicinity to Macquarie Island, and Bishop and Clerk Island. No records occur in the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area due to the lack of suitable habitat
Rostratula australis	Australian Painted Snipe	Endangered	Endangered	1, 6.38%, 0.07%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Rostratula benghalensis (sensu lato)	Painted Snipe	Endangered	Not Listed	0, 0, 0.07%	Category 2	The species is generally accepted as *Rostratula australis*. The Australian painted snipe is now accepted as a full species rather than a sub species of *Rostratula benghalensis*, based on morphological differences (listing advice). This does not need assessment because *Rostratula australis* is being assessed
Sternula nereis nereis	Australian Fairy Tern	Vulnerable	Not Listed	0, 0, 0	Category 2	The species' extent occurs along the coast from NSW to Western Australia, including Tasmania. It is associated with offshore estuarine or lake islands, wetlands, beaches, and spits. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Thalassarche bulleri	Buller's Albatross, Pacific Albatross	Vulnerable; Migratory	Not Listed	0, 0, 0	Category 2	The species is a non-breeding visitor to Australian waters with a broad distribution. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Thalassarche bulleri platei	Northern Buller's Albatross, Pacific Albatross	Vulnerable	Not Listed	0, 0, 0	Category 2	The species is a non-breeding visitor to Australian waters with a broad distribution. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Thalassarche cauta	Tasmanian Shy Albatross	Vulnerable; Migratory	Vulnerable	0, 0, 0	Category 2	The species is accepted as being the same as *Thalassarche cauta cauta*. It is a non-breeding visitor to Australian waters and does not occur on the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Thalassarche cauta cauta	Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Not Listed	0, 0, 0	Category 2	The species is a non-breeding visitor to Australian waters with a broad distribution. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Thalassarche cauta steadi	White-capped Albatross	Vulnerable	Not Listed	0, 0, 0	Category 2	The species is a non-breeding visitor to Australian waters, particularly off the coast of south-east Australia. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Thalassarche eremita	Chatham Albatross	Endangered	Not Listed	0, 0, 0	Category 2	The species' principle foraging range occurs in waters off the coast off eastern and southern New Zealand, and Tasmania. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Thalassarche impavida	Campbell Albatross, Campbell Black-browed Albatross	Vulnerable	Not Listed	0, 0, 0	Category 2	The species is a non-breeding visitor to Australian waters. Its Australian distribution occurs over the oceanic continental slope off the coast of Tasmania, Victoria, and NSW. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Thalassarche melanophris	Black-browed Albatross	Vulnerable; Migratory	Vulnerable	0, 0, 0	Category 2	The species breeds on Heard Island, Macquarie Island, McDonald Islands, and Bishop and Clerk Islets and has a broad Australian oceanic distribution. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Thalassarche salvini	Salvin's Albatross	Vulnerable	Not Listed	0, 0, 0	Category 2	The species is a non-breeding visitor to Australian waters, with a broad distribution. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
MAMMALS						
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	Vulnerable; FPAL	Vulnerable	0, 3.19%, 0.61%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (south-eastern mainland population)	Endangered	Vulnerable	1, 0.4%, 0.98%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern)	Endangered	Endangered	0, 0, 0.59%	Category 2	The species distribution extends from the Hawkesbury River in NSW to Kangaroo Island in South Australia. In NSW it occurs in two populations located in Ku-ring-gai Chase and Garigal National Parks, and far south-east NSW around Ben Boyd National Park. It is unlikely to occur in the Strategic Assessment Area
Megaptera novaeangliae	Humpback Whale	Vulnerable; FPAL	Vulnerable	0, 0, 0	Category 2	The species occurs in marine areas. It is unlikely to occur in the Strategic Assessment Area
Petauroides volans	Greater Glider	Vulnerable; FPAL	Not Listed	3, 0.15%, 0.37%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Petrogale penicillata	Brush-tailed Rock-wallaby	Vulnerable; FPAL	Endangered	0, 0, 0.87%	Category 2	The species' distribution occurs along the Great Dividing Range from Queensland to Victoria. No records occur in the Strategic Assessment Area, and it is unlikely to be reliant on the area
Phascolarctos cinereus	Koala (combined populations of Queensland, New South Wales, and the Australian Capital Territory)	Vulnerable; FPAL	Vulnerable	1, 0.89%, 0.22%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Potorous longipes	Long-footed potoroo	Endangered; FPAL	Critically Endangered	0, 0, 0	Category 2	The species occurs in Victoria and south-eastern NSW. No records occur in the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	Vulnerable; FPAL	Vulnerable	0, 0, 0	Category 2	The species' distribution occurs from Queensland to eastern Victoria and Tasmania. No records occur on the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area
Pseudomys fumeus	Smoky mouse	Endangered	Critically Endangered	0, 0, 0	Category 2	The species occurs in south-east NSW in the vicinity of Kosciuszko National Park. No records occur on the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Pseudomys novaehollandiae	New Holland Mouse, Pookila	Vulnerable; FPAL	Not Listed	0, 0, 2.09%	Category 2	The species has a fragmented distribution from Queensland down to Tasmania. While recent records of this species have been identified on the far eastern edge of the Strategic Assessment Area in the Holsworthy locality, the habitat in this area is generally different to typical habitat of the Strategic Assessment Area. The species is unlikely to rely upon the Strategic Assessment Area.
Pseudomys oralis	Hastings River mouse	Endangered	Endangered	0, 0, 0	Category 2	The species' range extends from Mount Royal National Park in NSW to Main Range National Park in Queensland. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	4, N/A, 0.42%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
REPTILES						
Caretta caretta	Loggerhead Turtle	Endangered; Migratory	Endangered	0, 0, 0	Category 2	The species is a marine animal. It is unlikely to occur in the Strategic Assessment Area
Chelonia mydas	Green Turtle	Vulnerable; Migratory	Vulnerable	0, 0, 0	Category 2	The species is a marine animal. It is unlikely to occur in the Strategic Assessment Area
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	Endangered; Migratory	Endangered	0, 0, 0	Category 2	The species is a marine animal. It is unlikely to occur in the Strategic Assessment Area
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable; Migratory	Not Listed	0, 0, 0	Category 2	The species is a marine animal. It is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Hoplocephalus bungaroides	Broad-headed Snake	Vulnerable	Endangered	0, 0.87%, 4.34%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Natator depressus	Flatback Turtle	Vulnerable; Migratory	Not Listed	0, 0, 0	Category 2	The species is a marine animal. It is unlikely to occur in the Strategic Assessment Area
AMPHIBIANS						
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable; FPAL	Vulnerable	0, 0.84%, 1.54%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Litoria aurea	Green and Golden Bell Frog	Vulnerable	Endangered	6, 63.09%, 5.48%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Litoria castanea	Yellow-spotted tree frog	Endangered	Critically Endangered	0, 0, 0	Category 2	The species' distribution occurs within the New England Tablelands and the South Eastern Highlands Bioregions. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Litoria littlejohni	Littlejohn's Tree Frog, Heath Frog	Vulnerable; FPAL	Vulnerable	0, 0, 0.74%	Category 2	The species does not occur on the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Litoria raniformis	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	Vulnerable	Endangered	0, 0, 0.15%	Category 2	The species occurs along the Murray and Murrumbidgee Rivers. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Mixophyes balbus	Stuttering Frog, Southern Barred Frog (in Victoria)	Vulnerable	Endangered	0, 0, 0.87%	Category 2	The species occurs along the east coast from southern Queensland to north-eastern Victoria. No records occur in the Strategic Assessment Area, and it is unlikely to be reliant on the area
INVERTEBRATES						
Pommerhelix duralensis	Dural Land Snail	Endangered	Endangered	4, 16.36%, 55.37%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
FISH						
Epinephelus daemelii	Black Rockcod, Black Cod, Saddled Rockcod	Vulnerable	Not Listed	0, 0, 0.13%	Category 2	The species occurs in marine areas. It is unlikely to occur in the Strategic Assessment Area
Macquaria australasica	Macquarie Perch	Endangered	Not Listed	1, 3.45%, 0.97%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30
Prototroctes maraena	Australian Grayling	Vulnerable; FPAL	Not Listed	0, 0, 0.55%	Category 2	There are no records of the species in the Strategic Assessment Area. It is unlikely to be reliant on the area
Thunnus maccoyii	Southern Bluefin Tuna	Conservation Dependent; FPAL	Not Listed	0, 0, 0	Category 2	The species is associated with marine areas. It is unlikely to occur in the Strategic Assessment Area

Table 28-2: Threatened flora

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	Vulnerable	Endangered	25, 10.12%, 9.54%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Acacia gordonii	Gordon's Wattle	Endangered; FPAL	Endangered	0, 2.5%, 4.83%	Category 2	The species only occurs in the lower Blue Mountains and Glenorie areas and is associated with sandstone. It is unlikely to occur in Strategic Assessment Area
Acacia meiantha		Endangered	Endangered	0, 0, 0	Category 2	The species is endemic to NSW and occurs in the Central Tablelands, west of the Great Dividing Range. It is unlikely to occur in the Strategic Assessment Area
Acacia pubescens	Downy Wattle, Hairy-stemmed Wattle	Vulnerable	Vulnerable	90, 96.05%, 61.16%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Acacia terminalis subsp. *terminalis MS*	Sunshine Wattle (Sydney region)	Endangered	Endangered	0, 0, 8.61%	Category 2	The species is associated with sandstone and is restricted to Sydney's eastern suburbs, northern suburbs, and northern beaches. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Allocasuarina glareicola		Endangered	Endangered	10, 88.89%, 30.69%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Asterolasia elegans		Endangered	Endangered	0, 0, 3.53%	Category 2	The species occurs in Baulkham Hills, Hawkesbury, and Hornsby LGAs. It is unlikely to occur in the Strategic Assessment Area
Bossiaea fragrans		Critically Endangered	Critically Endangered	0, 0, 0	Category 2	The species occurs only in Abercrombie Karst reserve in NSW. It is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Caladenia attenuata	Duramana fingers	Critically Endangered	Critically Endangered	0, 0, 0	Category 2	The species occurs only in the Duramana area, north of Bathurst. It is unlikely to occur in the Strategic Assessment Area
Caladenia tessellata	Thick-lipped Spider-orchid, Daddy Long-legs	Vulnerable; FPAL	Endangered	0, 10%, 3.28%	Category 2	The species is primarily associated with sandstone derived communities in coastal areas. It is unlikely to occur in the Strategic Assessment Area
Callistemon purpurascens		Critically Endangered	Not Listed	0, 0, 0	Category 2	The species occurs only in the far west of the Blue Mountains. It is unlikely to occur in the Strategic Assessment Area
Commersonia prostrata	Dwarf Kerrawang	Endangered	Endangered	1, 0.96%, 13.45%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Vulnerable	0, 0, 1.4%	Category 2	The species does not occur on the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered	9, 4.87%, 4.7%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Darwinia biflora		Vulnerable	Vulnerable	0, 1.46%, 30.61%	Category 2	This species met the criteria for a Category 1 species. However, in preparing the Assessment Report it was found that no records or potential habitat occurs for the species in the Strategic Assessment Area. As a result, the species was changed to Category 2 and was not assessed further
Deyeuxia appressa		Endangered	Endangered	0, 81.63%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Diuris eborensis		Endangered	Endangered	0, 0, 0	Category 2	The species is not known or predicted on the Cumberland subregion. Its distribution is contained within the New England Plateau. It is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Eucalyptus aggregata	Black Gum	Vulnerable	Vulnerable	0, 0, 0.35%	Category 2	The species does not occur on the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Eucalyptus benthamii	Camden White Gum, Nepean River Gum	Vulnerable	Vulnerable	8, 84.19%, 54.41%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Eucalyptus camfieldii	Camfield's Stringybark	Vulnerable	Vulnerable	0, 0.08%, 6.49%	Category 2	The species is restricted to sandstone and shale-capped ridges to the north-east of the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Eucalyptus largeana	Craven Grey Box	Endangered	Endangered	0, 0, 0	Category 2	The species occurs between Dungog and Taree; and does not occur on the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Eucalyptus sp. Cattai (NSW 318983)	Cattai Stringybark	Critically Endangered	Critically Endangered	0, 0, 0	Category 2	The species is found on sandstone ridges in the north-east of the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Genoplesium baueri	Yellow Gnat-orchid	Endangered	Endangered	1, 3.13%, 16.1%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Grevillea caleyi	Caley's Grevillea	Critically Endangered	Critically Endangered	0, 0, 0.6%	Category 2	The species is highly restricted to the Ingleside area of north-east Sydney. It is unlikely to occur in the Strategic Assessment Area
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	Vulnerable	Vulnerable	10, 4.66%, 13.98%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Haloragis exalata subsp. *exalata*	Wingless Raspwort, Square Raspwort	Vulnerable	Vulnerable	0, 0, 8.13%	Category 2	The species favours sandstone gullies. It is unlikely to occur on the Cumberland subregion or be reliant on the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Haloragodendron lucasii	Hal	Endangered	Endangered	0, 3.45%, 2.12%	Category 2	The species occurs on Hawkesbury Sandstone and is restricted to Turramurra and Pymble in northern Sydney. It is unlikely to occur in the Strategic Assessment Area
Hibbertia puberula subsp. *glabrescens*		Critically Endangered	Not Listed	1, 3.77%, 100%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Hibbertia spanantha	Julian's Hibbertia	Critically Endangered	Critically Endangered	0, 0, 0	Category 2	The species occurs mainly in Turramurra and Pymble. It is unlikely to occur in the Strategic Assessment Area
Lasiopetalum joyceae		Vulnerable	Vulnerable	0, 1.52%, 2.21%	Category 2	The species is found in the sandstone country to the north-east and north of the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Leptospermum deanei	Deane's Tea-tree	Vulnerable	Vulnerable	0, 25%, 14.42%	Category 2	The species is known only from the Lane Cove Valley area. It is unlikely to occur in the Strategic Assessment Area
Leucopogon exolasius	Woronora Beard-heath	Vulnerable	Vulnerable	2, 8.2%, 16.18%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Melaleuca biconvexa	Biconvex Paperbark	Vulnerable	Vulnerable	0, 0, 1.29%	Category 2	The species distribution is limited to coastal districts and adjacent tablelands in NSW, from Jervis Bay to Port Macquarie. There are no records in the Strategic Assessment Area, and it is considered unlikely to occur
Melaleuca deanei	Deane's Melaleuca	Vulnerable	Vulnerable	2, 16.35%, 10.35%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Micromyrtus minutiflora		Vulnerable	Endangered	14, 98.41%, 94.62%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Olearia cordata		Vulnerable	Vulnerable	0, 0, 0.3%	Category 2	The species is associated with woodland on exposed Hawkesbury Sandstone ridges. No records occur in the Strategic Assessment Area it is unlikely to be reliant on the area
Pelargonium sp. *striatellum (G.W. Carr 10345)*	Omeo Stork's-bill	Endangered	Endangered	0, 0, 1.77%	Category 2	The species occurs in the South Eastern Highlands and South East Corner IBRA bioregions as well as the Hawkesbury-Nepean, Murrumbidgee, Southern Rivers and North East Natural Resource Management Regions. No records occur in the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area
Persicaria elatior	Tall Knotweed	Vulnerable	Vulnerable	N/A	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Persoonia acerosa	Needle Geebung	Vulnerable	Vulnerable	0, 0, 3.26%	Category 2	The species' distribution is restricted to the central coast and Blue Mountains. No records occur on the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area
Persoonia bargoensis	Bargo Geebung	Vulnerable	Endangered	1, 69.7%, 62.77%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Persoonia glaucescens	Mittagong Geebung	Vulnerable	Endangered	10, 8.02%, 8.92%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	Endangered	Endangered	6, 6.27%, 12.51%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Persoonia mollis subsp. *maxima*		Endangered	Endangered	0, 2.68%, 25.72%	Category 2	The species occurs in the sandstone surrounding northern Sydney and beyond the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Persoonia nutans	Nodding Geebung	Endangered	Endangered	9, 96.66%, 88.45%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Pimelea curviflora var. *curviflora*		Vulnerable	Vulnerable	3, 6.79%, 26.75%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Pimelea spicata	Spiked Rice-flower	Endangered	Endangered	26, 98.06%, 74.42%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Pomaderris brunnea	Rufous Pomaderris	Vulnerable	Endangered	3, 67.12%, 16.02%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Pomaderris cocoparrana		Endangered	Endangered	0, 0, 0	Category 2	The species is endemic to NSW and mainly occurs in and around the Cocoparra Range, northeast of Griffith. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Pomaderris delicata		Critically Endangered	Critically Endangered	0, 0, 0	Category 2	The species occurs between Goulburn and Bungonia. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Prostanthera marifolia	Seaforth Mintbush	Critically Endangered	Critically Endangered	0, 0.61%, 4.29%	Category 2	The species is endemic to NSW. It only occurs in the Manly area in northern Sydney, in the Duffy's Forest ecological community. It is unlikely to occur in the Strategic Assessment Area
Pterostylis gibbosa	Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	Endangered	Endangered	0, 0, 7.1%	Category 2	The species only occurs in the Illawarra and middle Hunter Valley. It is closely related to *Pterostylis saxicola*. It does not occur in the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Pterostylis pulchella	Pretty Greenhood	Vulnerable	Vulnerable	0, 0, 4.78%	Category 2	The species is restricted to the Illawarra escarpment and Southern Highlands of NSW. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Pterostylis saxicola	Sydney Plains Greenhood	Endangered	Endangered	8, 88%, 59.69%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Pultenaea aristata		Vulnerable	Vulnerable	0, 0, 2.23%	Category 2	The species occurs from Heathcote to Port Kembla in NSW and is associated with low nutrient sandstone soils. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Pultenaea glabra	Smooth Bush-pea, Swamp Bush-pea	Vulnerable	Vulnerable	0, 0, 2.46%	Category 2	The species occurs in disjunct populations in Queensland, NSW, and Victoria. In NSW it is restricted to the higher Blue Mountains. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Pultenaea parviflora		Vulnerable	Endangered	15, 98.96%, 92.95%	Category 1	A detailed impact analysis has been carried out for this species in Chapter 29
Rhizanthella slateri	Eastern Underground Orchid	Endangered	Vulnerable	0, 0, 4.4%	Category 2	The species is endemic to NSW and occurs from the mid-north coast to the south coast. There are no records of the species in the Strategic Assessment Area, and it is unlikely to be reliant on the area

Scientific name	Common name	Commonwealth status (EPBC Act)	NSW status	No. of important populations, Post 1990 Cumberland records as % of NSW records, % of total Commonwealth distribution	Category	Comment
Syzygium paniculatum	Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry	Vulnerable	Endangered	0, 7.28%, 5.7%	Category 2	The species is only found in NSW and occurs from Upper Lansdowne on the north coast to Conjola National Park on the south coast. Six records occur in the Strategic Assessment Area, but it is unlikely to be reliant on the area and likely results from records of planted individuals as the species is popular in cultivation
Thelymitra kangaloonica	Kangaloon Sun Orchid	Critically Endangered	Critically Endangered	0, 0, 11.77%	Category 2	The species only occurs in Wingecarribee, NSW. It does not occur in the Cumberland subregion or the Strategic Assessment Area
Thesium australe	Austral Toadflax, Toadflax	Vulnerable	Vulnerable	0, 0, 0.84%	Category 2	The species is considered to be extinct on the Cumberland as no records have been recorded since the original specimen was collected. It is unlikely to rely on the Cumberland subregion as it is distributed across NSW, ACT and parts of Queensland and Victoria
Wollemia nobilis	Wollemi pine	Critically Endangered	Critically Endangered	N/A	Category 2	The species is found naturally only in western Wollemi National Park. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Zieria involucrata		Vulnerable	Endangered	0, 0, 1.54%	Category 2	The species has a restricted distribution between Yengo National Park and Marramarra National Park adjacent to the Blue Mountains National Park. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area
Zieria parrisiae		Critically Endangered	Critically Endangered	N/A	Category 2	The species is highly restricted to one site on a private property west of Pambula, NSW. It does not occur on the Cumberland subregion and is unlikely to occur in the Strategic Assessment Area

28.2.2 THREATENED ECOLOGICAL COMMUNITIES

All TECs identified as potentially occurring in the Strategic Assessment Area were assigned to Category 1 (see Table 28-3).

There are nine Category 1 TECs in total. The assessments of each TEC are contained in Chapter 31.

Table 28-3: Threatened ecological communities

Commonwealth-listed TEC	Commonwealth status
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	Critically Endangered
River-Flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria	Critically Endangered
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered

28.2.3 MIGRATORY SPECIES

The following listed migratory species were assigned to Category 1:

- 21 species of migratory shorebirds (see Table 28-4)
- 8 other migratory birds (see Table 28-5)

Table 28-4: Migratory shorebirds

Scientific name	Common name	Commonwealth status (EPBC Act)	Species recorded in the Cumberland subregion	Category	Comment
Actitis hypoleucos	Common Sandpiper	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Arenaria interpres	Ruddy Turnstone	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Calidris acuminata	Sharp-tailed Sandpiper	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Calidris canutus	Red Knot	Migratory; Endangered; FPAL	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Calidris ferruginea	Curlew Sandpiper	Migratory; Critically Endangered; FPAL	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Calidris melanotos	Pectoral Sandpiper	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Calidris ruficollis	Red-necked Stint	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Calidris subminuta	Long-toed Stint	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Charadrius bicinctus	Double-banded Plover	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Charadrius leschenaultii	Greater Sand-plover	Migratory; Vulnerable; FPAL	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Gallinago hardwickii	Latham's Snipe	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32

Scientific name	Common name	Commonwealth status (EPBC Act)	Species recorded in the Cumberland subregion	Category	Comment
Limosa lapponica	Bar-tailed Godwit	Migratory; Vulnerable; FPAL	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Limosa limosa	Black-tailed Godwit	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Numenius madagascariensis	Eastern Curlew	Migratory; Critically Endangered; FPAL	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 30 in relation to its listing as a threatened species, and Chapter 32 in relation to its listing as a migratory species
Numenius minutus	Little Curlew	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Philomachus pugnax	Ruff	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Pluvialis fulva	Pacific Golden Plover	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Pluvialis squatarola	Grey Plover	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Tringa glareola	Wood Sandpiper	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Tringa nebularia	Common Greenshank	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Tringa stagnatilis	Marsh Sandpiper	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32

Table 28-5: Other migratory species*

Scientific name	Common name	Commonwealth status (EPBC Act)	Species recorded in the Strategic Assessment Area	Category	Comment
BIRDS					
Anous stolidus	Common Noddy	Migratory	No	Category 2	The species has a broad distribution and mainly occurs in the ocean off the coast of Queensland. It is unlikely to occur in the Strategic Assessment Area
Apus pacificus	Fork-tailed Swift	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Calonectris leucomelas	Streaked Shearwater	Migratory	No	Category 2	The species is migratory and occurs in waters off the coast of northern and eastern Australia. It is unlikely to occur in the Strategic Assessment Area
Cuculus optatus	Oriental Cuckoo, Horsfield's Cuckoo	Migratory	No	Category 2	The species is the same as *Cuculus saturates* (IUCN, 2018)
Cuculus saturatus	Oriental Cuckoo, Himalayan Cuckoo	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Fregata ariel	Lesser Frigatebird, Least Frigatebird	Migratory	No	Category 2	The species has a broad oceanic distribution in Australia with no records on the Cumberland subregion. It is unlikely to occur in the Strategic Assessment Area
Fregata minor	Great Frigatebird, Greater Frigatebird	Migratory	No	Category 2	The species is a pelagic bird with a broad Australian oceanic distribution. No records occur on the Cumberland subregion, and it is unlikely to occur in the Strategic Assessment Area
Monarcha melanopsis	Black-faced Monarch	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Motacilla flava	Yellow Wagtail	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Myiagra cyanoleuca	Satin Flycatcher	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Pandion haliaetus	Osprey	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Rhipidura rufifrons	Rufous Fantail	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32
Symposiachrus trivirgatus	Spectacled Monarch	Migratory	Yes	Category 1	A detailed impact analysis has been carried out for this species in Chapter 32

Scientific name	Common name	Commonwealth status (EPBC Act)	Species recorded in the Strategic Assessment Area	Category	Comment
FISH					
Lamna nasus	Porbeagle, Mackerel Shark	Migratory	No	Category 2	The species occurs in marine areas. It is unlikely to occur in the Strategic Assessment Area
Manta alfredi	Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray	Migratory	No	Category 2	The species occurs in marine areas. It is unlikely to occur in the Strategic Assessment Area
Manta birostris	Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray	Migratory	No	Category 2	The species occurs in marine areas. It is unlikely to occur in the Strategic Assessment Area.

* This table does not include migratory species that are also listed as threatened under the EPBC Act. These species are dealt with in Section 28.2.1.

28.2.4 FINALISED PRIORITY ASSESSMENT LIST (FPAL)

All relevant species and ecological communities on FPAL lists up to and including the assessment period commencing 1 October 2020 were reviewed (see Table 28-6). There are four threatened fauna species that are nominated for uplisting from vulnerable to endangered. They are all assigned to Category 1 and assessed in detail as part of Chapter 30.

Table 28-6: Matters on the FPAL list

Species or ecological community	Assessment completion date	Category	Comment
Calidris canutus (Red Knot)	30/10/2022	Category 1	This species is already assessed listed as Endangered and assessed as Category 1. The species is listed as FPAL to have its listing downgraded to Vulnerable
Calidris ferruginea (Curlew Sandpiper)	30/10/2022	Category 1	This species is already assessed listed as Critically Endangered and assessed as Category 1. The species is listed as FPAL to have its listing downgraded to Endangered
Chalinolobus dwyeri (Large-eared Pied Bat)	30/10/2022	Category 1	This species is already assessed listed as Vulnerable and assessed as Category 1. The species is listed as FPAL to have its listing upgraded to Endangered
Charadrius leschenaultii (Greater Sand Plover)	30/10/2022	Category 1	This species is already assessed listed as Vulnerable and assessed as Category 1. The species is listed as FPAL to have its listing downgraded to Not Listed
Heleioporus australiacus (Giant Burrowing Frog)	30/10/2022	Category 1	This species is already assessed listed as Vulnerable and assessed as Category 1. The species is listed as FPAL to have its listing upgraded to Endangered
Limosa lapponica baueri (Bar-tailed Godwit)	30/10/2022	Category 1	This species is already assessed listed as Vulnerable and assessed as Category 1. The species is listed as FPAL to have its listing upgraded to Endangered.
Numenius madagascariensis (Eastern Curlew)	30/10/2022	Category 1	This species is already assessed listed as Critically Endangered and assessed as Category 1. The species is listed as FPAL to have its listing downgraded to Endangered
Petauroides volans (Greater Glider)	30/10/2021	Category 1	This species is already assessed listed as Vulnerable and assessed as Category 1. The species is listed as FPAL to have its listing upgraded to Endangered
Phascolarctos cinereus (Koala)	30/10/2021	Category 1	This species is already assessed listed as Vulnerable and assessed as Category 1. The species is listed as FPAL to have its listing upgraded to Endangered

28.2.5 RAMSAR

Towra Point Nature Reserve is the only wetland of international importance (Ramsar Wetland) that was identified as being relevant to the strategic assessment. It occurs outside and downstream of the Strategic Assessment Area. It has been assigned to Category 1 and a detailed impact assessment is presented in Chapter 33.

28.2.6 WORLD AND NATIONAL HERITAGE

Four World and/or National Heritage Places were identified as being present within, or within 10 km of the Strategic Assessment Area (see Chapter 34). These include:

- The Greater Blue Mountains World Heritage Area which is listed as both a World and National Heritage Place
- Parramatta Female Factory and Institutions Precinct which is listed as a National Heritage Place
- Old Government House and Government Domain which is listed as both a World and National Heritage Place
- Ku-ring-gai Chase National Park which is listed as a National Heritage Place

A detailed impact assessment for each place is presented in Chapter 34.

28.2.7 COMMONWEALTH LAND

Commonwealth land is a protected matter under the EPBC Act. It has been assigned to Category 1 and an impact assessment is provided in Chapter 35.

29 Threatened flora impact assessment

29.1 INTRODUCTION

There are 23 Category 1 threatened flora species that are assessed in this Chapter. These species were identified as needing detailed assessment (see Part 3 for the approach, and Chapter 28 for the results) as they are reliant on the Cumberland subregion and have some potential to be impacted (directly, indirectly, or cumulatively).

The Chapter is structured around the level of risk of residual adverse direct impacts (prior to the application of offsets) occurring to each species (see Table 29-1). Species most at risk from development under the Plan are discussed first, with species at lower levels of risk discussed subsequently.

The overall assessment approach for threatened flora is presented below in Section 28.2, and the methodology for the risk assessment is set out in Section 29.3.

The analysis in this Chapter concludes that the avoidance, mitigation, and offset measures in the Plan will ensure that the long-term viability of all 23 threatened flora species will not be adversely influenced.

Table 29-1: Species assessed in the threatened flora chapter categorised according to the risk of residual adverse direct impacts

Level of risk of residual adverse direct impacts to species	Number of species	Species names
High risk	2	• *Pimelea spicata* • *Pultenaea parviflora*
Medium risk	2	• *Cynanchum elegans* • *Persoonia nutans*
Low risk	4	• *Eucalyptus benthamii* • *Grevillea parviflora* subsp. *parviflora* • *Melaleuca deanei* • *Persoonia bargoensis* • *Pomaderris brunnea*
Very low risk	9	• *Acacia bynoeana* • *Acacia pubescens* • *Allocasuarina glareicola* • *Micromyrtus minutiflora* • *Persicaria elatior* • *Persoonia hirsuta* • *Pimelea curviflora* var. *curviflora* • *Pterostylis saxicola*
No risk	6	• *Commersonia prostrata* • *Deyeuxia appressa* • *Genoplesium baueri* • *Hibbertia puberula* subsp. *glabrescens* • *Leucopogon exolasius* • *Persoonia glaucescens*

29.2 THREATENED FLORA ASSESSMENT APPROACH

The assessments for threatened flora follow a standard format. However, the content is tailored for the specific context of each species.

There are eight sections to the assessments. They are described below and include:

- Species background
- Approach to baseline data
- Occurrence in the Strategic Assessment Area
- Avoidance of impacts
- Direct impacts and offsets
- Potential indirect impacts and mitigation
- Potential additional impacts from essential infrastructure and tunnels
- Likely effects of implementation of the Plan on the long-term viability of the species
- Data tables

To assist the reader, standard explanatory text about the purpose and content of each section is provided throughout the assessments in *blue italics text*. The text is repeated for each species. It enables the reader to quickly understand the content of each section and where in the broader report more detailed information is available about a particular issue.

29.2.1 SPECIES BACKGROUND

Sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

29.2.2 APPROACH TO BASELINE DATA

Provides a summary of the baseline information used in the assessment. It sets out:

- If the species is a candidate species under the Biodiversity Certification Assessment Report (BCAR) process. A candidate species is a species that has been determined through the BCAR assessment as needing to be assessed because suitable habitat occurs in the nominated areas. A candidate species can be either an ecosystem credit species (ECS) (one that can be reasonably predicted to occur within a nominated area based on the habitat that occurs there - surveys are not required to determine the presence of these species); or a species credit species (SCS) (one that cannot be reasonably predicted to occur within a nominated areas based on habitat – species in these areas may either be assumed present, or their presence needs to be determined through surveys or a report prepared by an expert on that species). Understanding whether a species has been categorised as a candidate species is useful to know for the EPBC Act assessments as it is based on the application of a systematic method under the BCAR process and provides an initial indication of how development in the nominated areas might interact with the species. This helps to shape the assessment narrative
- If an expert report was prepared for the species under the BCAR process. Expert reports were prepared as part of the BCAR process for a subset of species that: could not be sufficiently surveyed for within the nominated areas due to either access restrictions, seasonality, or their cryptic nature; or had highly specific habitat requirements and restrictions for which expert advice was required. It is relevant to note that the expert reports were prepared as a requirement of the BCAR process and were not specifically prepared to support the EPBC assessments. As a result, the expert reports are not relied on heavily in these assessments and instead, information (particularly relating to species ecology and distribution) has been identified and drawn on as relevant
- An overview of the habitat mapping for the species within and outside the nominated areas. Habitat maps were generated using either species distribution models (SDMs), knowledge-based maps (KBMs) reflecting broad habitat associations (for instance, with mapped PCTs), and expert polygons defined through the expert reports under the BCAR process
- An overview of the population mapping for the species. This includes:
    - Any filters applied to the use of species (BioNet) records
    - Assumptions made in identifying biological populations from the species records. It is relevant to note that the method used to define populations for this assessment was tailored to the available data and purpose of the

baseline mapping. While the definition used is based on the theoretical definition of a biological population used elsewhere in the literature, it is confounding to try to match or relabel these populations to corresponding populations in other publications, such as recovery plans or species profiles, which will be based on a different dataset, often with a different purpose, set of criteria and level of resolution. The population mapping presented in this report therefore needs to be considered as standalone and fit for purpose

- Any criteria met in determining the importance of populations

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

29.2.3 OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

Describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file (layered PDF). The map provides critical context for the assessment and should be viewed in conjunction with the text presented in the assessments. This section also provides a qualitative description of where records and habitat occur.

29.2.4 AVOIDANCE OF IMPACTS

Provides an overview of the area of potential habitat that was avoided for each species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan.

The definition of what constitutes avoidance has been adopted from the BCAR process. Under the BAM, avoidance refers to land that is suitable for development and included in the area proposed for development or biodiversity certification but has been avoided and not certified because of its biodiversity value. This is referred to as avoided for 'biodiversity purposes' in this assessment.

Land not impacted because it is not suitable for development or biodiversity certification, or land that has been excluded from the area proposed for development is not considered to have been avoided under the BAM. This land is referred to as avoided for 'other purposes' and includes:

- Land that is mapped as a riparian corridor associated with a Strahler order 3 stream or above (or Strahler order 2 streams with mapped vegetation, adjacent to avoided lands or that contribute to landscape connectivity). Riparian buffers applied are consistent with the *Water Management Act 2000*:
  - Strahler stream order 2 - buffer 20 m either side
  - Strahler stream order 3 - buffer 30 m either side
  - Strahler stream order 4 and above - buffer 40 m either side
- State protected land within avoided lands (>18 degrees slope, considered too steep for urban development)

Flood-prone land is not included in the list of land avoided for other purposes because significant development does occur within flood-prone land in the Plan Area. The use of fill and other flood-mitigation works means that flood-prone land does not necessarily constrain urban development.

Some land within the nominated areas was not considered for inclusion in the area proposed for development and has therefore been identified as 'excluded' land. These lands include:

- Existing protected land, including reserves and established offset sites
- Council owned land which is zoned for environmental conservation, environmental management, or recreation
- Commonwealth land, such as Defence Establishment Orchard Hills
- Lands within the nominated areas already assessed as part of another development approval (Bingara Gorge), or lands progressing through an alternate assessment (Mount Gilead, Menangle Park, Sydney Metro Stage 1)
- Lands already developed (existing urban areas, urban land zones, and roads)

A further, detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.2.5 DIRECT IMPACTS AND OFFSETS

Provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat.

Direct impacts were determined based on an intersect of the urban capable lands and transport corridors with the baseline mapping generated for each threatened flora species. It has been assumed that total permanent clearing will occur within the urban capable lands and transport corridors for the purposes of the assessment. However, it is important to note that in reality:

- Further avoidance will be undertaken within the transport corridors (see Chapter 7)
- Direct impacts will occur progressively over the life of the Plan, which reduces the severity of impacts

The extent or scale of loss is presented in terms of:

- Number and size of populations/important populations
- Hectares of potential habitat

The analysis also considers the likelihood of direct impacts leading to fragmentation of populations and areas of potential habitat.

To provide a sense of the magnitude and importance of direct impacts, the risk of residual adverse impacts to each species occurring as a result of any direct impacts was characterised as per the methodology set out in Section 29.3 below.

The Plan provides offsets for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.2.6 POTENTIAL INDIRECT IMPACTS AND MITIGATION

Identifies the potential indirect impacts to each species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to a species if:

- The indirect impact is identified as a threat in a relevant profile, conservation advice or recovery plan, *and*
- The threat is present in the Cumberland subregion, *and/or*
- The Plan has the potential to introduce or exacerbate the threat in a way that may affect the known occurrence of a species or associated habitat

Relevant indirect impacts were identified by drawing on distribution, ecological and life history information in SPRAT and other species profiles, conservation advices, and recovery plans, and species records and habitat maps prepared for this Assessment Report.

The indirect impacts section then goes on to determine if the generic management strategies in the Plan will be adequate for addressing indirect impacts, or if species-specific commitments are necessary. Species-specific commitments were generally considered necessary where a species was found to have a particular vulnerability or susceptibility to a potential indirect impact in a discrete location.

Please refer to Chapter 15 for a detailed discussion and analysis of the type and nature of indirect impacts associated with the classes of action and the relevant mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.2.7 POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

Considers the potential additional impacts to species due to essential infrastructure projects that are needed to support development within the nominated areas. These might include projects such as water and electricity utilities, communications facilities, stormwater management systems, and waste or resource management systems. The assessment covers projects that may need to be located outside urban capable lands and on areas that are identified as avoided lands within the nominated areas.

This section also assesses the likelihood of potential additional impacts to species due to the tunnel sections of the transport corridors. The impacts of tunnels were assessed separately to the rest of the transport corridors as only small areas of the footprints will be disturbed and it is not possible to determine at this stage the nature and extent of those impacts.

Please refer to the following chapters for details about these development types:

- Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels
- Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)

29.2.8 LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

Considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.2.9 DATA TABLES

Sets out the data tables for occurrence, avoidance, and direct impacts for each species.

29.3 RISK ASSESSMENT APPROACH FOR THREATENED FLORA

This section sets out:

- The purpose of the risk assessment approach
- The risk assessment framework
- A description of the risk ratings
- The likelihood and consequence definitions for direct impacts to populations and/or potential habitat
- The likelihood and consequence definitions for direct impacts leading to fragmentation

29.3.1 PURPOSE

The purpose of the risk assessment for threatened flora was to determine the level of risk of residual adverse impacts occurring to a species as a result of direct impacts. Indirect impacts were assessed differently (see Chapter 15) and were not subject to the same risk assessment process.

The term "residual adverse impacts" was used as it forms part of the EPBC Act Environmental Offsets Policy (DSEWPC, 2012c). Offsets are typically required under the EPBC Act when residual adverse impacts remain after avoidance and mitigation measures have been applied. In this case, the Plan provides offsets for species which are considered to be at high or medium risk of residual adverse impacts. Offsets are not provided for species which are considered to be at low or very low risk. As outlined above, the rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

A risk-based approach to considering residual adverse impacts is appropriate for the strategic assessment. The Terms of Reference (Clause 4.2) identify the need for the impact assessment to consider the "level of likely risk to each protected matter". The spatial and temporal scale of the Plan means that there is an inherent level of uncertainty in the baseline data (both for habitat and records). In particular, the potential habitat mapping for the majority of species is highly precautionary and does not necessarily indicate with great certainty if a species will occur in an impact area. It is critical therefore to understand the level of risk to each species rather than take a simplistic view of direct impacts as presented in the impact numbers.

29.3.2 RISK ASSESSMENT FRAMEWORK

Risk is generally considered to be the combination of the likelihood and consequence of an event occurring. The methodology used in the assessment is based on an adapted version of the Australian Standard on Risk Management (Standards Australia, 2018).

The assessment for threatened flora was based on:

- The risk ratings table shown in Table 29-2
- Understanding the risk of residual adverse impacts due to direct impacts to populations and/or potential habitat based on:
  - The likelihood definitions in Table 29-3
  - The consequence definitions in Table 29-4, Table 29-5, Table 29-6, and Table 29-7
- Understanding the risk of residual adverse impacts due to fragmentation based on:
  - The likelihood definitions in Table 29-8
  - The consequence definitions in Table 29-11

The final level of risk for a species was determined on a precautionary basis. The highest level of risk based on the consideration of impacts to populations, potential habitat, or due to fragmentation was taken.

29.3.3 RISK RATINGS

Four levels of risk were defined through the process (see Table 29-2). They were:

- Very low risk = very low risk that residual adverse impacts to a species will occur. Offsets for residual impacts were not considered necessary
- Low risk = low risk that residual adverse impacts to a species will occur. Offsets for residual impacts were not considered necessary
- Medium risk = medium risk that residual adverse impacts to a species will occur. Offsets were considered necessary
- High risk = high risk that residual adverse impacts to a species will occur. Offsets were considered necessary

Where there were no direct impacts to a species, there was considered to be no risk of residual adverse impacts.

Table 29-2: Risk ratings table

	CONSEQUENCE				
LIKELIHOOD	**Negligible**	**Minor**	**Moderate**	**Major**	**Extreme**
Almost certain	Low	Medium	Medium	High	High
Likely	Low	Low	Medium	Medium	High
Possible	Very low	Low	Low	Medium	Medium
Unlikely	Very low	Very low	Low	Low	Medium

29.3.4 LIKELIHOOD AND CONSEQUENCE DEFINITIONS FOR DIRECT IMPACTS TO POPULATIONS AND/OR POTENTIAL HABITAT

LIKELIHOOD

Table 29-3 sets out the definitions for the likelihood that a threatened flora species will be directly impacted due to impacts to populations and/or potential habitat. These definitions:

- Draw on the baseline data for the species in terms of records and potential habitat mapping
- Consider the level of confidence in the records and potential habitat mapping. Strict definitions of "high", "moderate" and "low" confidence are not provided as they are species specific in relation to the baseline data. Judgements about the level of confidence in the data were instead determined based on the expert judgement of the assessment team who created the baseline data

Table 29-3: Likelihood definitions for direct impacts to populations and/or potential habitat

Likelihood	Definition
Almost certain	• Direct impacts to a known population with high confidence in the accuracy of the records
Likely	• Direct impacts to a known population with some uncertainty in the accuracy of the records OR • Direct impacts to potential habitat with high confidence that the species occurs in the impact area
Possible	• No direct impacts to a known population • Direct impacts to potential habitat with moderate confidence that the species occurs in the impact area
Unlikely	• No direct impacts to a known population • Direct impacts to potential habitat with low confidence that the species occurs in the impact area

CONSEQUENCES

Consequence was determined by separately considering impacts to potential habitat as well as any impacts to known populations. The highest ranking of consequence was then taken for a species.

The criteria for determining consequence were based on a range of factors including:

- Conservation status. Impact thresholds for consequence were smaller for critically endangered species than for endangered species, and smaller for endangered species than for vulnerable species
- If the species is considered to be an SAII entity under the BCAR process or is endemic (>90 per cent of records in the subregion) to the Cumberland subregion. Species that met either of these criteria were treated under the consequence thresholds for critically endangered species even if they had a lower conservation status
- The application of both population impact thresholds and potential habitat impact thresholds. It should be noted that like all threshold approaches the numbers are arbitrary to a degree. However, the thresholds are considered to be appropriate because they:
    - Reflect the nature of the baseline data. In particular the potential habitat mapping which has been generated across the Strategic Assessment Area is precautionary in many cases and over-maps habitat
    - Are structured around conservation status
    - Reflect the expert view of the assessment team about the level of risk to species

The consequence definitions for direct impacts due to impacts to populations and/or potential habitat are set out in:

- Table 29-4 – habitat for vulnerable species
- Table 29-5 – habitat for endangered species
- Table 29-6 – habitat for critically endangered, SAII, and/or endemic species
- Table 29-7 - populations

Table 29-4: Consequence definitions for direct impacts to potential habitat for vulnerable species

Potential habitat thresholds	Confidence that species occurs in impact area		
	High	Moderate	Low
Loss of >15% of mapped potential habitat	Extreme	Extreme	Minor
Loss of 10-15% of mapped potential habitat	Extreme	Major	Minor
Loss of 6-10% of mapped potential habitat	Major	Moderate	Negligible
Loss of 2-6% of mapped potential habitat	Moderate	Minor	Negligible
Loss of <2% of mapped potential habitat	Minor	Negligible	Negligible

Table 29-5: Consequence definitions for direct impacts to potential habitat for endangered species

Potential habitat thresholds	Confidence that species occurs in impact area		
	High	Moderate	Low
Loss of >10% of mapped potential habitat	Extreme	Extreme	Minor
Loss of 7-10% of mapped potential habitat	Extreme	Major	Minor
Loss of 3-7% of mapped potential habitat	Major	Moderate	Negligible
Loss of 1-3% of mapped potential habitat	Moderate	Minor	Negligible
Loss of <1% of mapped potential habitat	Minor	Negligible	Negligible

Table 29-6: Consequence definitions for direct impacts to potential habitat for critically endangered, SAII* and/or endemic species**

Potential habitat thresholds	Confidence that species occurs in impact area		
	High	Moderate	Low
Loss of >5% of mapped potential habitat	Extreme	Extreme	Minor
Loss of 2-5% of mapped potential habitat	Extreme	Major	Minor
Loss of 1-2% of mapped potential habitat	Major	Moderate	Negligible
Loss of 0.5-1% of mapped potential habitat	Moderate	Minor	Negligible
Loss of <0.5% of mapped potential habitat	Minor	Negligible	Negligible

* SAII = species that are potentially subject to Serious and Irreversible Impacts as identified through the BCAR process

** Endemic = species that are considered endemic to Cumberland subregion because more than 90 per cent of records of the species occur within the subregion

Table 29-7: Consequence definitions for direct impacts to populations

Consequence	TYPE OF IMPACT	MEASURE BY CONSERVATION STATUS		
		Vulnerable	Endangered	Critically endangered or SAII* or endemic**
Extreme	• Impacts to known population, OR	• Loss of 2 or more important populations	• Loss of 2 or more populations	• Loss of 1 or more populations
	• Impacts to population at edge of occurrence	• Loss of 1 important population at edge of occurrence	• Loss of 1 population at edge of occurrence	• Loss of records within a population at the edge of occurrence
Major	• Impacts to known population, OR	• Loss of 1 important population	• Loss of 1 population	• Loss of records within a population
	• Impacts to population at edge of occurrence	• Loss of records within an important population at the edge of occurrence	• Loss of records within a population at the edge of occurrence	• N/A
Moderate	• Impacts to known population, OR	• Loss of records within an important population, or the loss of a non-important population	• Loss of records within a population	• N/A
	• Impacts to population at edge of occurrence	• N/A	• N/A	• N/A
Minor	• Impacts to known population, OR	• Loss of records within a non-important population	• N/A	• N/A
	• Impacts to population at edge of occurrence	• N/A	• N/A	• N/A
Negligible	• Impacts to known population, OR	• N/A	• N/A	• N/A
	• Impacts to population at edge of occurrence	• N/A	• N/A	• N/A

* SAII = species that are potentially subject to Serious and Irreversible Impacts as identified through the BCAR process

** Endemic = species that are considered endemic to Cumberland subregion because more than 90 per cent of records of the species occur within the subregion

29.3.5 LIKELIHOOD AND CONSEQUENCE DEFINITIONS FOR FRAGMENTATION IMPACTS

LIKELIHOOD

Table 29-8 sets out a matrix for determining the likelihood that a threatened flora species will be impacted by fragmentation. The two axes of the matrix are:

- Barrier likelihood which represents a judgement about how likely a particular development will disrupt connectivity for a species. Table 29-9 provides examples of different barrier likelihoods
- Fragmentation type which sets out how a species may be impacted. Table 29-10 provides criteria for fragmentation types

Table 29-8: Likelihood definitions for fragmentation

	FRAGMENTATION TYPE*			
BARRIER LIKELIHOOD (See Table 29-9)	**Certain impact within population**	**Likely impact within population OR certain impact between populations**	**Possible impact between populations OR likely impact to habitat connected to a population**	**Impact to mapped habitat only**
Certain barrier	Almost certain	Almost certain	Likely	Possible
Likely barrier	Almost certain	Likely	Possible	Possible
Possible barrier	Likely	Likely	Possible	Unlikely
Unlikely barrier	Possible	Possible	Unlikely	Unlikely

* See Table 29-10

Table 29-9: Examples of barrier likelihood

Barrier likelihood	Examples
Certain barrier	• If a species is thought to be unable to cross barriers >100 m, a barrier of 120 m or more is inconsistent with dispersal requirements • If a species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with little to no vegetation (such as high density urban and/or commercial areas) are inconsistent with dispersal requirements • If a species is highly susceptible to being impacted by major roads with high traffic density (either through high roadkill rates, through aversion to noise and light, or through aversion to crossing open spaces) a major road is inconsistent with dispersal requirements
Likely barrier	• If a species is thought to be unable to cross barriers >100 m, a 100-120 m barrier is likely to be inconsistent with dispersal requirements • If a species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with sparse vegetation (such as low to moderate density urban areas with gardens) are likely to be inconsistent with dispersal requirements • If a species is thought to be susceptible to being impacted by major roads with high traffic density (either through moderate roadkill rates, through moderate aversion to noise and light, or through moderate aversion to crossing open spaces) a major road is likely to be inconsistent with dispersal requirements
Possible barrier	• If a species is thought to be unable to cross barriers >100 m, an 80-100 m barrier may be inconsistent with dispersal requirements • If a species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with sparse vegetation (such as rural residential areas and agricultural areas) may be inconsistent with dispersal requirements

Barrier likelihood	Examples
	• If a species is thought to have potential to be impacted by major roads with high traffic density (either through possible roadkill occurrences, possible aversion to noise and light, or through possible aversion to crossing open spaces), a major road may be inconsistent with dispersal requirements
Unlikely barrier	• If a species is thought to be unable to cross barriers >100 m, barrier of <80 m is unlikely to be inconsistent with dispersal requirements • If a species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with moderate vegetation density (such as parks, nature reserves and vegetated areas) are unlikely to be inconsistent with dispersal requirements • If a species is not known to be impacted by major roads with high traffic density (the species is not known to be susceptible to roadkill, noise or light aversion, or aversion to open spaces), then a major road is unlikely to be inconsistent with dispersal requirements

Table 29-10: Criteria for fragmentation types

Fragmentation type	Criteria
Certain impact within population	• Barrier is placed between records of a single population, with high confidence in the accuracy of the records
Likely impact within population **OR** **Certain impact between populations**	• Barrier is placed between records of a single population, with some uncertainty in the accuracy of the records OR • Barrier is placed in mapped potential habitat between records of two or more different populations, with high confidence in the accuracy of the records
Possible impact between populations **OR** **Likely impact to habitat connected to a population**	• Barrier is placed in mapped potential habitat between records of two or more different populations, with some uncertainty in the accuracy of the records OR • Barrier is placed in mapped potential habitat, where the mapped habitat is in the vicinity of, or connected to, only one known population of the species
Impact to mapped habitat only	• Barrier is placed in mapped potential habitat, where the mapped habitat is not connected to any known populations of the species

CONSEQUENCES

Consequence was determined by considering fragmentation type and applying different criteria depending on the conservation status of the species.

Table 29-11: Consequence definitions for fragmentation by conservation status

Consequence	Fragmentation type	Criteria for vulnerable	Criteria for endangered	Criteria for critically endangered or SAII* or endemic**
Extreme	Internal fragmentation	• Internal fragmentation of two or more important populations, OR • Internal fragmentation of an important population at edge of occurrence	• Internal fragmentation of two or more populations, OR • Internal fragmentation of a population at edge of occurrence	• Internal fragmentation of one population
	Fragmentation between populations	• Fragmentation between populations, which impacts an important population at the edge of occurrence	• Fragmentation between populations, which impacts a population at the edge of occurrence	• Fragmentation between populations, which impacts a population at the edge of occurrence, OR • Fragmentation between populations, which impacts two or more populations which are not at the edge of occurrence
	Fragmentation between a population and potential habitat	• N/A	• N/A	• N/A
	Fragmentation of potential habitat	• N/A	• N/A	• N/A
Major	Internal fragmentation	• Internal fragmentation of one important population	• Internal fragmentation of one population	• N/A
	Fragmentation between populations	• Fragmentation between populations, which impacts two or more important populations which are not at the edge of occurrence	• Fragmentation between populations, which impacts two or more populations which are not at the edge of occurrence	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one important population, where the population is separated from a large area of connected mapped potential habitat	• Fragmentation of one population, where the population is separated from a large area of connected mapped potential habitat, OR	• Fragmentation of one population, where the population is separated from a large area of connected mapped potential habitat, OR

Consequence	Fragmentation type	Criteria for vulnerable	Criteria for endangered	Criteria for critically endangered or SAII* or endemic**
			• Fragmentation of two or more populations, where each population is connected to either a moderate or small area of connected mapped potential habitat	• Fragmentation of two or more populations, where each population is connected to either a moderate or small area of connected mapped potential habitat
	Fragmentation of potential habitat	• N/A	• N/A	• Fragmentation of a large area of potential habitat with no associated records
Moderate	Internal fragmentation	• Internal fragmentation of two or more non-important populations	• N/A	• N/A
	Fragmentation between populations	• Fragmentation between populations, which impacts one important population and one or more non-important populations not at the edge of occurrence	• N/A	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one important population, where the population is separated from a moderate area of connected mapped potential habitat	• Fragmentation of one population, where the population is separated from a moderate area of connected mapped potential habitat	• Fragmentation of one population, where the population is separated from a moderate area of connected mapped potential habitat
	Fragmentation of potential habitat	• Fragmentation of a large area of potential habitat with no associated records	• Fragmentation of a large area of potential habitat with no associated records	• Fragmentation of a moderate area of potential habitat with no associated records
Minor	Internal fragmentation	• Internal fragmentation of one non-important populations	• N/A	• N/A
	Fragmentation between populations	• Fragmentation between populations, which impacts two or more non-important populations not at the edge of occurrence	• N/A	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one important population, where the population is separated from a small area of	• Fragmentation of one or more populations, where the population is	• Fragmentation of one population, where the population is separated

Consequence	Fragmentation type	Criteria for vulnerable	Criteria for endangered	Criteria for critically endangered or SAII* or endemic**
		connected mapped potential habitat, OR • Fragmentation of one or more non-important population, where the population is separated from a large area of connected mapped potential habitat	separated from a small area of connected mapped potential habitat	from a small area of connected mapped potential habitat
	Fragmentation of potential habitat	• Fragmentation of a moderate area of potential habitat with no associated records	• Fragmentation of a moderate area of potential habitat with no associated records	• Fragmentation of a small area of potential habitat with no associated records
Negligible	Internal fragmentation	• N/A	• N/A	• N/A
	Fragmentation between populations	• N/A	• N/A	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one or more non-important populations, where the population is separated from a moderate or small area of connected mapped potential habitat	• N/A	• N/A
	Fragmentation of potential habitat	• Fragmentation of a small area of potential habitat with no associated records, OR • Fragmentation of mapped habitat, where impacted habitat occurs outside of the known range of the species	• Fragmentation of a small area of potential habitat with no associated records, OR • Fragmentation of mapped habitat, where impacted habitat occurs outside of the known range of the species	• Fragmentation of mapped habitat, where impacted habitat occurs outside of the known range of the species

* SAII = species that are potentially subject to Serious and Irreversible Impacts as identified through the BCAR process

** Endemic = species that are considered endemic to Cumberland subregion because more than 90 per cent of records of the species occur within the subregion

29.4 MEETING AUSTRALIA'S INTERNATIONAL OBLIGATIONS REGARDING THREATENED SPECIES

To satisfy approval requirements under the EPBC Act (specifically, requirements associated with section 146B and 146K of the Act), the Plan must not be inconsistent with Australia's obligations under:

- The Biodiversity Convention
- The Convention of the Conservation of Nature in the South Pacific (Apia Convention)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This section provides an overview of how the Plan is not inconsistent with these obligations. The remainder of Chapter 29 assesses the relevant threatened flora species in detail.

29.4.1 BIODIVERSITY CONVENTION

The objectives of the Biodiversity Convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the use of genetic resources.

The conservation of biological diversity is a key priority of the Plan, and is achieved through commitments to avoid and minimise impacts (Commitments 2, 3, and 4), commitments to mitigate indirect impacts (Commitments 5, 6, and 7), commitments to conserve flora, fauna and habitat (Commitments 8, 9, 10, 11, 12, 13, and 14), commitments to manage landscape threats (Commitments 15, 16, 17, 18, and 19), and commitments to build knowledge and capacity in the community to bolster conservation efforts (Commitments 20, 21, 22, and 23).

Overall, the Plan is not considered to be inconsistent with the Biodiversity Convention.

29.4.2 APIA CONVENTION

The Apia Convention encourages the creation of protected areas which, together with existing protected areas, will safeguard representative samples of natural ecosystems (including endangered species), as well as superlative scenery, striking geological formations, and regions and objects of aesthetic interest or historic, cultural, or scientific value.

The Apia Convention was suspended with effect from 13 September 2006. While this Convention has been suspended, Australia's obligations under the Convention have been taken into consideration.

The Plan will lead to the creation of multiple new protected areas within the Strategic Assessment Area, which will contribute to the protection of a range of MNES (Commitments 8, 9, 10, 11, 12, 13, and 14). A specific example of this is the creation of the Georges River Koala Reserve (Commitment 10), which will safeguard the iconic Koala population of Southern Sydney. Further, the protection of important biodiversity areas within the Strategic Assessment Area will be increased, through the implementation of new mechanisms such as the SEPP (Strategic Conservation Planning) and Ministerial Direction.

The Plan is not inconsistent with the Convention which has the general aims of conservation of biodiversity.

29.4.3 CITES

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The Plan is not inconsistent with CITES as the actions under the Plan do not involve international trade.

SPECIES AT HIGH RISK OF DIRECT IMPACTS

29.5 *PIMELEA SPICATA* (SPIKED RICE-FLOWER)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	A slender, low growing shrub with narrow elliptical leaves, pink tinged white flowers, and green fruit. It grows up to 50 cm tall. (DoEE, 2018f)
ECOLOGY	Flowers and fruits throughout the year, although flowering is more common in summer, particularly following rainfall. The species is known to be pollinated by native bees and may also be capable of self-pollination (James, 2018a). While reproduction is the primary means of recruitment, established plants can re-sprout from a taproot after defoliation due to disturbance (James, 2018a). It is estimated that the species requires over three years to develop a sufficient tap root to enable this process to occur. Regrowing from a taproot significantly depletes energy reserves and reduces the plant's capacity to re-sprout from subsequent disturbances. The species maintains a long-lived, persistent soil seed bank. Sites which have been undisturbed for a long period of time, or sites that are subject to a high level of weed infestation, may exhibit strong recruitment following a disturbance event. Optimum disturbance frequencies are unknown for this species. It is estimated that disturbance should not occur at less than 10-year intervals. Seed dispersal is highly localised (within 30 cm of adult plants). The life span of the species could be 20-30 years or more. (DoEE, 2018f; TSSC, 2016g)
DISTRIBUTION AND HABITAT	The species occurs in the Sydney Basin IBRA: in the Cumberland Plain in the west, and Illawarra region on the coast, south of Sydney. Current known distribution in the Cumberland Plain extends from Marayong and Prospect Reservoir south to Narellan Vale and Douglas Park. In Illawarra it exists from Lansdowne past Shellharbour to northern Kiama. Habitat is associated with: • Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest • Western Sydney Dry Rainforest and Moist Woodland on Shale Woodland

	In both vegetation types it occurs on well-structured clay soils derived from Wianamatta shales, in areas of undulating topography. As of 2005, the species had a known area of occupancy of 17 ha. In 2006, 80 per cent of populations had a small area of occupancy of less than 0.5 ha. (DEC, 2005a; TSSC, 2016g)
POPULATIONS	In 2006 the total population was 4,300 individual plants across 30 known populations. Of these populations, 25 were on the Cumberland Plain. They varied in size from a few individuals to more than 500 plants. Over half were populations of less than 50 individuals. (DEC, 2005a; DoEE, 2018f) Since 2006, the species has been shown to respond well to recovery actions, leading to a significant increase in abundance and area of occupancy of some populations, with examples numbering in the thousands (TSSC, 2016g). Assessment of all BioNet records of the species indicates that over 90 per cent of known records occur within the Cumberland subregion. Therefore, for the purposes of this assessment, *P. spicata* is considered to be an endemic species to the region.
SOS SITES	The following SOS sites for the species have been identified: • Prospect Nature Reserve • Narellan
RELEVANT PLANS AND POLICIES	Conservation Advice for *Pimelea spicata* (Spiked Rice-Flower) (TSSC, 2016g) *Pimelea spicata R. Br.* Recovery Plan (DEC, 2005a) Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=20834

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		Yes	Yes	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	Yes, (James, 2018a) and (James, 2018b). Available at Supporting Document C				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Expert report and expert report polygons: Overview of available information Two expert reports have been produced which separately map habitat polygons within GPEC and WSA, and in GMAC and Wilton. Both reports were authored by the same expert, T. James (James, 2018a, 2018b).				

As part of the expert report preparation process, James produced:

- Expert reports which outline:
  - The ecological characteristics of *P. spicata*
  - An overview of available data for *P. spicata* within the region
  - The method used to map habitat polygons in each nominated area
  - An overview of the habitat mapped in each nominated area
- Expert report polygons, which are shapefiles which indicate the areas of potential habitat of *P. spicata* in each of the nominated areas. Note that the expert report polygons were provided to the consulting team in association with the expert reports to enable habitat analysis

The expert report polygons provided by James have been used directly by the consulting team to conduct assessments of *P. spicata*. These uses include:

- Calculating the amount of habitat available in each nominated area
- Calculating the amount of habitat that will be impacted by urban capable and/or transport development
- Calculating the amount of habitat within avoided and/or excluded land

It is recognised that *P. spicata* is a cryptic species, which is often difficult to detect when not flowering, and may not be visible above ground during dry periods where it may persist in the soil as rootstock and/or seeds. The species flowers in response to rainfall, and therefore survey following rain is recommended. While surveys were undertaken by the consulting team for the strategic assessment during 2017-18, and then again in 2019 (during which the species was not found), it is noted that field conditions at the time of survey were hot and dry, and therefore the surveys undertaken by the consulting team are not considered to constitute proof of absence for the species. Subsequently, survey results were not used to modify the habitat polygons produced in association with the expert report.

Overview of discrepancies between expert reports and expert report polygons

It is noted that the expert report polygons used by the consulting team match the maps of potential habitat included in the two expert reports (Figures 4, 5, 5a, 6, 6a, 7, 8, 9, 10, and 12 in the expert report for GMAC and Wilton, and Figures 5 and 6 in the expert report for GPEC and WSA (James, 2018a, 2018b)).

However, for all nominated areas, there are some details within the written expert reports which are at odds with the expert report polygons provided by James. Differences include:

- Differences in the total area of habitat mapped within each nominated area
- Differences in the identified PCTs which have been mapped to contain habitat for *P. spicata*
- Differences in the vegetation condition states of vegetation used to identify habitat for *P. spicata*

Unfortunately, the expert author is unavailable to provide comment or clarification on the discrepancies between the written reports and the expert report polygons. The consulting team have therefore based this assessment upon the data contained within the expert report polygons, where discrepancies with the written reports exist.

Habitat mapped in GPEC and WSA

In the written report, James (James, 2018b) notes that *P. spicata* is known to occur in the following vegetation communities: PCT 849, 850, 806, 807, 830, 835, 1395. James (James, 2018b) then identifies habitat mapped for *P. spicata* within the following vegetation communities: PCT 850, 849, 835, 724, 1395 (as per Table 11 of the expert report). It is noted that the expert report polygons map habitat for *P. spicata* within the following PCTs: 724, 725, 781, 835, 849, 850, 1395, and 1800, in addition to urban native/exotic vegetation with no associated PCT number.

James (James, 2018b) further states that, as *P. spicata* is tolerant of disturbance and may re-appear in disturbed habitat, the following condition states were considered when determining suitable habitat: intact, thinned, scattered trees, derived shrubland and grassland. It is noted that the expert report polygons for *P. spicata* map habitat in vegetation of the following conditions: intact, thinned, scattered trees, derived native grassland, non-offsettable grassland, and urban native/exotic.

	The characteristics of the physical environment were also used to identify suitable habitat, where suitable sites include slopes in undulating low hilly terrain on Wianamatta Group shales, on moist soils, often on protected south or east facing slopes (James, 2018b). It is recognised that the expert report identifies a total of 2,168 ha of habitat in GPEC and 564 ha of habitat in WSA (James, 2018b), whilst the associated expert report polygons indicate a total of 2,164 ha of habitat in GPEC and 512 ha of habitat in WSA. Habitat mapped in GMAC and Wilton In the written report for GMAC and Wilton, James (James, 2018a) notes that *P. spicata* is known to occur in the following vegetation communities: PCT 849, 850, 806, 807, 830, 1395. James (James, 2018a) then identifies habitat mapped for *P. spicata* within the following vegetation communities: PCT 850, 849, 608, 609, 830, 835, 1395 (as per Table 14 of the expert report). It is noted that the expert report polygons map habitat for *P. spicata* within the following PCTs: 830, 835, 849, 850, 1181, 1395, in addition to urban native/exotic vegetation with no associated PCT number. James (James, 2018a) further states that, as *P. spicata* is tolerant of disturbance and may re-appear in disturbed habitat, the following condition states were considered when determining suitable habitat: intact, thinned, scattered trees, derived shrubland and grassland. It is noted that the expert report polygons for *P. spicata* map habitat in vegetation of the following conditions: intact, thinned, scattered trees, derived native grassland, non-offsettable grassland, and urban native/exotic. The characteristics of the physical environment were also used to identify suitable habitat, where suitable sites include slopes in undulating low hilly terrain on Wianamatta Group shales, on moist soils, often on protected south or east facing slopes (James, 2018a). It is recognised that the expert report identifies a total of 542 ha of habitat in GMAC and 405 ha of habitat in Wilton (James, 2018a), whilst the associated expert report polygons indicate a total of 475 ha of habitat in GMAC and 664 ha of habitat in Wilton. Characteristics of *P. spicata* occurrence with respect to interpretation of mapped habitat The ideal habitat of *P. spicata* is intact woodland with open, grassy understorey. However, it is recognised that *P. spicata* may persist in disturbed areas (often surviving as a long-lived seedbank), and may re-occur after disturbance to that environment has ceased and vegetation is permitted to regenerate (e.g. after mowing or grazing of a site ceases) (James, 2018a, 2018b) Habitat that has been mapped within the four nominated areas occurs across a variety of vegetation condition states, from intact vegetation through to non-offsettable grasslands. While *P. spicata* has the potential to be present within vegetation of very low condition, such as heavily grazed paddocks, it is recognised that the species is less likely to be present in these environments than in higher condition, more intact vegetation communities with fewer threatening processes such as livestock grazing. While it is suitable to map low condition vegetation as potential habitat for *P. spicata* (as the species does have a real potential to be present in these areas), it is recognised that the quality of habitat for the species in these areas is likely to be significantly degraded and therefore, the likelihood that the species persists in these environments is low. The habitat mapping for *P. spicata* is therefore considered to be precautionary, and it is considered unlikely that *P. spicata*, if present, would be present in high densities in degraded areas of vegetation.
	OUTSIDE THE NOMINATED AREAS
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. The report for this process (Supporting Document F) notes that several of the SDM layers are expected to over-predict the likely areas where mapped flora species occur, and therefore resultant habitat maps may be precautionary. No targeted surveys as part of this project were undertaken outside the nominated areas.
POPULATION MAPPING	**RECORD SELECTION**
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.

	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *P. spicata* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *P. spicata* were downloaded in May 2021.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Populations of the species were defined to include clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	Populations of *P. spicata* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. All populations of *P. spicata* are considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-20 for a map of records and habitat across the Strategic Assessment Area.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-13 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *P. spicata* in the Strategic Assessment Area.
	Records
	The majority of records for the species occur in the Blacktown, Prospect, Bankstown and Narellan districts. Populations within the vicinity of Campbelltown and Wollondilly LGAs are close to the southern limit of the species' range (James, 2018a).
	Within the Strategic Assessment Area, a total of 27 important populations have been mapped. Five populations are either wholly or partly located in existing conservation reserves. The majority of these tend to be small and scattered. However, population 53 contains 771 records, and is referred to in the Conservation Advice as a large population containing around 6,000 plants. It occurs outside of the nominated areas within the Camden Golf Club in the suburb of Narellan. Further, population 31 is located within excluded land in GPEC, and contains 375 records. The vast majority of these records are newly identified (recorded in mid-2020) and so are not referred to the Conservation Advice. None of the records for population 375 identify the number of individuals associated with each record, so it is assumed that the population is at least 375 individuals yet could be larger than this.
	Within the nominated areas the following populations have been recorded:
	• GPEC:
	  ○ Population 31 – 375 records within Cranebrook surrounded by existing urban development. The population does not occur within urban capable land
	  ○ Population 34 – Two records near Ropes Creek in Wianamatta Regional Park. The population does not occur within urban capable land
	  ○ Population 534 – One record adjacent to the Western Motorway (M4) in Orchard Hills. The population does not occur within the transport corridor footprint

- WSA – no records
- GMAC:
  - Population 51 – One record within roadside vegetation near to an existing industrial area. The population does not occur within urban capable land
  - Population 532 – One record to the east of the Hume Motorway and south of Glenlee Road within urban capable land of the nominated area
  - Population 533 – Two records near the eastern boundary of the nominated area and Strategic Assessment Area. The population occurs in land avoided for biodiversity
- Wilton – no records

Potential habitat

The baseline mapping for this assessment has mapped approximately 34,815.5 ha of known and potential habitat within the Strategic Assessment Area. Habitat is present across the majority of the central and eastern areas of the Strategic Assessment Area and occurs as follows:

- In the north, habitat is present in the locality of Freemans Reach and Scheyville, with large areas of habitat also present within the Londonderry locality
- Habitat is scattered throughout GPEC and WSA, including (but not confined to) localities such as Cranebrook, Mount Druitt, Glenmore Park, Luddenham, and Kemps Creek
- Large, connected areas of habitat occur to the east and south of the WSA, spanning from Wetherill Park, down through Kemps Creek and Leppington, to Camden in the south and to Theresa Park in the west
- Further areas of scattered habitat occur to the south of Theresa Park and Camden, in localities such as Razorback and Wilton

It is noted that mapped habitat is present within all nominated areas for this species.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.5.1 NOMINATED AREAS

RECORDS

A total of seven known populations of the species occurs within the nominated areas (three within GMAC and four within GPEC). Of these:

- Five populations (31, 34, 534, 51, and 623) occur entirely within excluded lands (four in GPEC and one in GMAC)
- One population (533) occurs entirely within land avoided for biodiversity purposes (in GMAC)
- One population (532) occurs within urban capable land (GMAC)

It is noted that the Plan includes a commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure on non-certified land to known populations of *P. spicata*.

POTENTIAL HABITAT

The baseline mapping for this assessment has mapped 1,444.2 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 573.8 ha (39.7 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 498.9 ha was avoided for biodiversity purposes
- 74.9 ha was avoided for other purposes

Of the land that was avoided for biodiversity purposes, 417.1 ha is of good to reasonable habitat condition (vegetation condition classes include intact, scattered trees, thinned and derived native grassland) and 81.8 ha is habitat in highly

degraded condition (vegetation condition classes include non-offsettable grasslands and urban native/exotic vegetation). The vast majority (84 per cent) of avoidance of biodiversity purposes therefore includes areas of higher quality habitat for the species.

A breakdown of avoidance of potential habitat across each nominated area is provided in Table 29-14.

It is important to note that the avoidance calculations in Table 29-14, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-14 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.5.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

It is noted that there is a total of 380.5 ha of potential habitat for *P. spicata* within tunnel footprints within the transport corridors, with large numbers of records in adjacent areas suggesting it is likely that the species does occur in the tunnel footprint. The Plan includes a commitment (Commitment 4.2) to avoid and minimise impacts to *P. spicata* as a result of tunnel construction activities within or adjacent to the footprints of the Outer Sydney Orbital (OSO) and Metro Rail Future Extension. This commitment will ensure that appropriate avoidance of impacts to *P. spicata* will occur during the development of the transport corridors in known habitat for the species.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.5.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to direct impacts to a known population and a loss of potential habitat. A summary of these impacts is provided in Table 29-15.

IMPACTS TO KNOWN POPULATION

Population 532 is an important population which occurs within the urban capable lands in GMAC. It consists of one record dated from October 2018, with 160 plants noted in the species' record. The record is located within a small (approximately 3 ha) patch of vegetation mapped as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest in a thinned condition. This vegetation patch is isolated from other vegetation and occurs in a significantly cleared landscape.

Given that one individual plant may consist of up to 50 stems (TSSC, 2016g), the exact number of individuals within the population is unclear. However, the population is likely to be moderate in size relative to other known populations, noting that a limited number of known populations contain thousands of individuals, while the majority contain 50 or less (TSSC, 2016g).

It is noted that the population is not located on the edge of the species' extent of occurrence and the small, degraded, and isolated condition of the habitat potentially limits the long-term viability of the population. However, as described in the species conservation advice, any habitat where populations are known to occur is considered habitat critical to the survival of the species and all populations are considered to be important populations that are necessary for the species' survival and recovery.

As the population occurs on the very edge of urban capable land, it is considered that at least part of this population would be present within the APZ of this locality. Appendix E of the Plan contains the following measure: "Undertake fire hazard management within the Asset Protection Zone at this location in a manner which protects existing *Pimelea spicata* individuals and which is sympathetic to the ongoing recruitment of new individuals of this species". The location of the measure is specifically identified as the location of population 532 within GMAC. The measure is associated with Commitment 5 of the Plan, which relates to mitigating indirect impacts from development on urban capable land. The implementation mechanisms identified for this measure include the Mitigation Measure Guideline and Cumberland Plain Conservation Plan Guidelines for Infrastructure Development. This measure will contribute to the protection of population 532 through minimising the risk of disturbance through APZ management activities.

However, while the above measure will reduce impacts to population 532, it is still possible that some individuals within the population may be lost. This may occur if individuals at that site are spread over a wider area which extends outside of the APZ (note that the record of this population identifies 160 plants yet does not provide information regarding how widely they are spread). This may also occur through active management of the site as an APZ, as it is acknowledged that the above measure will only reduce the risk of impacts yet will not eliminate the possibility of accidental impacts associated with regular site management.

Therefore, it is considered that the Plan is likely to result in the loss of individuals within population 532 yet is unlikely to result in the loss of the entire population.

LOSS OF POTENTIAL HABITAT

974 ha of potential habitat for the species will be impacted. This is 2.8 per cent of mapped potential habitat across the Strategic Assessment Area. The loss of potential habitat occurs across all of the nominated areas and transport outside the nominated areas.

It is recognised that, of the 974 ha of potential habitat impacted, 456.7 ha (46.9 per cent of impacted vegetation) is in a highly degraded state (being classed as either non-offsettable grassland, or urban native/exotic vegetation). As outlined in the habitat mapping approach overview above, while there is a potential that *P. spicata* may persist in areas of degraded habitat, it is considered highly unlikely that the species would be present in high densities in such areas. Therefore, the habitat mapping for *P. spicata* within impacted areas is considered to be precautionary.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of direct impacts to an important population is considered to be high. This risk ranking is triggered for impacts to species' records, as follows:

- The likelihood of actual impacts occurring to the species has been categorised as almost certain. There will be direct impacts to a known population of the species, with high confidence in the accuracy of the records
- The consequence of any impacts to the species (if they did occur) has been categorised as major. There will be a loss of records within a population (endemic) which is not at the edge of the species' occurrence

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be medium. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as possible. While there will be direct impacts to potential habitat, there is moderate confidence that the species will occur in the impact area (it is noted that habitat mapping for this species includes significant areas (456.7 ha) of degraded habitat, where there is a lower likelihood of species persistence, and therefore the habitat mapping is considered precautionary)
- The consequence of impacts to the species (if they did occur) has been categorised as major. There will be a loss of 2.8 per cent of mapped potential habitat (endemic species), with moderate confidence that the species occurs in the impact area

29.5.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The Plan will lead to fragmentation of potential habitat in the following locations:

- Fragmentation of a moderate area of mapped habitat associated with records of the species at Cobbitty due to the development of the OSO
- Fragmentation of a small area of mapped habitat associated with records of the species within GPEC due to the development of the OSO within Wianamatta Regional Park

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of fragmentation is considered to be low. This is because:

- The likelihood of fragmentation has been categorised as possible. This is because:
  - The likelihood that development presents a barrier to dispersal of the species is likely. While seed dispersal of *P. spicata* is highly localised (within 30 cm of adult plants), it is recognised that the species is pollinated by insects and therefore genetic connectivity has potential to be maintained if pollinator movement is not obstructed. While detailed planning for development within the transport corridors has not yet been completed, it is thought to be likely that the OSO will constitute a likely barrier to seed dispersal for the species
  - The type of fragmentation (as defined in the risk assessment approach in Section 29.3) is impact to habitat connected to a population. This is because there are known records located on mapped potential habitat which is fragmented by the OSO development
- The consequence of fragmentation has been categorised as moderate. This is because the area to be fragmented is connected to a known population of the species and is of moderate size

29.5.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the species, the Plan includes a commitment to secure 3 offset locations for the species as part of the conservation program (Commitment 9). This will provide a substantial addition to the level of protection of the species within the Strategic Assessment Area where currently only five populations (out of a total of 27) occur in protected areas. In situ protection of *P. spicata* populations is a fundamental component of the species' recovery plan.

In addition to this, a total of 109.2 ha of potential habitat for *P. spicata* is contained within three of the Plan's proposed reserves. These include:

- 91.3 ha of mapped habitat in the Georges River Koala Reserve
- 17 ha within the Confluence Reserve investigation area
- 0.9 ha of mapped habitat in the Gulguer Reserve investigation area

Further, an important population of *P. spicata* is located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.5.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (TSSC, 2016g) and Recovery Plan (DEC, 2005a) (and other key documents) for *P. spicata* identify a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in key species documents) are considered relevant to implementation of the Plan:

- Weed invasion
- Inappropriate fire regimes
- Hydrological disturbance such as increased urban run-off
- Illegal dumping of rubbish and garden waste
- High frequency land management (e.g. mowing and slashing, weed control including herbicide use)

Browsing by rabbits and intensive livestock grazing have also been identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. spicata* are discussed below for each identified indirect impact.

It is noted that the Plan includes a commitment for three offset locations for *P. spicata*. Further, a total of 109.2 ha of potential habitat for *P. spicata* is contained within three of the Plan's proposed reserves, and an important population of the species is located within the Georges River Koala Reserve. The establishment of known offset sites and conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

It is noted that population 31 is an important population with a substantial number of records within GPEC and is already surrounded by existing urban land. This population is therefore likely to already be subject to a range of threatening processes associated with existing development in the locality. Population 31 is not directly adjacent to development under the Plan. While this population may be at risk of existing threats, it is considered unlikely that implementation of the Plan would exacerbate these threats. Further, it is possible that the Plan's landscape-scale approach to managing threats within the Strategic Assessment Area (such as managing weeds) may benefit this population. Overall, the Plan is not considered to pose a risk of indirect impacts to population 31.

WEED INVASION

Weed invasion is identified as a potential threat to *P. spicata*. Weed species which form dense thickets or ground covers are recognised to pose a particular threat to the species. Weeds may out-compete and displace *P. spicata,* reducing reproductive success and re-sprouting potential of adults, and reducing the successful growth of seedlings. Key weed species which threaten *P. spicata* include African olive, lantana (*Lantana camara*), African lovegrass (*Eragrostis curvula*), Rhodes grass (*Chloris gayana*), Kikuyu grass (*Pennisetum clandestinum*), and bridal creeper (*Asparagus asparagoides*) (TSSC, 2016g).

These weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

Key risk areas are those that are easily accessible to the public and in close proximity to urban development and roads. Higher risk areas (where *P. spicata* is located in proximity to urban development, roads and publicly accessible land) are located as follows:

- Near Menangle Park, where population 532 occurs adjacent to urban capable development
- Near Twin Creeks, were population 40 occurs in proximity to urban capable development
- North of the Western Motorway, where population 534 occurs adjacent to urban capable development
- Within Wianamatta Regional Park, where population 34 occurs to the west of the OSO footprint

- Where potential habitat for the species is mapped adjacent to urban capable and transport development (which occurs in multiple scattered locations in each nominated area)

The Plan incorporates species-specific measures for the protection of *P. spicata*, which will contribute to the control of weeds within known and potential habitat for the species. Species-specific measures which are relevant to weed control include:

- Protecting three known offset locations for *P. spicata* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species
- A measure in Appendix E which relates to managing key threats to the species, including the spread of weeds, during tunnel construction and operation

The Plan further incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *P. spicata*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include managing the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *P. spicata* from the increased risk of weeds associated with development. This is because:

- Three known offset locations for *P. spicata* will be obtained (Commitment 9) and managed for conservation purposes, which will ensure long-term protection of known populations and habitat of this species
- The proposed Georges River Koala Reserve (Commitment 10) includes mapped potential habitat and a known population of *P. spicata.* Protection of this reserve and management for conservation purposes will contribute to long-term protection of known populations and habitat of *P. spicata*
- There is a specific measure in Appendix E for the impact of weeds to be managed with regards to the requirements of *P. spicata* in relation to the development of tunnels within major transport corridors
- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

These controls are consistent with a number of suggested management actions in the Conservation Advice, including (TSSC, 2016g):

- "Incorporate weed management/habitat restoration plans in site-specific management plans developed for all known spiked rice-flower populations, including surrounding buffer zones"

- "Implement relevant weed control measures according to site-specific weed management plans"

INAPPROPRIATE FIRE REGIMES

Altered fire regimes are identified as a potential threat to *P. spicata* (TSSC, 2016g). This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the mechanisms outlined above. It is noted *P. spicata* is threatened by both very frequent and very infrequent fire, as frequent fire prevents maturation and reproduction of individuals, whilst infrequent fire reduces the germination of seeds (TSSC, 2016g).

Key risk areas are those that are easily accessible to the public and in close proximity to urban development and roads. As outlined above, higher risk areas include populations 532, 40, 534, and 34, in addition to scattered areas of mapped potential habitat in each nominated area.

The Plan incorporates a species-specific measure to protect three known offset locations for *P. spicata* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species. This measure will contribute to the maintenance of appropriate fire regimes within species' habitat and provide for protection for the species.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. spicata* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Require asset protection zones (APZs) wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *P. spicata*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP (Strategic Conservation Planning) requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include ensuring measures to manage fire risk avoid and minimise impacts to biodiversity

The package of measures in the Plan is expected to adequately manage the risk to *P. spicata* from altered fire regimes as a result of development. This is because:

- Three known offset locations for *P. spicata* will be obtained (Commitment 9) and managed for conservation purposes, which will ensure long-term protection of known populations and habitat of this species
- The proposed Georges River Koala Reserve (Commitment 10) intercepts mapped potential habitat and a known population of *P. spicata.* Protection of this reserve and management for conservation purposes will contribute to long-term protection of known populations and habitat of *P. spicata*

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *P. spicata* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *P. spicata* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

These controls are consistent with a number of suggested management actions in the Conservation Advice, including (TSSC, 2016g):

- "Develop and implement a Fire Management Strategy for conservation of the based on research of the species' fire ecology and in consultation with the NSW Rural Fire Service and other relevant stakeholders with regards to fire control measures"
- "Physical damage to the habitat and individuals of the threatened species must be avoided during and after fire operations"

HYDROLOGICAL DISTURBANCE

Hydrological disturbance as a result of changed land use patterns has been identified as a potential threat to *P. spicata* (TSSC, 2016g). Key risk areas are those that are those which are in proximity to areas of development (such as urban and industrial areas and roads), which may experience altered runoff and hydrological patterns as a result of development. As outlined above, higher risk areas include populations 532, 40, 534 and 34, in addition to scattered areas of mapped potential habitat in each nominated area.

The Plan incorporates a range of measures to mitigate the risks associated with changes to hydrology for *P. spicata*. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to *P. spicata* from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to biodiversity values, including potential habitat for *P. spicata*
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to biodiversity values, including potential habitat for *P. spicata*

ILLEGAL DUMPING OF RUBBISH AND GARDEN WASTE

Habitat degradation through illegal dumping of rubbish and garden waste is identified as a threat to *P. spicata* (TSSC, 2016g). Development under the Plan may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

Populations on public land are considered most at risk from this impact. While illegal access to privately owned land may increase, the rate of increase is expected to be minor in the context of potential impacts to *P. spicata.* This risk will be managed in areas of public land that are managed for conservation. This will include all new conservation areas established by the Plan. However, the risk will remain and likely increase in areas of public land managed for other purposes.

The Plan incorporates a species-specific action (Action 8) under Commitment 5 to consult with relevant public land managers to minimise disturbance and impacts associated with land management to *P. spicata*, particularly with regards to mowing, slashing, and managing rubbish dumping. Appendix E of the Plan also includes a mitigation measure to "Consult with land managers of land containing known populations or habitat for [*P. spicata*] to mitigate indirect impacts from human disturbance during construction and operation of the development, including controlling public access... and managing rubbish dumping...". This mitigation measure applies to all four nominated areas and will be implemented via consultation with local councils and other public agencies. This measure in Appendix E is associated with Commitment 5.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for *P. spicata*. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the three offset locations to be obtained for *P. spicata* in association with Commitment 9, as well as *P. spicata* populations and mapped potential habitat within the Georges River Koala Reserve to be established under Commitment 10)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas. This commitment is consistent with a number of actions in the Conservation Advice around educating the community about *P. spicata*

These measures under the Plan are expected to adequately manage the threat posed by illegal dumping of rubbish and garden waste to *P. spicata.*

HIGH FREQUENCY LAND MANAGEMENT

High frequency land management (e.g. mowing and slashing and use of herbicides for weed control) has the potential to reduce the viability of populations and cause local extinctions. Although slashing and mowing activities have largely ceased in government reserves that are known to support the species, these are still considered to exist as a broader landscape risk in areas that are unknown to provide habitat. Indirect impacts from use of herbicides are also considered to be a current threat to the species (TSSC, 2016g). The Plan has the potential to exacerbate this risk in these areas that are close to new development.

The Plan incorporates a species-specific action (Action 8) under Commitment 5 to consult with relevant public land managers to minimise disturbance and impacts associated with land management to *P. spicata*, particularly with regards to mowing, slashing, and weed control activities.

Appendix E of the Plan also includes a mitigation measure to "Consult with land managers of land containing known populations or habitat for [*P. spicata*] to mitigate indirect impacts from human disturbance during construction and

operation of the development, including ...managing maintenance activities such as mowing and slashing...". This mitigation measure applies to all four nominated areas and will be implemented via consultation with local councils and other public agencies. This measure in Appendix E is associated with Commitment 5.

Implementation of these measures under the Plan is considered adequate to mitigate the threat of high frequency land management impacts to *P. spicata*.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.5.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

Records of *P. spicata* occur within GMAC and GPEC, and potential habitat for the species is mapped in all nominated areas. One population (population 533) occurs partially within avoided land within GMAC, between Appin Road and the Georges River near Wedderburn. This population consists of two recent records (dated from 2019) both of which occur within the proposed footprint for Stage 1 of the Koala Reserve. It is therefore likely that this site will be formally protected for conservation purposes in the future, subject to approval of the proposed layout of the Koala Reserve and implementation of the Reserve. Nonetheless, the Plan includes a number of measures to protect *P. spicata* from impacts associated with essential infrastructure, which are outlined below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design

- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect *P. spicata* from impacts from essential infrastructure. These include:

- Commitment 2.2, which specifically prioritises avoidance of impacts to *P. spicata* with regards to essential infrastructure
- A measure in the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, which requires that avoidance of impacts to *P. spicata* be prioritised

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *P. spicata* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.5.8 POTENTIAL IMPACTS FROM TUNNELS

There is a total of 380.5 ha of potential habitat for *P. spicata* within the footprints of the Metro Rail Future Extension and OSO tunnels. While there are no records of *P. spicata* within the tunnel footprints, it is likely that the species may occur within these areas due to known records of the species occurring in close proximity to the tunnels (such as population 53, which is a large population at Camden Golf Club, immediately adjacent to the tunnel footprint).

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

Further, species-specific measures for *P. spicata* are included as follows:

- Commitment 4.2 requires TfNSW to specifically avoid and minimise direct impacts to known populations and habitat of *P. spicata* within and adjacent to the OSO and Metro Rail Future Extension tunnel sections
- A measure in Appendix E of the Plan to manage key threats to the species. This measure applies to the Metro Rail Future Extension and will be implemented via the State Significant Infrastructure assessment and approval process. Key threats which will be managed include:
    - Hydrological disturbance
    - Spread of weeds
    - Spread of infection/disease
    - Soil erosion and sedimentation
    - Ground settling or subsidence

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.5.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (TSSC, 2016g) and Recovery Plan (DEC, 2005a) identify the following key issues that are likely to have the greatest influence on the long-term viability of *P. spicata* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Illegal dumping of rubbish and garden waste
  - Weed invasion and competition
  - High-frequency land-use/management activities
  - Inappropriate fire regimes
  - Hydrological disturbance

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to:

- Direct impacts to a known population (population 532) of the species
- Loss of approximately 974 ha of mapped habitat within the nominated areas and transport corridors
- Potential fragmentation of habitat in two locations

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is high.

The likelihood of potential impacts to population 532 within the urban capable lands in GMAC is the key driver for this risk rating. There is a high level of confidence that the population is extant given the locational accuracy, reputable observer and date of observation attached to the record. The population is of a moderate size comprising up to 160 plants. It is likely that this population is important to the ongoing viability and recovery of the species, in line with the species conservation advice that identifies:

- Any habitat where populations are known to occur as habitat critical to the survival of the species and
- All known populations as important populations that are necessary for the species' survival and recovery

It is considered likely that some or all or population 532 would occur within the APZ of any developed land at this site. Appendix E of the Plan contains a measure to undertake fire hazard management within the APZ at this location in a manner which protects *P. spicata* individuals from impacts. This measure will provide a level of protection for individuals of population 532. However, it is still likely that some individuals of population 532 may be lost as a result of development under the Plan.

The Plan will deliver three offset locations to address the high risk to *P. spicata* from direct impacts of development (Commitment 9). This will provide a substantial addition to the level of protection for the species which is currently under-represented in protected areas. In situ protection of *P. spicata* populations is a fundamental component of the species' recovery plan. The recovery plan's overall objective is to ensure the continued and long-term survival of *P. spicata* in the wild by promoting the in-situ conservation of the species across its natural range; with a specific [sub] objective to conserve *P. spicata* using land-use and conservation planning mechanisms.

In addition, the Plan includes a broader set of commitments and actions which are likely to benefit the species. The SCA contains approximately 2,031.1 ha of mapped potential habitat for *P. spicata*. It is very likely that areas of potential habitat in addition to the three offset sites will be protected within the SCA as part of offset commitments for other species and ecological communities under the Plan. For example, three of the proposed reserves in the Plan contain mapped habitat for the species (including 91.3 ha in the Georges River Koala Reserve).

The Conservation Advice for *P. spicata* notes that populations of the species have significantly increased in abundance and area of occupancy following the removal of threats (including the removal of weeds and fencing to prevent rabbits). The protection and management of offset sites and potential habitat within the SCA (including habitat within conservation reserves established under the Plan) therefore provides a real opportunity for recovery within areas where the species might currently be suppressed.

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts of development within the nominated areas and transport corridors associated with inappropriate habitat disturbance, weed invasion, and inappropriate fire regimes have been analysed and determined to be adequately managed and mitigated through:

- A species-specific action (Commitment 5, Action 8) which provides protection against habitat disturbance
- A species-specific measure in Appendix E of the Plan which provides protection against habitat disturbance
- A species-specific measure in Appendix E of the Plan which provides protection against indirect impacts associated with the construction of tunnels
- Generic management strategies in the Plan which provide for protection against and management of indirect impacts

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

Development under the Plan will lead to impacts to one known population of *P. spicata* and areas of potential habitat. While these impacts are considered to present a high risk of adversely impacting the species, implementation of the Plan is not expected to negatively influence the long-term viability of the species for the following key reasons:

- Direct impacts to known population 532 will be mitigated through a measure in Appendix E of the Plan, which will minimise impacts to the population and likely lead to part of the population being retained. It is noted that the long-term persistence of this population in the absence of any further development is already uncertain given the isolated and degraded nature of habitat.
- The Plan will lead to the protection of three sites known to support the species. This will contribute substantially to the level of existing protection and support the objective underpinning the species' Recovery Plan
- Protection and management of known habitat through the offset commitment, as well as the protection and management of additional areas of suitable habitat through the Plan's broader commitments with the SCA (including conservation reserves), is likely to contribute meaningful outcomes for *P. spicata,* which has been shown to respond positively to the removal of threats on land where it is known to occur
- Potential indirect impacts are addressed through species-specific and general management measures in the Plan

29.5.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan (DEC, 2005a) is to ensure the continued and long-term survival of *P. spicata* in the wild by promoting the in-situ conservation of the species across its natural range. Specific objectives include:

- Conserve *P. spicata* using land-use and conservation planning mechanisms
- Identify and minimise the operation of threats at sites where *P. spicata* occurs
- Develop and implement a survey and monitoring program that will provide information on the extent and viability of *P. spicata*
- Provide the community with information that assists in conserving the species
- Raise awareness of the species and involve the community in the recovery program
- Conduct research that will assist future management decisions

Implementation of the Plan will support a number of these strategies and will not prevent the achievement of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT THE IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to support the overall recovery of *P. spicata*. The Plan will not prevent implementation of any of the actions.

29.5.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-12 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *P. spicata,* there are no relevant Threat Abatement Plans.

Table 29-12: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. spicata*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-13: Occurrence of *P. spicata* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	27	5
(IMPORTANT POPULATIONS)	(27)	(5)
HABITAT MAPPING (Ha)	34,815.5	3,153.3

Table 29-14: Avoidance of *P. spicata* within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	664.4	475.5	510.2	2,164.1	3,814.3
HABITAT WITHIN EXCLUDED LANDS (ha)	88.6	286.5	43.9	1,951.1	2,370.1
HABITAT WITHOUT EXCLUDED LANDS (ha)	**575.7**	**189.0**	**466.3**	**213.1**	**1,444.2**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	179.6	103.8	129.4	86.0	498.9
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	31.2	54.9	27.7	40.4	34.5
AVOIDANCE FOR OTHER REASONS (ha)	8.4	19.3	34.6	12.6	74.9
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	1.5	10.2	7.4	5.9	5.2
TOTAL AVOIDANCE (ha)	**188.1**	**123.1**	**164.0**	**98.7**	**573.8**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**32.7**	**65.1**	**35.2**	**46.3**	**39.7**

Table 29-15: Direct impacts to *P. spicata* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	387.7	66.0	302.4	114.4	103.6	**974.0**
DIRECT IMPACTS TO POPULATIONS (Number)	0	1	0	0	0	**1**

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(1)	(0)	(0)	(0)	**(1)**

29.6 *PULTENAEA PARVIFLORA*

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	A small shrub with single yellow flowers with reddish markings. Usually less than 1 m tall but rarely up to 2 m. (DoEE, 2018f)
ECOLOGY	Flowers mainly from August to November. Fruiting occurs from October to November. There is no evidence of vegetative reproduction for this species. Pollinators for this species are unknown. Seeds may be dispersed by ants. Reproductive maturity is reached after 3-4 years, and peak seed production does not occur until 5-6 years of age. Species is suggested to live for roughly 20 years. Plants are killed by fire and re-establish from soil-stored seed. Plants appear in response to disturbance, such as fire events. Germination can be prolific following medium to high intensity fire events. Repeated and frequent disturbance of populations is likely to result in population decline (when disturbance occurs at intervals of less than 6-8 years) or extinction (when disturbance occurs at intervals of less than 4 years). A fire interval of 10-15 years is required to allow for the development of suitable seed bank, and to create suitably high fuel levels to create moderate to high intensity fires which are required to promote seed germination. Disturbance history is important for influencing the number of individuals present at a site. Fire-induced recruitment tends to produce more evenly aged populations than soil-disturbance-induced recruitment. (DoEE, 2018f; OEH, 2017f)
DISTRIBUTION AND HABITAT	Confined to the Cumberland Plain, mainly between Penrith and Windsor. Outlier populations are recorded from Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in derived grasslands on lateralised Wianamatta Shale or Tertiary alluvium, on infertile sandy to clay soils. (DoEE, 2018f; OEH, 2017f)
POPULATIONS	Populations have been recorded to range in size between 10 and over 5,000 individuals. As of 1995, populations were known to occur within the Blacktown, Hawkesbury, Liverpool, and Penrith Local Government Areas.

	As of 2002, the species had been recorded within the following reserved areas: • Scheyville National Park • Windsor Downs Nature Reserve • Castlereagh Nature Reserve • ADI Regional Park (now Wianamatta Regional Park) (DoEE, 2018f) Assessment of all BioNet records of the species indicates that over 90 per cent of known records occur within the Cumberland subregion. Therefore, for the purposes of this assessment, *P. parviflora* is considered to be an endemic species to the region.
SOS SITES	The following SOS sites for the species have been identified: • Scheyville • Castlereagh Nature Reserve • Wianamatta Nature Reserve • Colebee
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Pultenaea parviflora* (DEWHA, 2008k)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=19380

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	No	No	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Potential habitat polygons were generated for this species using BioNet PCT associations, vegetation condition (intact, thinned) and elevation (less than 120 m). To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. These surveys either confirmed presence (known habitat) or absence (no longer considered potential habitat). The species was recorded during surveys in a number of locations.				
	OUTSIDE THE NOMINATED AREAS				
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. No targeted surveys were undertaken outside the nominated areas.				

POPULATION MAPPING	**RECORD SELECTION** Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset. **BIONET RECORD DOWNLOAD DATE** The initial assessment of *P. parviflora* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *P. parviflora* were downloaded in October 2020. **POPULATION DEFINITION** Biological populations were defined using the records dataset and available information about the nature of the species. Records within 500 m of each other were considered to be a single population. **IMPORTANT POPULATION CRITERIA** Populations of *P. parviflora* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. For this species, populations were considered important because they met one or more of the following criteria: • A population is important for maintaining the Extent of Occurrence of a species • A population within a conservation reserve • A large population • Population is associated with a commitment made under the Sydney Growth Centres conservation program • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-23 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-17 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *P. parviflora* in the Strategic Assessment Area. **Records** The Strategic Assessment Area is the core location for the species. Records occur in the northern half of the Strategic Assessment Area with the majority of records occurring in the locality of Londonderry/Marsden Park. A total of 37 populations have been mapped within the Strategic Assessment Area, 19 are considered important. Nine populations are wholly or partly located in existing conservation reserves. The majority of populations of this species, including several large populations, are located in the northern region of the Strategic Assessment Area, in the area bounded by Freemans Reach to the

	north, Scheyville National Park to the east, the northern region of GPEC to the south (including Wianamatta Regional Park), and Agnes Banks to the west. Scattered populations also exist to the south of this region, including areas within and adjacent to GPEC and WSA, and in areas to the east in localities including Prospect Reservoir, Bass Hill, and Cecil Park. It is further noted that there are multiple populations in the vicinity of Kemps Creek, of which four are important populations. **Potential habitat** The baseline mapping for this assessment has mapped approximately 20,270.9 ha of known and potential habitat within the Strategic Assessment Area. The majority of this habitat is located to the north of GPEC, in the localities of Londonderry, Scheyville and Freemans Reach. In addition to this, there are: • Moderate areas of habitat on the western, eastern, and southern boundaries of WSA, in the localities of Mulgoa, Luddenham, Kemps Creek, and Erskine Park • Small, scattered areas of habitat in the southern portion of the Strategic Assessment Area, particularly along the boundaries of the assessment area, occupation of these latter areas in the southern part of the Strategic Assessment Area is not known as it is not associated with known records

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.6.1 NOMINATED AREAS

RECORDS

A total of six important populations of this species occurs within the nominated areas (all of which are within GPEC). Of these:

- Four populations (126, 128, 131, and 225) occur entirely within excluded lands
- Two populations (118 and 127) occur within the OSO transport corridor. Of these:
    - Population 118 is partially located within the OSO transport corridor, as it is part of a larger and connected population which extends outside of GPEC into Shanes Park
    - Population 127 occurs entirely within the OSO transport corridor

A total of eight non-important populations of this species occurs within the nominated areas (two in WSA and six in GPEC). Of these:

- Six populations (219, 223, 224, 517, and 516) occur entirely within excluded lands (four in GPEC, one in WSA)
- One population (181) in WSA occurs partially in land avoided for biodiversity purposes (four records), partially in the urban capable lands (14 records), and partially in excluded land (60 records)
- One population (226) in GPEC occurs partially in land avoided for biodiversity purposes (1 record) and partially in the urban capable lands (1 record)
- One population (542) in GPEC occurs partially in the OSO transport corridor (23 records) and partially in excluded land (1 record)

The Plan includes a commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure on non-certified land to known populations of *P. parviflora.*

POTENTIAL HABITAT

The baseline mapping for this assessment has mapped 191.6 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 86 ha (44.9 per cent) of this has been avoided as part of the urban capable lands and transport corridors (not including excluded lands). Almost all of this was avoided for biodiversity purposes.

A breakdown of avoidance across each nominated area is provided in Table 29-18.

It is important to note that the avoidance calculations in Table 29-18, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-18 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.6.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

It is noted that population 127 of *P. parviflora* is currently mapped to occur entirely within the footprint of transport corridors.

It is recognised that the Plan contains a commitment to avoid and minimise impacts to areas of high biodiversity value and threatened species and their habitat during the detailed planning of certified major infrastructure corridors within the Plan's nominated areas (Commitment 3), and therefore some avoidance of this population is likely to occur. However, as this detailed planning has not yet occurred, for the purposes of this assessment (which takes a precautionary approach), it is assumed that the entirety of the OSO transport corridor at this location will be impacted, and therefore that this population will be lost.

The Plan also contains a species-specific commitment (Commitment 4.1) to avoid and minimise impacts to known *P. parviflora* populations within the strategically assessed portions of the OSO and M7/Ropes Crossing Link Road corridors which occur outside of the nominated areas.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.6.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will:

- Lead to direct impacts to six populations, of which three are important populations
- Lead to a loss of potential habitat
- Lead to fragmentation of potential habitat

A summary of the direct impacts to populations and habitat is provided in Table 29-19.

IMPACTS TO KNOWN POPULATIONS

Important populations

Population 118

Population 118 is located in Shanes Park which almost entirely occurs outside of the nominated areas and transport corridors to the north of GPEC. A small part of the southern portion of Shanes Park occurs within the M7/Ropes Crossing Link Road on the northern boundary of GPEC.

The majority of Shanes Park consists of native vegetation in good condition; it is one of the last remaining remnants of largely unmodified native vegetation in the Cumberland subregion (URS, 2008). Subsequently, the majority of Shanes Park is listed on the Commonwealth Heritage List in recognition of its high biodiversity values. The site contains a number of threatened species.

The population consists of 416 BioNet records in total. All BioNet records for this population do not specify the number of plants recorded, and so each record is considered to account for a single plant. Of these:

- 289 BioNet records are located outside of the Strategic Assessment Area
- 127 BioNet records are located inside the Strategic Assessment Area

The majority of the records within the Strategic Assessment Area were recorded in 2018 and in 2019 as part of the targeted surveys for this assessment. All 127 of these records are located within the footprint of the M7/Ropes Crossing Link Road.

Population 119

This population is primarily located in a Metro offset site at Colebee to the north-east of GPEC outside of the Strategic Assessment Area. This site is mapped as containing Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849), in an intact condition.

In 1999, 2,000 plants were recorded as part of this population, whilst in November 2017, 655 plants were recorded within this population.

One plant from this population has been recorded within the footprint of the proposed M7/Ropes Crossing Link Road. This plant was recorded in 2015 and is the southernmost record of Population 119.

Population 127

This population consists of 87 BioNet records from between 2016 and 2019 in Wianamatta Regional Park in the north of GPEC. This site was surveyed by the consulting team in June of 2019, during which 83 individuals of the species were recorded, indicating the population is extant and common on site. The site contains Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion, ranging from intact to thinned condition.

All records of this population are located within the transport corridor of the Outer Sydney Orbital.

The Plan includes commitments to avoid impacts threatened species and their habitat during the development of major infrastructure corridors within the nominated areas (Commitment 3), and therefore some avoidance of impacts to this community is expected to occur in the future. However, for the purposes of this assessment (which takes a precautionary approach), it is assumed that the entirely of the OSO transport corridor at this location will be impacted, and therefore that this population will be lost.

Non-important populations

Population 181

This population consists of 78 BioNet records near Kemps Creek within the south-east of WSA. All BioNet records for this population do not specify the number of plants recorded, and so each record is considered to account for a single plant. Records of this population range in date from 2015 to 2018. The majority of plants are located along the roadside of Clifton Ave.

Vegetation in the locality is mapped to include patches of Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (PCT 724, ranging from intact to thinned condition), and Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (PCT 725, in an intact condition). The wider landscape is otherwise heavily cleared.

Of the 78 records, 14 are mapped within urban capable lands and will be impacted. Remaining plants outside urban capable land will be avoided.

There is one important population within close proximity of this population (population 130 which is approximately 850 m to the south). This population contains hundreds of plants and is protected under commitments associated with the Sydney Growth Centres Conservation Program.

Population 226

This population consists of two BioNet records near Twin Creeks in Luddenham in the south of GPEC. The first record is from 2013 and does not state the number of individual plants (and so is assumed to constitute a single plant sighting). The second record is from 2016 and reports 150 plants with an accuracy of 100 m.

This site is mapped as containing Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849), in a thinned condition. Satellite imagery of the site indicates significant areas of the site have been cleared.

The 2013 record is located within the proposed urban capable land, and so will be removed. The 2016 record is sufficiently separated from the proposed urban capable land and will be avoided.

Population 542

This population is located along the northern boundary of GPEC (near Bidwill and Hassall Grove) largely within the footprint of the M7/Ropes Crossing Link Road.

The site is mapped to contain Cumberland Shale Woodlands and Shale-Gravel Transition Forest (PCT 724 and PCT 849, in a thinned condition). It is noted that this site was surveyed in August of 2019 by the consulting team and therefore there is high confidence in the accuracy of mapped habitat conditions. The vegetation exists as a thin corridor, bounded to the south by urban development and to the north by areas of urban and commercial development.

The population consists of 24 BioNet records, 23 of these are located within the footprint of the M7/Ropes Crossing Link Road. The population is not considered to be large in the context of the species and is not key for maintaining the species' extent of occurrence.

LOSS OF POTENTIAL HABITAT

There will be direct impacts to approximately 218.7 ha of potential habitat. This represents 1.1 per cent of potential habitat within the Strategic Assessment Area. Habitat loss is primarily associated with transport projects inside the nominated areas (Outer Sydney Orbital and M7/Ropes Crossing Link Road).

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of direct impacts to populations is considered to be high. This risk ranking is triggered for impacts to species' records, as follows:

- The likelihood of actual impacts occurring to the species has been categorised as almost certain. There will be direct impacts to known populations of the species, with high confidence in the accuracy of the records
- The consequence of any impacts to the species has been categorised as major. There will be a loss of an important population (population 127) which is not at the edge of the species' occurrence

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat (away from known populations) is considered to be medium. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within areas of mapped habitat away from known populations has been categorised as likely. There will be direct impacts to potential habitat, with high confidence that the species occurs in the impact area (given that most mapped habitat for this species is associated with records, it is considered likely that the habitat mapping accurately represents species' occurrence)
- The consequence of impacts to the species (if they did occur) has been categorised as moderate. There will be a loss of 1.1 per cent of mapped potential habitat (endemic species), with high confidence that the species occurs in the impact area

29.6.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The Plan will lead to fragmentation of habitat in relation to two important populations and associated habitat due to the development of the OSO within Wianamatta Regional Park.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of fragmentation is considered to be medium. This is because:

- The likelihood of fragmentation has been categorised as likely. This is because:
  - The likelihood that development is presents a barrier to dispersal of the species is likely. While the pollinators for this species are unknown, it is thought that seed dispersal may occur via ants (OEH, 2017f). It is thought that the development of the OSO is likely to pose a barrier to reproduction and/or dispersal of this species
  - The type of fragmentation is certain impact between populations. This is because the OSO will fragment habitat between two important populations (population 118 and 128. It is noted that population 127 is considered to be lost as a result of direct impacts)
- The consequence of fragmentation has been categorised as major. This is because the Plan will lead to fragmentation between populations which impacts two or more important populations which are not at the edge of occurrence of the species

29.6.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the species, the Plan includes a commitment to secure two offset locations for the species as part of the conservation program (Commitment 9). This will improve the level of protection of the species within the Strategic Assessment Area where nine populations (out of a total of 37) currently occur in protected areas.

In addition to this, a total of 192.6 ha of potential habitat for *P. parviflora* is contained within three of the Plan's proposed reserves. These include:

- 107.2 ha of mapped habitat in the Georges River Koala Reserve
- 74.4 ha within the Confluence Reserve investigation area
- 11 ha of mapped habitat in the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.6.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DEWHA, 2008k) (and other key documents) for *P. parviflora* identifies a range of threats to the species. Where these threats are relevant to the implementation of the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate habitat disturbance from uncontrolled vehicle access and rubbish dumping

- Weed invasion
- Inappropriate fire regimes

Dryland salinity has also been identified as a key threat. However, it is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the threat across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. parviflora* are discussed below for each identified indirect impact.

It is noted that the Plan includes a commitment for two offset locations for *P. parviflora.* Further, a total of 192.6 ha of potential habitat for *P. spicata* is contained within three of the Plan's proposed reserves. The establishment of known offset sites and conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE HABITAT DISTURBANCE

Habitat degradation through uncontrolled vehicular access and rubbish dumping have been identified as a key threat to *P. parviflora* (DEWHA, 2008k). Development within GPEC and WSA may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

Populations of *P. parviflora* considered most at risk of this threat are those that occur in:

- Public land, as these areas are accessible without the deterrent that comes with trespassing. Nine important populations occur on public land managed for conservation. They are:
  - Scheyville National Park - population 124
  - Windsor Downs Nature Reserve - population 122
  - Castlereagh Nature Reserve - population 117
  - Agnes Banks Nature Reserve - population 123
  - Wianamatta Nature Reserve - population 116
  - Wianamatta Regional Park - populations 126 and 128 (note population 127 is considered to be lost as a result of development)
  - Kemps Creek - population 130
- An area of freehold land to the north of GPEC which is often mistaken for Crown land. This area contains a number of access tracks, and issues associated with rubbish dumping have been recorded for the site

It is noted that the national parks, nature reserves and Wianamatta Regional Park are managed (three of these sites are Priority Management Sites under the NSW SOS program for *P. parviflora*). Assuming this management continues and adapts to potential increasing visitation over the life of the Plan, the risk to *P. parviflora* from disturbance is expected to be adequately addressed.

With regards to Kemps Creek, it is noted that this site was briefly visited in association with site surveys which were undertaken during preparation of the expert report for *Acacia pubescens*. The expert report for *A. pubescens* notes that remnant habitat at Kemps Creek was "seen to be largely unmanaged and degrading due to several threats" (Douglas, 2019c). This site is part of the Sydney Growth Centres Program, and it is recommended that the management of habitat at Kemps Creek under this program be improved. It is considered that improved and ongoing management of habitat at Kemps Creek will provide protection of *P. parviflora* within this locality from impacts associated with inappropriate habitat disturbance.

With regards to site visitation in public land to the north of GPEC, in the absence of tighter controls over access, there is potential for increased disturbance to occurrences of *P. parviflora* on this site as a result of the Plan.

Appendix E includes the following species-specific measure to mitigate impacts of habitat disturbance to *P. parviflora*: "Consult with land managers of land containing known populations or habitat for relevant species to mitigate indirect impacts from human disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and slashing, and managing rubbish dumping". This measure

is linked to Commitment 5, applies within GPEC and WSA, and will contribute to protecting the species from inappropriate habitat disturbance.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including two offset locations for *P. parviflora* under Commitment 9)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *P. parviflora* from inappropriate habitat disturbance as a result of development. This is because:

- A species-specific measure will be applied from Appendix E of the Plan which will help to mitigate impacts of inappropriate habitat disturbance
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands (including offset sites secured for *P. parviflora* under Commitment 9) will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

These controls are consistent with a number of priority actions in the Conservation Advice (DEWHA, 2008k). For example, to "raise awareness of *P. parviflora* within the local community, including education about the effects of rubbish dumping, unauthorised vehicular access…" and "control access routes to suitably constrain public access to known sites on public land".

WEED INVASION

P. parviflora is threatened with invasion and competition by weeds. This species is particularly threatened by invasive perennial grasses, which increase the risk of high-frequency, high-intensity fires which can destroy propagules of the species (OEH, 2017f).

Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development within the northern half of the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

P. parviflora is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include:

- The southern end of Shanes Park where the M7/Ropes Crossing Link Road occurs adjacent to potential habitat areas
- The north-eastern section of Wianamatta Regional Park, where the Outer Sydney Orbital intersects a known population and potential habitat

The Plan incorporates species-specific measures for the protection of *P. parviflora*, which will contribute to the control of weeds within known and potential habitat for the species. Species-specific measures which are relevant to weed control include:

- Protecting two known offset locations for *P. parviflora* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species
- With regards to development within urban capable land, implementing the following species-specific mitigation measure from Appendix E of the Plan: "Implement mitigation measures to manage weeds for flora populations and habitat adjacent to urban and infrastructure development during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy". This measure is connected to Commitment 5 and Commitment 16 and applies in GPEC and WSA. It will be implemented via a range of mechanisms including: the DCP template, Mitigation Measures Guideline, Weed Control Strategy, and Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
- With regards to development of the major transport corridors, implementing the following species-specific mitigation measure from Appendix E of the Plan: "Implement mitigation measures to manage weeds for flora populations and habitat adjacent to major infrastructure corridors during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy". This measure is connected to Commitment 5 and Commitment 16 and applies to the OSO in Wianamatta Regional Park and the M7/Ropes Crossing Link Road. It will be implemented via the State Significant Infrastructure assessment and approval process

The Plan further incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA. This includes a number of actions, of which the following are the most relevant to the outcome for *P. parviflora*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include managing the spread of weeds

These measures under the Plan are expected to adequately manage the potential threat to *P. parviflora* from weed invasion. This is because:

- Two known offset locations for *P. parviflora* will be obtained (Commitment 9) and managed for conservation purposes, which will ensure long-term protection of known populations and habitat of this species
- Two species-specific measures within Appendix E of the Plan will be implemented to mitigate the impacts of weeds associated with development in urban capable land and major transport corridors
- Commitment 15 which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

INAPPROPRIATE FIRE REGIMES

P. parviflora largely relies upon fire events in order to successfully germinate. Therefore, occasional fire events are likely to be required to maximise the species' ability to recover and persist. Plants are killed by fire, with subsequent generations germinating from seeds stored within the soil. Fire intervals of 10-15 years are recommended to:

- Enable development of adequate seed reserves in the soil to enable successful germination
- Allow for the development of suitable fuel loads for moderate to high intensity fires, which are required for seed germination

Increased human activity within the nominated areas may result in altered fire frequencies. This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the mechanisms outlined above.

Increased and/or decreased fire intervals poses a threat to the long-term persistence of *P. parviflora* within the Strategic Assessment Area as both too-frequent and too-infrequent fires would negatively impact upon the species' ability to successfully reproduce. Key risk areas are those that are easily accessible to the public and in close proximity to urban development.

Several populations of *P. parviflora* occur in conservation reserves with existing fire management strategies. These conservation reserves are:

- Scheyville National Park
- Agnes Banks Nature Reserve
- Windsor Downs Nature Reserve
- Shanes Park
- Castlereagh Nature Reserve
- Wianamatta Nature Reserve
- Wianamatta Regional Park

The Plan incorporates species-specific measures for the protection of *P. parviflora*, which will contribute to the maintenance of appropriate fire regimes within species' habitat and provide for protection for the species. Species-specific measures which are relevant to fire regime management include:

- Protecting two known offset locations for *P. parviflora* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species
- Implementing a species-specific measure in Appendix E of the Plan to "Consult with land managers of land containing known populations or habitat for [*P. parviflora*] to mitigate indirect impacts from fire during construction and operation of the development, taking into account guidance in the Fire Management Strategy". This measure applies within GPEC and WSA

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. parviflora*:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy

  - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
  - Require asset protection zones (APZs) wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *P. spicata*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP (Strategic Conservation Planning) requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include ensuring measures to manage fire risk avoid and minimise impacts to biodiversity

The package of measures in the Plan is expected to adequately manage the risk to *P. parviflora* from altered fire regimes as a result of development. This is because:

- Two known offset locations for *P. parviflora* will be obtained (Commitment 9) and managed for conservation purposes, which will ensure long-term protection of known populations and habitat of this species
- A species-specific measure in Appendix E of the Plan will be implemented which will mitigate indirect impacts from fire during the construction and operation of development within GPEC and WSA
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *P. parviflora* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *P. parviflora* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.6.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The species has been recorded on avoided lands in GPEC and WSA. Within GPEC, population 226 (a non-important population with a total of two records) contains one record comprising 150 individuals within avoided land. This population is located in the south-east of the nominated area, near Twin Creeks. In WSA, population 181 (a non-important population with a total of 78 records) contains 4 records within avoided lands. This population is located in the south-east of the nominated area, near Kemps Creek. The Plan includes a number of measures to protect *P. parviflora* from impacts associated with essential infrastructure, which are outlined below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect *P. parviflora* from impacts from essential infrastructure. These include:

- Commitment 2.2, which specifically prioritises avoidance of impacts to *P. parviflora* with regards to essential infrastructure
- A measure in the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, which requires that avoidance of impacts to *P. parviflora* be prioritised

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *P. parviflora* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.6.8 POTENTIAL IMPACTS FROM TUNNELS

There is a total of 0.4 ha of potential habitat for *P. parviflora* mapped within the tunnel footprint under the Plan. However, there are no records of *P. parviflora* in the locality; it is noted that the tunnel footprints are over 10 km south of the southernmost known record of this species, suggesting that the tunnels are likely to occur outside of the extent of occurrence of this species. It is therefore considered to be unlikely that the development of tunnels under the Plan will negatively impact *P. parviflora.*

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.6.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008k) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *P. parviflora* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Inappropriate habitat disturbance
  - Inappropriate fire regimes
  - Weed invasion

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to:

- Direct impacts to 6 populations, including:
  - The loss of one important population (population 127)
  - Impacts to records of two important populations (population 118 and 119)
  - Impacts to records of three non-important populations (population 181, 226, and 542)
- Loss of approximately 218.7 ha of potential habitat within the nominated areas and transport corridors
- Potential fragmentation of habitat in one location

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is high.

The likelihood of the loss of population 127 as a result of the development of the OSO within Wianamatta Regional Park in GPEC is the key driver for this risk rating. There is a high level of confidence that the population is extant as the population was detected during site surveys undertaken for this strategic assessment. The population is of a moderate size comprising 87 plants. It is noted that the Plan commits (Commitment 3) to avoid and minimise impacts to threatened species due to the construction of the Outer Sydney Orbital in GPEC. It will be critical that this process avoids and minimise impacts as far as possible to reduce the scale of impacts.

To address the overall residual risks associated with direct impacts, the Plan will deliver two offset locations to address the high risk to *P. parviflora* from direct impacts of development (Commitment 9), which will provide for additional protection for the species. The process of protecting land in the Strategic Assessment Area is likely to support a priority action in the Conservation Advice to "investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure".

In addition, the Plan includes a broader set of commitments and actions which are likely to benefit the species. The SCA contains approximately 1,302.7 ha of mapped potential habitat for *P. parviflora*. It is very likely that areas of potential habitat in addition to the two offset sites will be protected within these SCA as part of offset commitments for other species and ecological communities under the Plan. For example, three of the proposed reserves in the Plan contain mapped habitat for the species (including 107.2 ha in the Georges River Koala Reserve).

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts of development within the nominated areas and transport corridors associated with inappropriate habitat disturbance, weed invasion, and inappropriate fire regimes have been analysed and determined to be adequately managed and mitigated through species-specific and generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

Development under the Plan will lead to impacts to six known populations of *P. parviflora* and areas of potential habitat. Of the six impacted populations, impacts to population 127 are considered to be the most severe. While these impacts are

considered to present a high risk of adversely impacting the species, implementation of the Plan is not expected to negatively influence the long-term viability of the species for the following key reasons:

- Direct impacts to population 127 are likely to be minimised through a commitment (Commitment 3) to avoid and minimise impacts to threatened species and their habitat due to the construction of the Outer Sydney Orbital in GPEC
- The Plan will lead to the protection of two sites known to support the species (Commitment 9), which will contribute to the level of existing protection
- Protection and management of known habitat through the offset commitment, as well as the protection and management of additional areas of suitable habitat through the Plan's broader commitments with the SCA, is likely to contribute meaningful outcomes for *P. parviflora,* which has been shown to respond positively to the removal of threats on land where it is known to occur
- Potential indirect impacts are addressed through management measures in the Plan

29.6.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.6.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-16 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *P. parviflora,* there are no relevant Threat Abatement Plans.

Table 29-16: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. parviflora*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-17: Occurrence of *P. parviflora* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	37	9
(IMPORTANT POPULATIONS)	(19)	(9)
HABITAT MAPPING (Ha)	20,270.9	2,218.2

Table 29-18: Avoidance of *P. parviflora* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	0.9	132.0	262.9	395.8
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	0.9	12.5	190.8	204.2
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**119.5**	**72.1**	**191.6**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	70.7	15.0	85.7
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	59.2	20.9	44.8
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	0.1	0.2	0.3
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.1	0.2	0.1
TOTAL AVOIDANCE (ha)	**0.0**	**0.0**	**70.8**	**15.2**	**86.0**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**0.0**	**59.3**	**21.1**	**44.9**

Table 29-19: Direct impacts to *P. parviflora* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	48.7	56.8	113.2	**218.7**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	1	4	1	**6**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(2)	(1)	**(3)**

SPECIES AT MEDIUM RISK OF DIRECT IMPACTS

29.7 *CYNANCHUM ELEGANS* (WHITE-FLOWERED WAX PLANT)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Cynanchum elegans* is a climber or twiner with a highly variable form, ovate to broadly ovate leaves, white tubular flowers and dry pointed-pod fruit. Mature stems can climb to 10 m high and be 3.5 cm thick. (DEWHA, 2008b; DoEE, 2018f)
ECOLOGY	Flowering occurs between August and May; seed production is variable and unreliable. Seeds are wind dispersed and it is thought to be unlikely that a soil seed bank exists for this species. Fruit can take four to six months to mature after flowering. Plants are also capable of clonal reproduction from underground suckering stems. Often seen after physical disturbance such as slashing and grazing. (DoEE, 2018f; OEH, 2018i)
DISTRIBUTION AND HABITAT	Occurs in eastern NSW, from Brunswick Heads on the north coast to the Illawarra region. The distribution overlaps with the following TECs: • Shale Sandstone Transition Forest • White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland • Cumberland Plain Woodlands • Upland Wetlands of the New England Tablelands and the Monaro Plateau • Turpentine-Ironbark Forest in the Sydney Basin Bioregion Inhabits the transition zone between dry subtropical rainforest and sclerophyll forest/woodland communities, occurring on steep slopes with varying degrees of soil fertility. (DEWHA, 2008b)
POPULATIONS	Records are restricted from Wollongong (NSW), north to southeast Queensland and west to Mt Danger. Population estimates are old. In 1993 the species was known from 31 sites with around 1,000 plants. Populations usually contain less than 30 individuals. (DoEE, 2018f)

SOS SITES	*C. elegans* has been assigned to the 'Keep-watch species' management stream under the SOS program. Currently, a considerable number (at least 40) populations of *C. elegans* are known to occur within existing conservation reserves in NSW. These sites are already actively managed for conservation purposes. Current management is considered sufficient to protect this species in NSW in the long-term. *C. elegans* is therefore a lower priority species for conservation investment in NSW. (EES, 2020c)
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Cynanchum elegans* (White-flowered Wax Plant) (DEWHA, 2008b)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=12533

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Not applicable as the species is not a candidate species credit species. Mapping was done as per the species distribution model described below.				
	OUTSIDE THE NOMINATED AREAS				
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. The report for this process (Supporting Document F) notes that there were few (23) records of *C. elegans* with which to produce a model (generally, over 50 records are required to produce a reliable SDM). The mapping is considered to be highly precautionary. The SDM produced for *C. elegans* is therefore considered to be indicative and should be treated with caution.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				

	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *C. elegans* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *C. elegans* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Little is known of the reproduction and dispersal ecology of *C. elegans* (DoEE, 2018f). As part of this assessment, a population was considered to be clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	Populations of *C. elegans* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. All populations were considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-5 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-21 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *C. elegans* in the Strategic Assessment Area. **Records** Populations are found in small, isolated remnant patches of dry rainforest within the Strategic Assessment Area. The baseline mapping for this assessment has mapped a total of nine populations (from 22 BioNet records), of which two population either wholly or partly occur on land which is already protected for conservation purposes. Of these: • One occurs in Kurrajong • One occurs at Cobbitty • One occurs in Abbotsbury • The remaining five occur in the Razorback district None of the identified populations occur within any of the nominated areas. **Potential habitat** Approximately 3,322.2 ha of potential habitat has been mapped within the Strategic Assessment Area, as follows: • Scattered habitat patches are mapped to occur in the Razorback district, in the locality bounded by Tahmoor in the south, Menangle in the east, Theresa Park in the north and the strategic assessment boundary in the west • Small, scattered habitat patches are mapped within Cobbitty and along the Nepean River to the east of Silverdale

	• A moderate habitat patch is mapped to occur in remnant vegetation in Abbotsbury, near the intersection of the M7 and Elizabeth Drive • Small, scattered areas of habitat occur in the north and north-east of the Strategic Assessment Area, including localities such as Castlereagh (along the Nepean River), Kurrajong, Freemans Reach and Wilberforce None of the mapped habitat occurs within any of the nominated areas.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.7.1 NOMINATED AREAS

There is no potential habitat for the species mapped within the nominated areas. Avoidance of habitat was therefore not necessary.

29.7.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

It is noted that the OSO at Cobbitty intersects habitat for the species, and records of the species adjacent to the OSO in this area suggest that there is potential for impacted habitat to be occupied by the species. The Plan includes a species-specific commitment (Commitment 4.1) to avoid and minimise impacts to *C. elegans* due to construction activities within or adjacent to transport corridors including the OSO. This commitment will ensure that appropriate avoidance of impacts to *C. elegans* will occur during the development of the transport corridors in known habitat for the species.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.7.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will not lead to any direct impacts to known records. However, it will lead to loss of potential habitat within a transport corridor outside of the nominated areas. A summary of direct impacts is provided in Table 29-22.

LOSS OF POTENTIAL HABITAT

Approximately 19.6 ha of potential habitat will be lost as a result of implementation of the Plan. The impacts relate to a transport project (the Outer Sydney Orbital) at Cobbitty. This is 0.6 per cent of mapped potential habitat across the Strategic Assessment Area. This habitat is in proximity to population 14, a known important population of *C. elegans*.

It is noted that, as detailed planning of the transport corridors has yet to be completed, the Plan includes a commitment (Commitment 4.1) to ensure that appropriate avoidance of impacts to *C. elegans* is undertaken as part of this process. The

commitment requires that the design of the OSO at Cobbitty avoids and minimises impacts to *C. elegans* populations and habitat.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of direct impacts to mapped habitat is considered to be low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species has been categorised as likely. While there is a commitment to avoid and minimise impacts as part of the design of the OSO, it will not be possible to avoid all mapped potential habitat. In addition, taking a precautionary approach there is high confidence that the species occurs in the impact area (given that the impacted mapped habitat occurs in close proximity to known records of the species, it is thought to be likely that the mapped habitat represents real habitat for the species)
- The consequence of impacts to the species (if they did occur) has been categorised as minor. There will be a loss of <1 per cent of mapped potential habitat (endangered species), with high confidence that the species occurs in the impact area

29.7.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

Implementation of the Plan will lead to fragmentation of a known population (population 14) due to the development of the OSO near Cobbitty. The population comprises six records from 1991 to 1996, with an accuracy of 100 m. The number of individuals in the records range from 0 (presumably 1) to 13.

The population occurs in in vegetation mapped as Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion (PCT 877), which is mapped to occur in association with Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850). This vegetation occurs in a wider landscape of scattered patches and corridors of vegetation within a landscape which has primarily been cleared for agricultural production.

The population will be fragmented because four records containing 5 individuals occur on the western side of the OSO and two records containing 14 individuals occur on the eastern side of the OSO.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of fragmentation is considered to be medium. This is because:

- The likelihood of fragmentation has been categorised as likely. This is because:
  - The likelihood that development is presents a barrier to dispersal of the species is likely. The breeding system for *C. elegans* is poorly understood (NPWS, 2002) although it is thought that seeds are wind dispersed (OEH, 2018i). Given the uncertainty regarding dispersal requirements for the species, the OSO has been considered to be a likely barrier to dispersal for the species based on the precautionary principle
  - The type of fragmentation is likely impact within a population. This is because the OSO will fragment habitat within a single population of the species (population 14), where there is some uncertainty associated with the accuracy of the records
- The consequence of fragmentation has been categorised as major. This is because the Plan will lead to internal fragmentation of a population of an endangered species

29.7.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the species, the Plan includes a commitment (Commitment 9) to secure two offset locations for the species as part of the conservation program. While the species is considered to be well protected across its range, these offsets will improve the level of protection of the species within the Strategic Assessment Area where two populations (out of a total of nine) currently occur in protected areas.

In addition to this, 2.7 ha of potential habitat for *C. elegans* is contained within the Gulguer Reserve investigation area.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.7.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (and other key documents) for *C. elegans* identifies a range of threats to the species (DEWHA, 2008b). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to the implementation of the Plan:

- Weed invasion
- Inappropriate fire regimes
- Hydrological disturbance
- Habitat disturbance due to track construction/widening

Disturbance due to landfill development and livestock grazing are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *C. elegans* are discussed below for each identified indirect impact.

It is noted that the Plan includes a commitment for two offset locations for *C. elegans*. Further, the Plan commits to establishing conservation reserves and securing land for conservation management, which contains habitat for *C. elegans*. The establishment of known offset sites and conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

WEED INVASION

C. elegans is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The species is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport infrastructure occur adjacent to known populations or habitat. The key risk area is where the OSO intersects habitat at Cobbitty in proximity to population 14.

The Plan incorporates species-specific measures for the protection of *C. elegans*, which will contribute to the control of weeds within known and potential habitat for the species. Species-specific measures which are relevant to weed control include:

- Protecting two known offset locations for *C. elegans* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species

- A measure in Appendix E of the Plan to "Implement mitigation measures to manage weeds for [*C. elegans*] populations and habitat adjacent to major infrastructure corridors during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy". This measure applies to the OSO at Cobbitty, and will be implemented via the State Significant Infrastructure assessment and approval process

The Plan further incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the SCA. This includes a number of actions, of which the following are the most relevant to the outcome for *C. elegans*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land

These commitments and actions under the Plan are expected to adequately manage the risk to *C. elegans* from weed invasion. This is because:

- Two known offset locations for *C. elegans* will be obtained (Commitment 9) and managed for conservation purposes, which will ensure long-term protection of known populations and habitat of this species
- There is a specific requirement in Appendix E of the Plan for the impact of weeds to be managed with regards to the requirements of *C. elegans* in relation to the development of the OSO at Cobbitty
- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species

INAPPROPRIATE FIRE REGIMES

Altered fire regimes are an identified potential threat to the species (DEWHA, 2008b) although the response to fire is not well understood.

Increased human activity within the Strategic Assessment Area has the potential to alter fire regimes through the following mechanisms:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation or key infrastructure

The area with the highest risk of potential impacts is where the OSO intersects habitat for *C. elegans* at Cobbitty.

The Plan incorporates species-specific measures for the protection of *C. elegans*, which will contribute to the maintenance of appropriate fire regimes within species' habitat and provide for protection for the species. Species-specific measures which are relevant to fire regime management include protecting two known offset locations for *C. elegans* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include: a commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *C. elegans* being:

- Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
- Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
- A process to work with delivery partners to implement the Fire Management Strategy

- Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans

The package of measures in the Plan is expected to adequately manage the risk to *C. elegans* from altered fire regimes as a result of development. This is because:

- Two known offset locations for *C. elegans* will be obtained (Commitment 9) and managed for conservation purposes, which will ensure long-term protection of known populations and habitat of this species
- Fire management authorities will be engaged to ensure they understand the requirements of *C. elegans* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas.

HYDROLOGICAL DISTURBANCE

Changes to hydrology are an identified threat to the species (OEH, 2018i). There is potential that the development and subsequent operation of the OSO near Cobbitty may lead to hydrological disturbance of the habitat for *C. elegans* within this locality.

The Plan incorporates species-specific measures for the protection of *C. elegans*, which will contribute to the control of hydrological disturbance within known and potential habitat for the species. Species-specific measures which are relevant to hydrological disturbance include:

- Protecting two known offset locations for *C. elegans* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species
- A measure in Appendix E of the Plan to "implement mitigation measures to manage hydrology impacts to [*C. elegans*] and habitat adjacent to major infrastructure corridors during construction and operation of the development". This measure applies to the OSO at Cobbitty, and will be implemented via the State Significant Infrastructure assessment and approval process

The Plan further incorporates a range of measures to mitigate the risks associated with changes to hydrology for *C. elegans*. In particular, these include the implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines. These include a range of provisions to mitigate and minimise changes to hydrology.

The package of measures in the Plan is expected to adequately manage the risk to *C. elegans* from changes to hydrology because:

- Offset sites will be secured to manage habitat for *C. elegans* for conservation purposes
- There is a species-specific measure in place to mitigate impacts to hydrology associated with development of the OSO at Cobbitty
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to biodiversity values, including potential habitat for *C. elegans*

HABITAT DISTURBANCE DUE TO TRACK CONSTRUCTION/WIDENING

Habitat disturbance due to track construction and/or widening may occur as either a temporary or permanent indirect impact within, or adjacent to, the OSO, and will depend upon the final design elements of the OSO which will influence the likelihood of site visitation and track use in the future. The mapped habitat for *C. elegans* at Cobbitty is more likely to experience site visitation and track creation if the site is made easily accessible to the public due to design decisions associated with the OSO (e.g. placement of a rest stop close to areas of habitat may encourage public visitation of the locality).

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for *C. elegans*. In summary, these include:

- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the two offset locations to be obtained for *C. elegans* in association with Commitment 9)

- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

These measures under the Plan are expected to adequately manage the risk to *C. elegans* from habitat disturbance. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to tunnels associated with transport projects.

Given that it is not present in the nominated areas, *C. elegans* is not at risk from essential infrastructure projects.

29.7.7 POTENTIAL IMPACTS FROM TUNNELS

There is a total of 0.4 ha of potential habitat for *C. elegans* mapped within the tunnel footprint under the Plan. While no records of *C. elegans* occur within the tunnel footprint, it is recognised that there are records of the species in the locality of the tunnel footprint near Cobbitty. However, given the small area of mapped potential habitat to be impacted, it is considered unlikely that development of the tunnel will lead to adverse impacts for *C. elegans*.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.7.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008b) and other key documents identify the following key issues that are likely to have the greatest influence on the long-term viability of *C. elegans* in relation to implementation of the Plan.

- Habitat loss and fragmentation
- Indirect impacts including

- Degradation of habitat due to weed invasion, grazing and inappropriate fire management
- Hydrological disturbance

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to:

- Loss of approximately 19.6 ha of mapped habitat within the transport corridors
- Potential fragmentation of population 14 due to the development of the OSO at Cobbitty

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is medium.

It is considered to be likely that the development of the OSO will result in internal fragmentation of a population of *C. elegans* near Cobbitty, which is the key driver for this risk rating. There is some uncertainty regarding the accuracy of the records, given that the most recent record of this population was recorded in 1996. The population is of moderate size comprising of up to 19 plants. It is likely that this population is important to the ongoing viability and recovery of the species, as this species is endangered.

The Plan will deliver two offset locations to address the medium risk to *C. elegans* from direct impacts of development (Commitment 9). Under the NSW Saving Our Species Program, it is noted that *C. elegans* already has a considerable number of populations (over 40) which are known to occur within existing conservation reserves in NSW, which are actively managed for conservation purposes (EES, 2020c). The addition of two new conservation reserves to protect this species will add to the existing level of protection for *C. elegans* in NSW and contribute to the long-term preservation of the species and its habitat.

In addition, the Plan includes a broader set of commitments and actions which are likely to benefit the species. The SCA contains approximately 1,569.3 ha of mapped potential habitat for *C. elegans*. It is very likely that areas of potential habitat in addition to the two offset sites will be protected within the SCA as part of offset commitments for other species and ecological communities under the Plan.

The current level of protection for *C. elegans* within NSW is considered to be sufficient to protect the species in the long-term (EES, 2020c). The Plan will add to existing protection for *C. elegans* by securing additional populations and areas of habitat within new conservation reserves.

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

C. elegans is most at risk from indirect impacts associated with the development of the OSO at Cobbitty. The potential indirect impacts of this development include weed invasion, inappropriate fire regimes, hydrological disturbance, and habitat disturbance. Indirect impacts have been analysed and determined to be adequately managed and mitigated through a number of species-specific measures, in addition to general management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

Development under the Plan will lead to fragmentation of one known population of *C. elegans* and impacts to areas of potential habitat. While these impacts are considered to present a medium risk of adversely impacting the species, implementation of the Plan is not expected to negatively influence the long-term viability of the species for the following key reasons:

- The Plan will lead to the protection of two sites known to support the species
- Potential indirect impacts are addressed through management measures in the Plan
- *C. elegans* is well-represented in conservation reserves in NSW, and subsequently its long-term future in the state is considered to be secure (EES, 2020c)

29.7.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.7.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-20 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *C. elegans,* there are no relevant Threat Abatement Plans.

Table 29-20: Relevant key Threatening Processes and associated Threat Abatement Plans for *C. elegans*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-21: Occurrence of *C. elegans* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	9	2
(IMPORTANT POPULATIONS)	(9)	(2)
HABITAT MAPPING (Ha)	3,322.2	459.4

Table 29-22: Direct impacts to *C. elegans* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	0.0	0.0	19.6	**19.6**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.8 *PERSOONIA NUTANS* (NODDING GEEBUNG)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Persoonia nutans* is an erect to spreading shrub with reddish stems and branches and yellow, pendant flowers. Grows from 0.5-2.5 m tall. (DoEE, 2018f)
ECOLOGY	Flowers from November to April. Main pollinators are wasps and native bees. Seed is likely to be dispersed after consumption by large birds such as currawongs and parrots, and mammals such as kangaroos, wallabies, and possums. Plants are killed by fire and other disturbances and recruitment is only by seed. Subsequently, populations are dynamic in space and time. It is not known how long seeds persist in the soil, or whether all seeds germinate in a single disturbance event. It is unlikely that high levels of germination would occur without the presence of disturbance as a trigger for germination. (DoEE, 2018f; Douglas, 2019d)
DISTRIBUTION AND HABITAT	Known records are restricted to the Cumberland subregion. In particular, between Richmond and Macquarie Fields, near the Nepean and Georges Rivers. The species is fragmented with 99 per cent occurring in the north at Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs. The species occurs predominantly in the Penrith area. The species has been found in the following vegetation communities: • Agnes Banks Woodland • Castlereagh Scribbly Gum Woodland • Cooks River/Castlereagh Ironbark Forest • Shale Sandstone Transition Forest The species is dependent on aeolian and alluvial sediments and is found in the Agnes Banks and Berkshire Park soil landscapes. It is more common on the deeper sands at the Agnes Banks soil landscape than at the edge of the deposit. It occurs on low rises rather than swales in the Berkshire Park formation. (DoEE, 2018f; NSW DEC, 2005)
POPULATIONS	As of 2005, there were around 5,500 individuals in total from 27 populations. Approximately 99 per cent are found in the north of the species range, and some isolated smaller populations are found in the south. (NSW DEC, 2005)

	Assessment of all BioNet records of the species indicates that over 90 per cent of known records occur within the Cumberland subregion. Therefore, for the purposes of this assessment, *P. nutans* is considered to be an endemic species to the region.
SOS SITES	The following SOS sites for the species have been identified: • Cumberland Plain
RELEVANT PLANS AND POLICIES	*Persoonia nutans R. Br.* (Nodding Geebung) Recovery Plan (NSW DEC, 2005) Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a) Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=18119

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	Yes (Douglas, 2019c). Available at Supporting Document C				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS** **Expert report polygons.** Potential habitat polygons were generated based on the occurrence of PCT 724, 725, 883, 1081, and 1395, with the application of riparian exclusion buffers to account for the fact that wetter and sometimes more thickly vegetated areas associated with drainage lines are unlikely habitat. All vegetation condition states were included except for derived native grasslands. To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. In some areas which were surveyed, no suitable habitat was identified for the species, and these areas were removed from the habitat mapping. If suitable habitat was determined to be present by surveys, then the area was retained within the habitat map, regardless of whether the species was detected on site during the survey. The species was recorded during surveys in GPEC. The potential habitat mapped through this process is considered precautionary and does not necessarily equate with actual habitat. The species is naturally rare and patchily distributed, which means that it is unlikely that a large percentage of the potential habitat would actually support the species, even though it can sometimes be locally abundant in favourable conditions. It is noted that different vegetation classes have different potential to be habitat for *P. nutans*; PCT 883 is considered to be highly likely to constitute habitat for this species, while PCT 724 and 725 have				

	moderate likelihood of constituting habitat, and PCT 1081 and 1395 have low and very low likelihoods respectively (Douglas, 2019d).
	OUTSIDE THE NOMINATED AREAS
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. The report for this process (Supporting Document F) notes that the model for the species predicts more potential habitat than would be expected in the far south and to the north-east of the Strategic Assessment Area. The mapping is considered to be highly precautionary. No targeted surveys as part of this project were undertaken outside the nominated areas.
POPULATION MAPPING	**RECORD SELECTION**
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *P. nutans* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *P. nutans* were downloaded in May 2021.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Populations of the species were defined to include clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	Populations of *P. nutans* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. All populations of *P. nutans* are considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-18 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-24 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *P. nutans* in the Strategic Assessment Area. **Records** A total of 10 important populations have been mapped within the Strategic Assessment Area and three are wholly or partly located in existing conservation reserves. The largest of these populations (population number 64, which comprises 1,530 records) is located in the Londonderry locality to the north of GPEC. This population partially occurs within existing lands protected for conservation purposes, including Agnes Banks Nature Reserve, Wianamatta Nature Reserve, Castlereagh Nature Reserve and Windsor Downs Nature Reserve.

Remaining populations are distributed as follows:

- 1 small population near Razorback, south of the Old Hume Highway
- 1 small population located to the north-west of Agnes Banks Nature Reserve, in Grose Wold
- 3 small populations occur within GPEC, in the following localities:
  - Wianamatta Regional Park and Ropes Crossing
  - Colyton
  - North of the M4 in Orchard Hills
- 1 small population occurs near Bill Anderson Park in Kemps Creek, within and adjacent to the southern border of WSA
- 2 populations (one large and one small) occur in the Holsworthy/Hammondville locality
- 1 moderate population occurs adjacent to the Georges River, near Macquarie Fields and Long Point

Potential habitat

The baseline mapping for this assessment has mapped approximately 15,043.3 ha of known and potential habitat has been mapped within the Strategic Assessment Area. The majority of habitat is located in the Londonderry area, where the majority of records of the species occurs.

Within the nominated areas, habitat is predicted to occur:

- In the GPEC and WSA nominated areas, at Wianamatta Regional Park, Ropes Crossing, North St Marys, Claremont Meadows, Colyton, and Kemps Creek and on either side of the GPEC – WSA boundary in the vicinity of Twin Creeks
- In the northern portion of GMAC, including Leumeah, Ingleburn, and Macquarie Fields

It is noted that there is no habitat mapped for *P. nutans* in Wilton.

Outside of the nominated areas, and in addition to the large area of habitat in the Londonderry locality, habitat is mapped to occur:

- As moderate and well-connected areas of habitat in the far east of the Strategic Assessment Area, in the Moorebank/Holsworthy/Macquarie Fields/Kentlyn district
- As a small area of habitat at Scheyville National Park
- As very small, scattered patches in the region to the south and east of WSA, ranging from Cobbitty in the south-west through to Leumeah in the south-east, up to the locality of Bossley Park

It is noted that the habitat map for *P. nutans* over-predicts habitat to occur outside the natural range of the species, and therefore habitat mapped in the south, and outside the north-east and north-west boundary of the strategic assessment is not considered to include real habitat for the species (Ascelin Gordon & Koshkina, 2018). It is thought that the related (and restricted) *Persoonia bargoensis* occupies the equivalent ecological niche in habitat in the south of the Strategic Assessment Area (Douglas, 2019c).

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.8.1 NOMINATED AREAS

RECORDS

A total of four populations of this species occurs within the nominated areas (three within GPEC and one within WSA). Of these:

- Two populations (61 and 524) occur entirely within excluded lands (all in GPEC)
- One population (60) has one record that occurs in land avoided for biodiversity purposes in WSA, whilst the remainder of the population occurs outside the boundary of WSA

- One population (63) occurs partially within excluded lands, and partially in certified land for transport development (in GPEC)

It is noted that the Plan includes a commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure on non-certified land to known populations of *P. nutans.*

Further, the Plan commits (Commitment 3) to avoid and minimise impacts to threatened ecological communities, species and their habitat (including *P. nutans*) due to the construction of certified major transport corridors, including the Outer Sydney Orbital in GPEC.

POTENTIAL HABITAT

The baseline mapping for this assessment has mapped 241 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 99 ha (41.1 per cent) of this has been avoided as part of the urban capable lands and transport corridors (not including excluded lands). Almost all of this was avoided for biodiversity purposes.

A breakdown of avoidance across each nominated area is provided in Table 29-25.

It is important to note that the avoidance calculations in Table 29-25, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-25 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.8.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.8.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to direct impacts to a known population, loss of potential habitat, and fragmentation of potential habitat. A summary of these impacts is provided in Table 29-26.

IMPACTS TO KNOWN POPULATIONS

Population 63

This population comprises six records from 1993 to 2019 in and to the north of GPEC. Of these, three records occur within Wianamatta Regional Park, one occurs adjacent to the southern boundary of Shanes Park, and the remaining two occur within Ropes Crossing. The number of individual plants ranges from 0 (presumed to be 1) to 7 across the records.

Of the records within Wianamatta Regional Park, one was detected during a survey conducted by the consulting team in June 2019, confirming that the species is still present at the site. This site contains Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion, ranging from intact to thinned condition. Based on the mapped location of the records within BioNet, three of the six records will be lost due to construction of the Outer Sydney Orbital.

LOSS OF POTENTIAL HABITAT

142.5 ha of potential habitat for the species will be lost. This is 0.9 per cent of mapped potential habitat across the Strategic Assessment Area. The loss of potential habitat occurs predominantly within GPEC and WSA.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to an important population is considered to be medium. This risk ranking is triggered for impacts to species' records, as follows:

- The likelihood of actual impacts occurring to the species has been categorised as almost certain. There will be direct impacts to a known population of the species, with high confidence in the accuracy of the records
- The consequence of any impacts to the species (if they did occur) has been categorised as moderate. There will be a loss of records within an important population which is not at the edge of the species' occurrence

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be medium. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as likely. There will be direct impacts to potential habitat with high confidence that the species occurs in the impact area
- The consequence of impacts to the species (if they did occur) has been categorised as moderate. There will be a loss of 0.9 per cent of mapped potential habitat (endemic species), with high confidence that the species occurs in the impact area

29.8.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The Plan will lead to fragmentation of a moderate area of mapped habitat associated with records of the species within GPEC due to the development of the OSO within Wianamatta Regional Park.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of fragmentation is considered to be low. This is because:

- The likelihood of fragmentation has been categorised as possible. This is because:
    - The likelihood that development presents a barrier to dispersal of the species is possible. The main pollinators of *P. nutans* are thought to be wasps and bees, and seed is likely to be dispersed by large birds and mammals. Transport infrastructure may represent a barrier to gene flow
    - The type of fragmentation is impact to habitat connected to a population. This is because there are known records located on mapped potential habitat which is fragmented by the OSO development
- The consequence of fragmentation has been categorised as moderate. This is because the area to be fragmented is connected to a known population of the species and is of moderate size

29.8.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the species, the Plan includes a commitment to secure two offset locations for the species as part of the conservation program (Commitment 9). This will provide an addition to the level of protection of the species within the Strategic Assessment Area where currently only three populations (out of a total of 11) occur in protected areas. In situ protection of *P. nutans* populations is a fundamental component of the species' recovery plan.

In addition to this, a total of 170.7 ha of potential habitat for *P. nutans* is contained within two of the Plan's proposed reserves. These include:

- 156.6 ha of mapped habitat in the Georges River Koala Reserve
- 14.1 ha within the Confluence Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.8.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan (NSW DEC, 2005) (and other key documents) for *P. nutans* identifies a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Habitat degradation and rubbish dumping related to unrestricted access
- Infection by root-rot fungus *Phytophthora cinnamomi*

Honeybee competition and grazing by rabbits have also been identified as key threats. However, these were not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. nutans* are discussed below for each identified indirect impact.

It is noted that the Plan includes a commitment for two offset locations for *P. nutans*. Further, a total of 170.7 ha of potential habitat for *P. nutans* is contained within two of the Plan's proposed reserves. The establishment of known offset sites and conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes constitute one of the major threats to the survival of *P. nutans* (NSW DEC, 2005). The species is an obligate seed regenerator, with fire being an important mechanism to promote germination. Too frequent fire will prevent maturation and reproduction of the species, while too infrequent fire will result in senescence and death of adults with minimal or no recruitment.

Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the following mechanisms:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Key risk areas are those that are easily accessible to the public and in close proximity to urban development and roads and include the Londonderry locality to the north of GPEC, potential habitat within and near Wianamatta Regional Park in GPEC, potential habitat near Kemps Creek in WSA, and potential habitat adjacent to the north-east boundary of GMAC near Holsworthy.

The Plan incorporates species-specific measures for the protection of *P. nutans*, which will contribute to the maintenance of appropriate fire regimes within species' habitat and provide for protection for the species. Species-specific measures which are relevant to fire regime management include:

- Protecting two known offset locations for P. nutans (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species.
- A measure in Appendix E of the Plan to consult with land managers of land containing known populations or habitat of P. nutans to mitigate indirect impacts from fire during construction and operation of the development, taking into account guidance in the Fire Management Strategy. The measure applies to GPEC and will be implemented by consultation with local councils and other public agencies and the Fire Management Strategy

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. nutans* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *P. nutans*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

These controls support a range of recovery actions within the species' Recovery Plan which suggests the species' fire requirements be taken into account with regards to site management plans (NSW DEC, 2005).

WEED INVASION

P. nutans is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development within the northern half of the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

P. nutans is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include:

- The southern end of Shanes Park where the M7/Ropes Crossing Link occurs adjacent to potential habitat areas
- The north-eastern section of Wianamatta Regional Park, where the Outer Sydney Orbital corridors within GPEC in areas of potential habitat

The Plan incorporates species-specific measures for the protection of *P. nutans*, which will contribute to the control of weeds within known and potential habitat for the species. Species-specific measures which are relevant to weed control include:

- Protecting two known offset locations for *P. nutans* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species

- A measure in Appendix E of the Plan which relates to development within urban capable land, to implement mitigation measures to manage weeds for *P. nutans* populations and habitat adjacent to urban and infrastructure development during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy. The measure applies in GPEC and WSA and will be implemented by the DCP template, Mitigation Measures Guideline, Weed Control Strategy and Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
- A measure in Appendix E of the Plan which relates to development within transport corridors, to implement mitigation measures to manage weeds for *P. nutans* populations and habitat adjacent to major infrastructure corridors during construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy. The measure will be implemented by the State Significant Infrastructure assessment and approval process and applies to the OSO in Wianamatta Regional Park and M7/Ropes Crossing link Road

The Plan further incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *P. nutans*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *P. nutans* from the increased risk of weeds associated with development. This is because:

- Two known offset locations for *P. nutans* will be obtained (Commitment 9) and managed for conservation purposes, which will ensure long-term protection of known populations and habitat of this species
- Species-specific measures in Appendix E will manage the threat of weeds from development
- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

HABITAT DEGRADATION AND RUBBISH DUMPING RELATED TO UNRESTRICTED ACCESS

Habitat degradation through unrestricted public access has been identified as a key threat to *P. nutans*. Development within GPEC and WSA may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

Populations of *P. nutans* on public land, and areas which are often mistaken for public land, are considered most at risk from this impact. It is noted that an area of freehold land to the north of GPEC which is often mistaken for Crown land, contains a number of access tracks, and issues associated with rubbish dumping have been recorded for the site.

Two populations occur on public land managed for conservation. They are:

- Population 63 – Wianamatta Regional Park
- Population 64 - Castlereagh Nature Reserve, Wianamatta Nature Reserve, Agnes Banks Nature Reserve, Windsor Downs Nature Reserve

The Plan incorporates species-specific measures for the protection of *P. nutans,* which will contribute to the control of habitat disturbance within known and potential habitat for the species. Species-specific measures which are relevant to habitat disturbance include:

- Protecting two known offset locations for *P. nutans* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species
- An action (Action 8, associated with Commitment 5) to consult with the relevant public land manager to minimise disturbance and impacts to *P. nutans* in accordance with Appendix E, including ensuring walking tracks and management trails in Wianamatta Regional Park are located in a way that avoids and minimises exposure of *P. nutans* to human disturbance
- A measure in Appendix E of the Plan to consult with land managers of land containing known populations or habitat for *P. nutans* to mitigate indirect impacts from human disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and slashing, and managing rubbish dumping. The measure will be applied through consultation with local councils and other public agencies and applies to GPEC

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the two offset locations to be obtained for *P. nutans* in association with Commitment 9)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas.

The package of measures in the Plan is expected to adequately manage the risk to *P. nutans* from inappropriate habitat disturbance as a result of development. This is because:

- Walking and maintenance trails within Wianamatta Regional Park will be located to minimise the risk of habitat disturbance to the species
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

INFECTION BY ROOT-ROT FUNGUS PHYTOPHTHORA CINNAMOMI

P. nutans is threatened by exposure to *Phytophthora cinnamomi,* a soil-borne water mould which is fatal to many *Persoonia* species.

Development under the Plan has the potential to increase the spread of *P. cinnamomi* through increased site visitation rates and earthworks activities conducted during construction works. The areas which are most at risk are those which are in close proximity to development sites, in particular available habitat within Wianamatta Regional Park which has potential to be impacted by the development of the OSO.

The Plan incorporates species-specific measures for the protection of *P. nutans,* which will contribute to the control of *P. cinnamomi* within known and potential habitat for the species. Species-specific measures which are relevant to management of *P. cinnamomi* include:

- Protecting two known offset locations for *P. nutans* (Commitment 9). It is noted that offset locations will be managed as conservation reserves which will provide for long-term protection of known populations of the species
- A measure in Appendix E of the Plan relating to development in urban capable land, to incorporate best practice site hygiene protocols to manage the potential spread of pathogens, such as *Phytophthora* and Myrtle Rust adjacent to potential habitat for *P. nutans*. The measure will be implemented by the DCP template, Mitigation Measures Guideline and Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, and applies to GPEC and WSA
- A measure in Appendix E of the Plan relating to development of transport corridors to incorporate best practice site hygiene protocols to manage the potential spread of pathogens, such as *Phytophthora* and Myrtle Rust adjacent to potential habitat for *P. nutans*. The measure will be implemented by the State Significant Infrastructure assessment and approval process and applies to the Outer Sydney Orbital in Wianamatta Regional Park

The Plan incorporates a range of general measures to manage the risks associated with *Phytophthora cinnamomi*. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
  - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
  - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to *P. nutans* from *Phytophthora cinnamomi* because:

- Conservation lands (including offset sites obtained for *P. nutans*) will be actively managed which will address threats in those areas including disease threats
- Development controls will be put in place to address potential impacts associated with construction
- It supports a landscape scale approach to the issue across the Cumberland subregion

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to development of essential infrastructure within nominated areas but outside the urban capable lands.

There is no mapped habitat within the footprints for the tunnels and the species will not be impacted in those areas.

29.8.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The species has been recorded in WSA and GPEC. However, no populations in GPEC occur on avoided lands. One population (population 60) has one record within avoided lands in WSA, with the remaining records of this population being located outside of the nominated area boundary.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect *P. nutans* from impacts from essential infrastructure. These include:

- Commitment 2.2, which specifically prioritises avoidance of impacts to *P. nutans*
- A measure in the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, which requires that avoidance of impacts to *P. nutans* be prioritised

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *P. nutans* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.8.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Recovery Plan (NSW DEC, 2005) (and other key documents) identify the following key issues that are likely to have the greatest influence on the long-term viability of *P. nutans* in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts including:
  - Inappropriate fire regimes
  - Weed invasion
  - Habitat degradation and rubbish dumping related to unrestricted access
  - Infection by root-rot fungus *Phytophthora cinnamomi*

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to:

- Direct impacts to a known population (population 63) of the species
- Loss of approximately 142.5 ha of potential habitat
- Potential fragmentation of habitat in one location

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is medium.

The likelihood of potential impacts to population 63 due to the development of the OSO within Wianamatta Regional Park in addition to potential impacts to habitat, are the key drivers for this risk rating. There is a high level of confidence that the impacted population is extant, as the population was detected on site during surveys conducted for this strategic assessment. Further, it is considered likely that the (endemic) species is present in impacted habitat, which comprises between 0.5-1 per cent of the total habitat within the Strategic Assessment Area.

It is noted that the Plan commits (Commitment 3) to avoid and minimise impacts to threatened ecological communities, species and their habitat (including *P. nutans*) due to the construction of the Outer Sydney Orbital in GPEC. It will be critical that this process avoids and minimise impacts as far as possible to reduce the scale of impacts.

The Plan will deliver two offset locations to address the medium risk to *P. nutans* from direct impacts of development (Commitment 9), which will provide for additional protection for the species. The process of protecting land in the Strategic Assessment Area is likely to support a performance criterion within the species' recovery plan, which aims to increase the level of protection afforded to *P. nutans* through conservation planning and land use decisions.

In addition, the Plan includes a broader set of commitments and actions which are likely to benefit the species. The SCA contains approximately 1,365 ha of mapped potential habitat for *P. nutans.* It is very likely that areas of potential habitat in addition to the two offset sites will be protected within the SCA as part of offset commitments for other species and ecological communities under the Plan. For example, two of the proposed reserves in the Plan contain mapped habitat for the species (including 156.6 ha in the Georges River Koala Reserve).

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, weed invasion, habitat disturbance, and rubbish dumping related to unrestricted access and infection by root-rot fungus *Phytophthora cinnamomi* have been analysed and determined to be adequately managed and mitigated through species-specific and generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

Development under the Plan will lead to impacts to a known population of *P. nutans* and areas of potential habitat. While these impacts are considered to present a medium risk of adversely impacting the species, implementation of the Plan is not expected to negatively influence the long-term viability of the species for the following key reasons:

- Direct impacts to population 63 are likely to be mitigated through a commitment (Commitment 3) to avoid and minimise impacts to threatened ecological communities, species, and their habitat (including *P. nutans*) due to the construction of the Outer Sydney Orbital in GPEC
- The Plan will lead to the protection of two sites known to support the species (Commitment 9), which will contribute to the level of existing protection
- Protection and management of known habitat through the offset commitment, as well as the protection and management of additional areas of suitable habitat through the Plan's broader commitments with the SCA, is likely to contribute meaningful outcomes for *P. nutans,* which has been shown to respond positively to the removal of threats on land where it is known to occur
- Potential indirect impacts are addressed through management measures in the Plan

29.8.9 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan (NSW DEC, 2005) to ensure the continued and long-term survival of *P. nutans* in the wild by promoting the in situ conservation of the species across its natural range. Specific objectives include:

- Minimise the loss and fragmentation of *P. nutans* habitat using land-use planning mechanisms
- Identify and minimise the operation of threats at sites where *P. nutans* occurs
- Implement a survey and monitoring program that will provide information on the extent and viability of *P. nutans*
- Provide public authorities with information that assists in conserving the species
- Raise awareness of the species and involve the community in the recovery program
- Promote research questions that will assist future management decisions.

Implementation of the Plan will support a number of these strategies and will not prevent the achievement of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT THE IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to support the overall recovery of *P. nutans*. The Plan will not prevent implementation of any of the actions.

29.8.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-23 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15. The Plan is not inconsistent with any Threat Abatement Plans.

Table 29-23: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. nutans*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus *(Phytophthora cinnamomi*)	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-24: Occurrence of *P. nutans* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	10	3
(IMPORTANT POPULATIONS)	(10)	(3)
HABITAT MAPPING (Ha)	15,043.3	1,608.5

Table 29-25: Avoidance of *P. nutans* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	27.7	149.2	315.3	492.2
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	27.7	16.1	207.3	251.2
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**133.0**	**107.9**	**241.0**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	74.2	24.5	98.7
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	55.8	22.7	40.9
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	0.1	0.2	0.3
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.1	0.2	0.1
TOTAL AVOIDANCE (ha)	**0.0**	**0.0**	**74.3**	**24.7**	**99.0**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**0.0**	**55.9**	**22.8**	**41.1**

Table 29-26: Direct impacts to *P. nutans* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	58.7	83.3	0.5	**142.5**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	1	0	**1**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(1)	(0)	**(1)**

SPECIES AT LOW RISK OF DIRECT IMPACTS

29.9 *EUCALYPTUS BENTHAMII* (CAMDEN WHITE GUM, NEPEAN RIVER GUM)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Eucalyptus benthamii* is a smooth, white barked tree with loose bark ribbons and a flaky bark stocking at its base. Has long thin leaves and white flowers. Grows to approximately 40 m tall. (OEH, 2017b)
ECOLOGY	Flowers in summer and autumn. Sporadic flowering may occur throughout the year. Depends on flooding for seedling establishment. (DoE, 2014b)
DISTRIBUTION AND HABITAT	Occurs west of Sydney in the Cumberland subregion and Blue Mountains. Distribution overlaps with the following EPBC Act-listed TECs: • Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest • Shale Sandstone Transition Forest Inhabits open forest in areas with deep, fertile alluvial sands and a flooding regime that permits the establishment of seedlings. Recruitment is successful on bare sediment deposits in rivers and streams after flooding. (DoE, 2014b)
POPULATIONS	Records occur on the flats of the Nepean River and its tributaries. As of 2005, two major sub-populations have been recorded: up to 6,500 individuals in Kedumba Valley of the Blue Mountains National Park and up to 300 plants in the Bents Basin State Recreation Area. (DoE, 2014b)
SOS SITES	The following SOS sites for the species have been identified: • Kedumba • Bents Basin • Camden Airport

RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Eucalyptus benthamii* (Camden White Gum) (DoE, 2014b) Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) (DoEE, 2017b)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=2821

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	Yes	Yes	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report available for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned, scattered trees), waterways (habitat restricted to within a 350 m buffer of the 'Nepean River Hydro Area'), geology ('Alluvium', 'Bringelly Shale', 'Hawkesbury Sandstone') and elevation (between 25 m and 300 m).				
	OUTSIDE THE NOMINATED AREAS				
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. The report notes that there were a moderate number (582) of records of *E. benthamii* with which to produce a model (generally, over 50 records are required to produce a reliable SDM). The approach to SDM mapping may over-predict habitat for the species. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *E. benthamii* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset.				

	The BioNet records used for the assessment of *E. benthamii* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. There is limited information available regarding pollination and dispersal thresholds for *E. benthamii.* Therefore, a population was considered to constitute clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	Populations of *E. benthamii* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. Populations of *E. benthamii* were considered important because they met one or more of the following criteria: • A population identified or inferred in a Commonwealth conservation advice, plan, final determination, or other relevant policy document as being important • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program • A large population • A population within a conservation reserve • A population that is important for maintaining the Extent of Occurrence of a species

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-7 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-28 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *E. benthamii* in the Strategic Assessment Area. **Records** A total of eight important populations (from 578 records) have been mapped within the Strategic Assessment Area. Of these: • One occurs along Werriberri Creek and its tributaries, near The Oaks in the south-west region of the Strategic Assessment Area • Remaining populations occur in scattered localities along the Nepean River and its tributaries, with populations occurring at Yarramundi, Glenmore Park, Wallacia, Gulguer, Theresa Park, the area spanning from Brownlow Hill through to Spring Farm, and Menangle Park It is noted that no records occur within the nominated areas. **Potential habitat** The baseline mapping for this assessment has mapped approximately 4,797.9 ha of potential habitat within the Strategic Assessment Area (see Table 29-28). Habitat is primarily associated with riparian corridors, particularly those associated with the Nepean River and its tributaries. Specifically, habitat is mapped to occur in the following localities: • Well-connected areas of habitat incorporating the Nepean River and its tributaries in the south-western area of the Strategic Assessment Area, in the locality bounded by Picton to the south, Belimbla Park in the west, Mulgoa in the north, and Menangle Park in the east • Scattered habitat along the Nepean River between Richmond and Jamisontown

	• Scattered occurrences along Wianamatta (South Creek), between Windsor and Wianamatta Regional Park, near Erskine Park, and between Badgerys Creek and Oran Park • Small, scattered occurrences along Hinchinbrook Creek, Georges River and Bunbury Curran Creek in the eastern section of the Strategic Assessment Area • Along Badgerys Creek, Bardwell Gully and Lowes Creek and Rileys Creek to the south of WSA

AVOIDANCE OF IMPACTS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.9.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 0.5 ha of potential habitat within the nominated areas (not including excluded lands). Of this land, <0.1 ha was avoided for biodiversity purposes, with the remaining land avoided for other reasons.

A breakdown of avoidance across each nominated area is provided in Table 29-29.

It is important to note that the avoidance calculations in Table 29-29, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-29 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.9.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

It is noted that the Plan contains a species-specific commitment (Commitment 4.2) to avoid and minimise impacts to *E. benthamii* as a result of tunnel construction activities in transport corridors.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.9.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to loss of potential habitat. A summary of these impacts is provided in Table 29-30.

LOSS OF POTENTIAL HABITAT

There will be approximately 47.3 ha of impacts to potential habitat (1 per cent of mapped habitat across the Strategic Assessment Area). These impacts are primarily due to the Outer Sydney Orbital as it traverses north from Cobbitty across a tributary of the Nepean River.

There is also one other very small and discrete loss of habitat where a transport corridor crosses Cosgroves Creek outside GPEC, in the vicinity of Twin Creeks.

The areas being impacted upon do not support known records or populations of *E. benthamii*.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be very low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as possible. While there will be direct impacts to potential habitat, there is moderate confidence that the species will occur in the impact area (it is noted that the impacted habitat was modelled via the SDM process, which is considered to be precautionary and may over-predict habitat. There are no records in close proximity to the impacted areas of habitat)
- The consequence of impacts to the species (if they did occur) has been categorised as negligible. There will be a loss of 1 per cent of mapped potential habitat (vulnerable species), with moderate confidence that the species occurs in the impact area

29.9.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The Plan will lead to fragmentation of potential habitat in the following locations:

- Fragmentation of a small area of mapped habitat associated with records of the species at Cobbitty due to the development of the OSO
- Fragmentation of a very small area of mapped habitat that is not associated with records of the species in the vicinity of Twin Creeks, where a proposed transport corridor crosses Cosgroves Creek to the south of GPEC

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of fragmentation is considered to be low. This is because:

- The likelihood of fragmentation has been categorised as possible. This is because:
    - The likelihood that development presents a barrier to dispersal of the species is possible. While seedling establishment is thought to occur in association with flooding events, there is otherwise limited information available regarding pollination and dispersal thresholds for *E. benthamii.* It is therefore thought to be possible that development of the OSO may constitute a dispersal barrier for this species
    - The type of fragmentation is impact to habitat connected to a population. This is because there are known records located on mapped potential habitat which is fragmented by the OSO development
- The consequence of fragmentation has been categorised as minor. This is because the area to be fragmented is connected to a known population of the species and is of small size

29.9.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for *E. benthamii.*

It is noted that a total of 192.4 ha of potential habitat for *E. benthamii* is contained within two of the Plan's proposed reserves. These include:

- 47.1 ha within the Confluence Reserve investigation area
- 145.2 ha of mapped habitat in the Gulguer Reserve investigation area

Further, an important population of *E. benthamii* is located within the Gulguer Reserve investigation area.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.9.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (and other key documents) for the *E. benthamii* identifies a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Changed hydrology
- Myrtle rust
- Weed invasion

Inappropriate revegetation works (impacting genetic diversity), isolated populations, impacts on genetic integrity (such as through hybridisation with *E. viminalis*), raising the height of the Warragamba Dam wall, construction of smaller dams, loss of regeneration opportunities and feral pigs have also been identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *E. benthamii* are discussed below for each identified indirect impact.

It is noted that a total of 192.4 ha of potential habitat for *E. benthamii* is contained within two of the Plan's proposed reserves, and an important population of the species is located within the Gulguer Reserve investigation area. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES

E. benthamii is threatened by altered fire regimes. The Plan has the potential to impact fire regimes as a result of increased human activity associated with development of urban capable land within the nominated areas and development of transport corridors outside of the nominated areas.

Small areas of mapped potential habitat occur in close proximity with urban capable development in the vicinity of Twin Creeks (outside of the nominated areas), and in the vicinity of Kemps Creek (outside of the nominated areas). Otherwise, mapped potential habitat is spatially removed from urban capable lands, and as such the likelihood of potential habitat being impacted by urban capable development is low.

Transport corridor development outside of the nominated areas has the potential to impact habitat for *E. benthamii* as a result of development of the OSO near Cobbitty, in addition to near Twin Creeks where a proposed transport corridor crosses Cosgroves Creek.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *E. benthamii* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk

The package of measures in the Plan is expected to adequately manage the risk to *E. benthamii* from altered fire regimes as a result of development. This is because fire management authorities will be engaged to ensure they understand the requirements of *E. benthamii* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas.

CHANGED HYDROLOGY

Changes to hydrology and nutrient runoff are an identified threat to the species. The Plan has the potential to impact hydrology as a result of development within urban capable land and transport corridors. As outlined above, the areas which are most at risk of indirect impacts from development are those in close proximity to areas of development and include mapped potential habitat near urban capable development at Twin Creeks, Kemps Creek, and mapped potential habitat close to the OSO footprint near Cobbitty.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

It is further noted that Appendix E of the Plan includes a species-specific measure to control indirect impacts (including changed hydrology) to *E. benthamii* associated with the development of the OSO tunnel. This measure is discussed

further below in Section 29.9.8, and will provide additional protection to *E. benthamii* from potential impacts associated with hydrological disturbance.

The package of measures in the Plan is expected to adequately manage the risk to *E. benthamii* from changes to hydrology because transport projects will apply best practice approaches to avoiding and minimising any potential impacts to biodiversity values, including potential habitat for *E. benthamii*.

MYRTLE RUST

E. benthamii is threatened by exposure to myrtle rust, an exotic fungus which can lead to growth defects and mortality of *Eucalyptus* species.

Development under the Plan has the potential to increase the spread of myrtle rust through increased site visitation rates and earthworks activities conducted during construction works. The areas which are most at risk are those which are in close proximity to development sites and include mapped potential habitat near urban capable development at Twin Creeks, Kemps Creek, and mapped potential habitat close to the OSO footprint near Cobbitty.

The Plan incorporates a range of general measures to manage the risks associated with myrtle rust. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

It is further noted that Appendix E of the Plan includes a species-specific measure to control indirect impacts (including spread of disease) to *E. benthamii* associated with the development of the OSO tunnel. This measure is discussed further below in Section 29.9.8 and will provide additional protection to *E. benthamii* from potential impacts associated with myrtle rust.

The package of measures in the Plan is expected to adequately manage the risk to *E. benthamii* from myrtle rust because:

- Development controls will be put in place to address potential impacts associated with construction
- It supports a landscape scale approach to the issue across the Cumberland subregion

WEED INVASION

E. benthamii is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development within the northern half of the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The species is most susceptible to the threat of weeds from development under the Plan where urban capable lands or transport occur adjacent to known populations or habitat. The areas most at risk include mapped potential habitat near urban capable development at Twin Creeks, Kemps Creek, and mapped potential habitat close to the OSO footprint near Cobbitty.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *E. benthamii*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program

  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

It is further noted that Appendix E of the Plan includes a species-specific measure to control indirect impacts (including weed invasion) to *E. benthamii* associated with the development of the OSO tunnel. This measure is discussed further below in Section 29.9.8, and will provide additional protection to *E. benthamii* from potential impacts associated with weed invasion.

The package of measures in the Plan is expected to adequately manage the risk to *E. benthamii* from the increased risk of weeds associated with development. This is because:

- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to biodiversity values, including potential habitat for *E. benthamii*
- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.9.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The species has been recorded in none of the nominated areas, and there is only a very small (0.5 ha) amount of potential habitat mapped for this species within avoided lands.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
  - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
  - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *E. benthamii* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.9.8 POTENTIAL IMPACTS FROM TUNNELS

Both the Metro Rail Future Extension and the OSO tunnels intercept mapped potential habitat for *E. benthamii*. Of these two tunnels, however, only the OSO is considered to have potential to negatively impact upon *E. benthamii*.

The Metro Rail Future Extension has a total of 1.5 ha of mapped potential habitat for *E. benthamii* within the impact footprint. This habitat is a small, isolated patch of habitat associated with Narellan Creek, which is in a heavily cleared and highly disturbed landscape in close proximity to existing urban development. There are no records of the species in the proximity of this habitat. It is considered to be unlikely that the species would be present at this site.

The OSO tunnel intercepts approximately 35.3 ha of potential habitat for *E. benthamii*, in addition to an important population of the species (population 95), which is partially located in two conservation reserves (a Registered Property Agreement site, and the Mater Dei BioBank site), in addition to occurring outside of the reserve boundaries in the Camden locality between Spring Farm and Cobbitty Road along the Nepean River. This population is recognised to be important for maintaining the genetic diversity of the species (DoE, 2014b).

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under Commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels

- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

In particular, for *E. benthamii*, the Plan includes the following measures:

- A commitment (Commitment 4.2) to avoid and minimise impacts to populations and habitat within or adjacent to the OSO and Metro Rail Future Extension footprints for *E. benthamii*
- A measure in Appendix E of the Plan to manage key threats to the species. This measure applies to the OSO tunnel and will be implemented via the State Significant Infrastructure assessment and approval process. Key threats which will be managed include:
    - Hydrological disturbance
    - Spread of weeds
    - Spread of infection/disease
    - Soil erosion and sedimentation
    - Ground settling or subsidence

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.9.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014b) and other key documents identifies the following key issues that are likely to have the greatest influence on the long-term viability of *E. benthamii* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
    - Inappropriate fire regimes
    - Changed hydrology
    - Myrtle rust
    - Weed invasion

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to:

- Loss of 47.3 ha of mapped habitat within the nominated areas and transport corridors
- Potential fragmentation of habitat in two locations

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is low. The total area of potential habitat which will be impacted is a small proportion of available habitat for the species with only moderate confidence of the species' presence in impacted areas. Fragmentation of a small area of mapped potential habitat connected with species' records will also occur. It is noted that no known records of the species are directly impacted or fragmented from other known records.

It is noted that *E. benthamii* occurs within the footprint of the proposed OSO tunnel. The Plan contains a species-specific commitment (Commitment 4.2) to avoid and minimise impacts to *E. benthamii* as a result of tunnel construction activities in transport corridors, which is considered to protect the individuals within the tunnel footprint from direct impacts.

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contain approximately 1,442.5 ha of potential habitat for *E. benthamii*. For example, two of the proposed reserves in the Plan contain mapped habitat for the species (including 145.2 ha in the Gulguer Reserve investigation area. Note that this reserve area also contains a known important population of *E. benthamii*).

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts of development corridors associated with inappropriate fire regimes, changed hydrology, myrtle rust and weed invasion have been analysed and determined to be adequately managed and mitigated through species-specific and generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.9.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.9.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-27 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15.

Table 29-27: Relevant key Threatening Processes and associated Threat Abatement Plans for *E. benthamii*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation, habitat degradation, competition, and disease transmission by feral pigs	Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) (DoEE, 2017b)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-28: Occurrence of *E. benthamii* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	8	2
(IMPORTANT POPULATIONS)	(8)	(2)
HABITAT MAPPING (Ha)	4,797.9	491.3

Table 29-29: Avoidance of *E. benthamii* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	73.3	0.0	0.2	73.4
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	72.8	0.0	0.2	72.9
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.5**	**0.0**	**0.0**	**0.5**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	<0.1	0.0	**0.0**	<0.1
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.2	0.0	0.0	0.2
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.5	0.0	0.0	0.5
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	99.8	0.0	0.0	99.8
TOTAL AVOIDANCE (ha)	**0.0**	**0.5**	**0.0**	0.0	**0.5**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**100.0**	**0.0**	**0.0**	**100.0**

Table 29-30: Direct impacts to *E. benthamii* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	0.0	0.0	47.3	**47.3**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.10 *GREVILLEA PARVIFLORA* SUBSP. *PARVIFLORA* (SMALL-FLOWER GREVILLEA)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Grevillea parviflora* subsp. *parviflora* is a low, open to erect shrub with narrow leaves and white flowers. Grows from 0.3-1 m high. (DEWHA, 2008d)
ECOLOGY	Flowers between July – December and between April – May. Reproduces vegetatively via rootstocks. Following fire, recruitment from seed is unlikely. Individuals can live for 25-60 years. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	Endemic to NSW, occurring in the Picton, Bargo, and Appin areas. Other disjunct populations occur in Holsworthy, the Lower Hunter Valley, on the Central Coast and in the Port Stephens area. It grows on crests, upper slopes, or flat plains on sandy to gravelly clay soils. Distribution overlaps with the following TECs: • Shale Sandstone Transition Forest • Cumberland Plain Woodlands • Turpentine-Ironbark Forest in the Sydney Basin Bioregion • Castlereagh Scribbly Gum and Agnes Banks Woodland • Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (DEWHA, 2008d)
POPULATIONS	Populations vary between small populations of less than 20 stems, medium populations of 50-100 stems, to a small number of large populations of over 2,000 individuals. It is hard to establish the number of plants within a population due to its suckering nature (DoEE, 2018f).
SOS SITES	The species is managed under the data-deficient species management stream under the SOS program. Currently there are no identified management sites.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) (DEWHA, 2008d)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64910

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">No</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report for this species.</td></tr>
<tr><td rowspan="4">HABITAT MAPPING</td><td colspan="5">WITHIN THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Knowledge based map (KBM). Potential habitat polygons were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned), elevation (between 25m and 300m), soil units (‘Berkshire Park’, ‘Lucas Heights’, ‘South Creek’) and rock units (‘alluvial channel deposits-in-channel bar’, ‘alluvial floodplain deposits’, ‘alluvium’, ‘Mittagong Formation’, ‘alluvial terrace deposits’). Additional habitat added where PCTs occur on or within 200m of Hawkesbury soils and sandstone geology.
To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. These surveys either confirmed presence (known habitat) or absence (no longer considered potential habitat). The species was recorded in Wilton during surveys.</td></tr>
<tr><td colspan="5">OUTSIDE THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. The mapping is considered to be highly precautionary. No targeted surveys as part of this project were undertaken outside the nominated areas.</td></tr>
<tr><td rowspan="4">POPULATION MAPPING</td><td colspan="5">RECORD SELECTION</td></tr>
<tr><td colspan="5">Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.</td></tr>
<tr><td colspan="5">BIONET RECORD DOWNLOAD DATE</td></tr>
<tr><td colspan="5">The initial assessment of G. parviflora subsp. parviflora was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020.
Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species’ distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset.
The BioNet records used for the assessment of G. parviflora subsp. parviflora were downloaded in September 2019.</td></tr>
</table>

	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Little is known about the life cycle of *G. parviflora* subsp. *parviflora.* Flowers are insect pollinated, and it is likely that seeds have limited dispersal distances (probably <2 m) (DoEE, 2018f). Populations were identified as clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	Populations of *G. parviflora* subsp. *parviflora* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. Populations of *G. parviflora* subsp. *parviflora* were considered important because they met one or more of the following criteria: • A population that is important for maintaining the Extent of Occurrence of a species • A population within a conservation reserve • A large population

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-9 for a map of records and habitat across the Strategic Assessment Area.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-32 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *G. parviflora* subsp. *parviflora* in the Strategic Assessment Area.
	Records
	A total of 11 important populations have been identified within the Strategic Assessment Area, of which five populations are either wholly or partly located in existing conservation reserves. Important populations are distributed as follows:
	• Within GPEC:
	  ○ Population 103: this population consists of 86 records and partially occurs within GPEC in the locality of Bingara Gorge, in addition to occurring in the land in between GPEC and GMAC, including within the Appin West Biobanking Agreement site and St Marys Tower Biobanking Agreement site. The majority of records within GPEC that are associated with this population are in an area subject to a previously approved EPBC Act approval (EPBC 2014/7400)
	  ○ Population 104: this population consists of 13 records and partially occurs in the north-west of Wilton, in addition to occurring outside the western boundary of Wilton. This is a large population with over 300 individuals recorded. Records of this population were detected during site surveys for this strategic assessment
	  ○ Population 518: this population consists of a single record of 50 individuals, and occurs to the south of population 104 within the western boundary of Wilton
	• To the south of WSA within Kemps Creek, in a site protected through the previous Growth Centres Program
	• One large population occurs adjacent to Anzac Creek near Holsworthy
	• Remaining populations are scattered throughout the southern portion of the Strategic Assessment Area
	A total of five non-important populations have been identified within the Strategic Assessment Area. These occur as follows:

- One occurs wholly within GPEC (adjacent to Ropes Creek near Colyton)
- One occurs adjacent to Kemps Creek, to the south of WSA
- One occurs partially within GMAC, adjacent to the Georges River to the east of Appin
- One occurs to the south of the Nepean River, between GMAC and Wilton
- One occurs in the south of the Strategic Assessment Area

Potential habitat

The baseline mapping for this assessment has mapped 7,468 ha of known and potential habitat within the Strategic Assessment Area.

The majority of this habitat occurs in a band spreading along the south-eastern boundary of the Strategic Assessment Area. Other areas of habitat occur as follows:

- Small, scattered patches of habitat occur in the locality of Ruse, Minto Heights, Ingleburn, and Denham Court
- A moderate patch occurs near Holsworthy and Moorebank, to the north-east of GMAC
- Small, scattered patches of habitat occur to the north and north-east of Holsworthy, in Chipping Norton, Fairfield and Miller
- Small, scattered patches of habitat occur within and near to the GPEC and WSA, in locations including Kemps Creek, Claremont Meadows, North St Marys, within and near Wianamatta Regional Park, within and near Castlereagh Nature Reserve and near Windsor Downs Nature Reserve

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.10.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 584.6 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 568.7 ha (97.3 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 427.5 ha was avoided for biodiversity purposes.
- 141.3 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 29-33.

It is important to note that the avoidance calculations in Table 29-33 including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-33 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

It is noted that there is a species-specific commitment under the Plan (Commitment 2.2) to prioritise avoidance of impacts from essential infrastructure on non-certified land to *Grevillea parviflora* subsp. *parviflora*.

29.10.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.10.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to direct impacts to mapped potential habitat. A summary of these impacts is provided in Table 29-34.

It is noted that population 101 is an important population that predominantly occurs in the Kemps Creek area of the existing South West Growth Centre. One record of this population is mapped to occur within the urban capable land footprint within WSA (to the north of Kemps Creek), however, information associated with this record indicates that the positional accuracy of the record is 100 m, and that the record is located within Kemps Creek Park at the western end of park in buffer zone between playing field and bushland, along a track. Therefore, this record is considered to be located within Kemps Creek Park (to the south of WSA), and placement of this record within WSA is not considered to be accurate. There will be no direct impacts to known records of this species as a result of implementation of the Plan.

The Plan will not result in fragmentation of habitat for *G. parviflora* subsp. *parviflora*.

LOSS OF POTENTIAL HABITAT

15.9 ha of potential habitat for the species will be lost. This is 0.2 per cent of mapped potential habitat across the Strategic Assessment Area. These impacts primarily relate to a transport project (the Outer Sydney Orbital within GPEC).

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to an important population is considered to be low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species has been categorised as likely. There will be direct impacts to potential habitat with high confidence that the species occurs in the impact area
- The consequence of any impacts to the species (if they did occur) has been categorised as minor. There will be a loss of <1 per cent of mapped potential habitat with high confidence of species' occurrence in the impact area

29.10.4 FRAGMENTATION OF HABITAT

The placement of urban capable land and transport corridors within the Strategic Assessment Area will not lead to fragmentation of records or habitat of *G. parviflora* subsp. *parviflora.*, as it will not lead to the removal of habitat which links other areas of habitat or records together. All impacts to habitat of *G. parviflora* subsp. *parviflora* are to already fragmented patches, or along the edges of habitat.

Therefore, there is no residual adverse risk of fragmentation as a result of loss of potential habitat under the Plan.

29.10.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for *G. parviflora* subsp. *parviflora.*

It is noted that a total of 129.6 ha of potential habitat for *G. parviflora* subsp. *parviflora* is contained within the Georges River Koala Reserve.

Further, an important population of *G. parviflora* subsp. *parviflora* is located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.10.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DEWHA, 2008d) (and other key documents) for *G. parviflora* subsp. *parviflora* identify a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in key species documents) are considered relevant to implementation of the Plan:

- Weed invasion
- Inappropriate fire regimes
- Habitat disturbance from recreational activities, rubbish dumping and road maintenance

Agriculture has also been identified as a key threat. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate this threat across the Strategic Assessment Area.

The important populations of *G. parviflora* subsp. *parviflora* which are most at risk of indirect impacts are those in close proximity to development associated with the Plan. Important populations which are in close proximity to development include:

- Population 103: This important population occurs in Wilton and between Wilton and GMAC, and includes records within: the Appin West Biobanking Agreement site, the St Marys Tower Biobanking Agreement site, and land subject to a previously approved EPBC Act approval (EPBC 2014/7400)
- Population 104: This is a large population which occurs along the north-western boundary of Wilton, on either side of the Nepean River
- Population 518: This is a moderate population which occurs within Wilton, to the south of population 104

Of these three populations, population 104 is the most at risk from indirect impacts, given its large size (and subsequent importance for species conservation), proximity to development and lack of current protection. Comparatively, population 103 already has a level of protection, through its inclusion in two Biobanking sites and conservation land associated with EPBC approval 2014/7400. Population 518, while not located in a conservation reserve, is not as large as population 104 and therefore is not considered to be as important for conservation of the species. Given the high risk associated with population 104, a number of species-specific measures will be implemented under the Plan to protect this population from indirect impacts, as outlined below.

It is noted that population 101 is an important population which occurs to the south of WSA at Kemps Creek, in a site associated with the Sydney Growth Centres Program. This site was briefly visited in association with site surveys which were undertaken during preparation of the expert report for *Acacia pubescens*. The expert report for *A. pubescens* notes that remnant habitat at Kemps Creek was "seen to be largely unmanaged and degrading due to several threats" (Douglas, 2019c). This site is part of the Sydney Growth Centres Program, and it is recommended that the management of habitat at Kemps Creek under this program be improved. It is considered that improved and ongoing management of habitat at Kemps Creek will provide protection of *G. parviflora* subsp. *parviflora* within this locality from impacts associated with indirect impacts.

The following sections consider the potential indirect impacts of development and proposed mitigation measures under the Plan on important populations 103, 104, and 518 of *Grevillea parviflora* subsp. *parviflora*.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *Grevillea parviflora* subsp. *parviflora* are discussed below for each identified indirect impact.

It is noted that a total of 129.6 ha of potential habitat for *Grevillea parviflora* subsp. *parviflora*, and one important population is located within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE HABITAT DISTURBANCE

Habitat degradation through unrestricted public access and rubbish dumping has been identified as a key threat to *G. parviflora* subsp. *parviflora* (DEWHA, 2008d).

Appendix E of the Plan includes a species-specific measure to consult with land managers of land containing population 104 of *Grevillea parviflora* subsp. *parviflora*, to mitigate indirect impacts from human disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and slashing, and managing rubbish dumping. This measure applies specifically to population 104 in Wilton and will be implemented through consultation with local councils and other public agencies.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the known *G. parviflora* subsp. *parviflora* population and mapped potential habitat within the Georges River Koala Reserve to be established under Commitment 10)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *G. parviflora* subsp. *parviflora* from inappropriate habitat disturbance as a result of development. This is because:

- The Plan contains a species-specific measure to protect population 104 from impacts associated with habitat disturbance
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

WEED INVASION

G. parviflora subsp. *parviflora* is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development have the potential to increase

the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

Appendix E of the Plan includes a species-specific measure to implement mitigation measures to manage weeds for population 104 of *G. parviflora* subsp. *parviflora* during the construction and operation of the development, taking into account relevant guidance in the Weed Control Strategy. This measure applies specifically to population 104 in Wilton and will be implemented via the DCP template, Mitigation Measures Guideline, Weed Control Strategy and Cumberland Plain Conservation Plan Guidelines for Infrastructure Development.

The Plan further incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *G. parviflora* subsp. *parviflora*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *G. parviflora* subsp. *parviflora* from the increased risk of weeds associated with development. This is because:

- There is a specific requirement for the impact of weeds to be managed for population 104 of *G. parviflora* subsp. *parviflora*
- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes are an identified threat to *G. parviflora* subsp. *parviflora* (DEWHA, 2008d). Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the following mechanisms:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Appendix E of the Plan includes a species-specific measure to consult with land managers of population 104 for *G. parviflora* subsp. *parviflora* to mitigate indirect impacts from fire during construction and operation of the development, taking into account guidance in the Fire Management Strategy. This measure applies specifically to population 104 in Wilton and will be implemented via consultation with local councils and other public agencies, and by the Fire Management Strategy.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *G. parviflora* subsp. *parviflora* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *G. parviflora* subsp. *parviflora*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to *G. parviflora* subsp. *parviflora* from altered fire regimes as a result of development. This is because:

- There is a species-specific measure to protect population 104 from impacts associated with altered fire regimes
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *G. parviflora* subsp. *parviflora* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *G. parviflora* subsp. *parviflora* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas (it is noted there is 2,924.3 ha for *G. parviflora* subsp. *parviflora* mapped within the SCA)

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

It is noted that no habitat or records are mapped for *G. parviflora* subsp. *parviflora* within the footprints of the proposed tunnels associated with transport corridors, and therefore it is considered that there is negligible potential for this species to be negatively impacted by the development of the tunnels.

29.10.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

Records of this species occur within GPEC, GMAC, and Wilton. Of these, records within GMAC and Wilton occur within avoided land.

A non-important population (519) within GMAC occurs on avoided lands to the east of Appin, near the Georges River. Within GMAC, this population occurs within the proposed footprint for Stage 1 of the Georges River Koala Reserve (Commitment 10). Given the proposed use of this land for conservation purposes under the Plan, population 519 is not considered to be at risk of impacts from essential infrastructure development.

Within Wilton, important population 104 and important population 518 occur within land avoided for biodiversity purposes. To minimise potential impacts to these populations, the Plan includes a species-specific commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure on non-certified land to *G. parviflora* subsp. *parviflora.* Further, the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development requires that avoidance of impacts to *G. parviflora* subsp. *parviflora* be prioritised with regards to development of essential infrastructure.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect *G. parviflora* subsp. *parviflora* from impacts from essential infrastructure. These include:

- Commitment 2.2, which specifically prioritises avoidance of impacts to *G. parviflora* subsp. *parviflora*
- A measure in the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, which requires that avoidance of impacts to *G. parviflora* subsp. *parviflora* be prioritised

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *G. parviflora* subsp. *parviflora* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.10.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008d) (and other key documents) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *G. parviflora* subsp. *parviflora* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Weed invasion
  - Inappropriate fire regimes
  - Habitat disturbance from recreational activities, rubbish dumping, and road maintenance

HABITAT LOSS AND FRAGMENTATION

As outlined above, the Plan will lead to impacts to potential habitat.

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is low. The total area of potential habitat which will be impacted is a small proportion of the total habitat available for the species, and there will be no other direct impacts (such as impacts to known records or fragmentation) under the Plan.

It is noted that the Plan includes a species-specific commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure on non-certified land to *G. parviflora* subsp. *parviflora.*

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contain approximately 2,924.3 ha of potential habitat for *G. parviflora* subsp. *parviflora.* For example, the Georges River Koala Reserve contains 129.6 ha of potential habitat and one important population of *G. parviflora* subsp. *parviflora.*

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate habitat disturbance, weed invasion, and inappropriate fire regimes have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan, and through a range of species-specific measures to protect important population 104 from indirect impacts associated with development under the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.10.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.10.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-31 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *G. parviflora* subsp. *parviflora,* there are no relevant Threat Abatement Plans.

Table 29-31: Relevant key Threatening Processes and associated Threat Abatement Plans for *G. parviflora* subsp. *parviflora*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-32: Occurrence of *G. parviflora* subsp. *parviflora* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	16	5
(IMPORTANT POPULATIONS)	(11)	(5)
HABITAT MAPPING (Ha)	7,468.0	590.9

Table 29-33: Avoidance of *G. parviflora* subsp. *parviflora* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	428.1	285.3	14.9	68.2	796.5
HABITAT WITHIN EXCLUDED LANDS (ha)	43.7	104.2	0.2	63.8	211.9
HABITAT WITHOUT EXCLUDED LANDS (ha)	**384.4**	**181.1**	**14.7**	**4.4**	**584.6**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	328.8	90.8	7.6	0.3	427.5
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	85.5	50.1	51.7	6.5	73.1
AVOIDANCE FOR OTHER REASONS (ha)	53.1	88.1	0.0	0.1	141.3
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	13.8	48.6	0.1	2.2	24.2
TOTAL AVOIDANCE (ha)	**381.9**	**178.9**	**7.6**	**0.4**	**568.7**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**99.3**	**98.7**	**51.8**	**8.7**	**97.3**

Table 29-34: Direct impacts to *G. parviflora* subsp. *parviflora* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	2.5	2.3	7.1	4.0	0.0	**15.9**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0*	0	0	**0***
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)*	(0)	(0)	**(0)***

*There is a record within WSA which is located within the urban capable footprint, however, the low positional accuracy and descriptive information of the record suggests that the record is located in a different position outside of the nominated area. Therefore, it is considered that this record is not impacted. Refer to Section 29.10.3 for further information.

29.11 *MELALEUCA DEANEI* (DEANE'S MELALEUCA)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Melaleuca deanei* is a flaky-barked shrub with narrow pointed leaves and white flowers. Grows to 3m tall. (DoEE, 2018f)
ECOLOGY	Flowers in mid-October to December. Produces seeds infrequently and relies on clonal reproduction. Seeds can be held for up to 15 years, until fire, frost or drought triggers their release. (DoEE, 2018f) Longevity of individuals can be 100 years. (NSW DECCW, 2010)
DISTRIBUTION AND HABITAT	Records occur primarily in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. Isolated records also occur in Springwood, Wollemi National Park, Yalwal, and Central Coast areas. It is known to occur in the Cumberland IBRA subregion (OEH, 2019e). More than 50 per cent of all populations are protected in nature reserves or national parks (NSW DECCW, 2010). Inhabits ridgetop woodland and wet heath, on sandstone and sandy soils (DoEE, 2018f; OEH, 2019e). The majority of records come from ridgetop woodland (OEH, 2019e). *M. deanei* is associated with sandy loam soils which are low in nutrients (NSW DECCW, 2010).
POPULATIONS	As of 1993, the species was known from 94 populations, of which very few were considered reproductively viable. In 1993, it was estimated that there were 1,000-3,000 individuals of this species though this was likely as a ramet (stem) count. Population distribution is fragmented. (DoEE, 2018f) An important population has been identified in Holsworthy Military Reserve, it contains 17 per cent of the known population outside formal conservation reserves (NSW DECCW, 2010).
SOS SITES	The following SOS sites for the species have been identified: • Ku-ring-gai Chase National Park • Berowra Valley National Park • Holsworthy • Nepean-Avon Plateau • Nepean Dam

RELEVANT PLANS AND POLICIES	National Recovery Plan for *Melaleuca deanei* F. Muell. (Deane's Paperbark) (NSW DECCW, 2010)
SPECIES-SPECIFIC GUIDELINES	There are no specific impact guidelines for this species
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=5818

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		Yes	Yes	No	No
EXPERT REPORT (BCAR PROCESS)	Yes (Douglas, 2019a). Available at Supporting Document C				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Expert report polygons. Potential habitat polygons were generated based on the occurrence of PCT 1081, 1181, and 1395, with the application of graded riparian exclusion buffers to account for the fact that wetter and sometimes more thickly vegetated areas associated with drainage lines are unlikely habitat. To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. These surveys either confirmed presence (known habitat) or absence (no longer considered potential habitat). The species was not recorded during surveys.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). Potential habitat polygons were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned), and elevation (below 400m) and rainfall thresholds (1000-1400mm) sourced from SPRAT. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *M. deanei* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020.				

	Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *M. deanei* were downloaded in May 2021.
	POPULATION DEFINITION
	Biological populations of were defined using the records dataset and available information about the nature of the species. A population is considered to be individuals within 500 m of each other, as species dispersal is unlikely to occur beyond this distance (NSW DECCW, 2010).
	IMPORTANT POPULATION CRITERIA
	Populations of *M. deanei* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. Populations of *M. deanei* were considered important because they were identified as a Serious and Irreversible Impacts (SAII) entity under the NSW BC Act

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-12 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-36 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *M. deanei* in the Strategic Assessment Area. **Records** There are three populations which have been identified within the Strategic Assessment Area, all of which are important populations. Population 77 is located adjacent to the confluence of Allens Creek with Stringybark Creek, within Wilton. This population occurs within the boundary of a previously approved development under the EPBC Act (EPBC 2014/7400). Population 520 occurs on the eastern edge of the Strategic Assessment Area to the north-east of Campbelltown, within the footprint of the proposed Georges River Koala Reserve. Population 463 occurs on the eastern edge of the Strategic Assessment Area to the east of Campbelltown and is also within the footprint of the proposed Georges River Koala Reserve. It is noted that numerous additional records of this species occur in remnant vegetation outside of the Strategic Assessment Area boundary, in areas to the south of Wilton and to the east of Appin, Campbelltown and Macquarie Fields. **Potential habitat** The baseline mapping for this assessment has mapped 14,395.2 ha of known and potential habitat within the Strategic Assessment Area. Habitat for this species tends to occur along the south-eastern, southern, western, and north-western boundary of the Strategic Assessment Area, with an absence of potential habitat throughout the middle and north-eastern areas of the assessment area. With respect to the nominated areas, well-connected habitat is mapped within Wilton and the southern section of GMAC, which strongly corresponds to the locations of wooded areas in these localities. There is no habitat mapped within GPEC or WSA. Outside of the nominated areas, habitat is mapped as follows: • Well-connected habitat occurs along the Strategic Assessment Area boundary, from the Holsworthy locality, down to the southern portion of the Strategic Assessment Area (including localities such as Douglas Park, Bargo, and Tahmoor)

	• Moderately connected habitat patches occur along the western boundary of the Strategic Assessment Area between Orangeville in the south through to Mulgoa in the north • Small, scattered patches of habitat occur in the north-west corner of the Strategic Assessment Area in the Kurrajong locality

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.11.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 1,750.3 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 1,644.1 ha (93.9 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,545.2 ha was avoided for biodiversity purposes.
- 98.9 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 29-37.

It is important to note that the avoidance calculations in Table 29-37, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-37 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.11.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.11.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to loss of potential habitat. It will not lead to direct impacts to known populations or fragmentation of potential habitat or populations. A summary of these impacts is provided in Table 29-38.

LOSS OF POTENTIAL HABITAT

Approximately 106.2 ha of potential habitat for the species will be lost. This is 0.7 per cent of mapped potential habitat across the Strategic Assessment Area. The loss of potential habitat occurs within GMAC and Wilton.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as possible. While there will be direct impacts to potential habitat, there is moderate confidence that the species will occur in the impact area. This is because of the small number of records of the species in the vicinity of impacted habitat, and based on knowledge that mapped habitat is precautionary as the species is naturally rare and patchily distributed (Douglas, 2019a)
- The consequence of impacts to the species (if they did occur) has been categorised as minor. There will be a loss of 0.5-1 per cent of mapped potential habitat (SAII species), with moderate confidence that the species occurs in the impact area

29.11.4 FRAGMENTATION OF HABITAT

The placement of urban capable land and transport corridors within the Strategic Assessment Area will not lead to fragmentation of records or habitat of *M. deanei*, as it will not lead to the removal of habitat which links other areas of habitat or records together. All impacts to habitat of *M. deanei* are to already fragmented patches, or along the edges of habitat.

Therefore, there is no residual adverse risk of fragmentation as a result of loss of potential habitat under the Plan.

29.11.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for *M. deanei.*

It is noted that a total of 1,837.9 ha of potential habitat for *M. deanei* is contained within two of the Plan's proposed reserves. These include:

- 937.6 ha of mapped habitat in the Georges River Koala Reserve
- 900.4 ha of mapped habitat in the Gulguer Reserve investigation area

Further, two important populations of *M. deanei* are located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the potential indirect impacts to the species that may occur as a result of development under the Plan. It also outlines if the generic management strategies in the Plan will be adequate for addressing indirect impacts, or if species-specific commitments are necessary.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.11.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan (NSW DECCW, 2010) (and other key documents) for *M. deanei* identify a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in key species documents) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes and mechanical methods of bushfire fuel reduction
- Inappropriate habitat disturbance from construction and maintenance of tracks and easements, unrestricted access, and rubbish dumping
- Weed invasion

Low fecundity and viability, hybridisation, and trampling/plant damage due to army training exercises have also been identified as key threats. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

There are three known populations of *M. deanei* within the Strategic Assessment Area. Populations 520 and 463 occur on the eastern edge of the Strategic Assessment Area within the footprint of the proposed Georges River Koala Reserve, and subsequently are not considered to be at risk of indirect impacts under the Plan due to the distance from urban capable land and the fact that the site will be managed for conservation purposes.

Population 77 occurs within Wilton and is located within habitat which is managed in accordance with an approved development under the EPBC Act (EPBC 2014/7400). Approval conditions which protect this population from indirect impacts include fencing to restrict access, and preparation of an environmental management plan for the approval of the Commonwealth to deal with pressures to the population. Overall, population 77 is not considered to be at risk of indirect impacts under the Plan as it has existing site management to protect the species from indirect impacts.

The following assessments therefore consider the potential impacts of development under the Plan upon mapped potential habitat for *M. deanei.* The areas which are most at risk of impact include mapped habitat within Wilton and the southern portion of GMAC, which occurs close to urban capable lands.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *M. deanei* are discussed below for each identified indirect impact.

It is noted that a total of 1,837.9 ha of potential habitat for *M. deanei* is contained within two of the Plan's proposed reserves, and two important populations of the species are located within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES AND MECHANICAL METHODS OF BUSHFIRE FUEL REDUCTION

Inappropriate fire regimes are an identified threat to *M. deanei* (NSW DECCW, 2010). Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the following mechanisms:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

It is additionally noted that mechanical bushfire reduction methods of habitat in close proximity to urban and other kinds of development pose a risk to *M. deanei* (NSW DECCW, 2010).

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *M. deanei* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *M. deanei*. While these APZs are

designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to *M. deanei* from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *M. deanei* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *M. deanei* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas (it is noted there is 7,466.4 ha for *M. deanei* mapped within the SCA)

INAPPROPRIATE HABITAT DISTURBANCE FROM CONSTRUCTION AND MAINTENANCE OF TRACKS AND EASEMENTS, UNRESTRICTED ACCESS, AND RUBBISH DUMPING

Impacts relating to construction and maintenance of tracks and easements, unrestricted site access and rubbish dumping have been identified as threats to *M. deanei* (NSW DECCW, 2010). Areas most at risk included areas of mapped potential habitat within Wilton and GMAC.

Appendix E of the Plan includes a species-specific measure to consult with land managers of land containing known populations or habitat for *M. deanei* to mitigate indirect impacts from habitat disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and weed control, and managing rubbish dumping. This measure applies to GMAC and Wilton and will be implemented via consultation with local councils and other public agencies.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 1,837.9 ha of potential habitat for *M. deanei* is contained within two of the Plan's proposed reserves, and two important populations of the species occurs within the Georges River Koala Reserve
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *M. deanei* from inappropriate habitat disturbance as a result of development. This is because:

- A species-specific measure will require consultation with land managers to ensure protection of *M. deanei* from inappropriate habitat disturbance
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance

- A program of education for the community will be run to help them understand the biodiversity values they live near

WEED INVASION

Inappropriate fire regimes are an identified threat to *M. deanei* (NSW DECCW, 2010). Areas most at risk of weed invasion due to development under the Plan included areas of mapped potential habitat within Wilton and GMAC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *M. deanei*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *M. deanei* from the increased risk of weeds associated with development. This is because:

- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

It is noted that there is no mapped potential habitat, and no known records of the species, within either the OSO tunnel footprint or the Metro Rail Future Extension tunnel footprint. It is therefore considered unlikely that development within the tunnel footprints will negatively impact *M. deanei*.

29.11.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There are no known records of *M. deanei* within avoided lands in any of the nominated areas. However, there is 1,644.1 ha of potential habitat mapped for the species within avoided lands within Wilton and GMAC, and therefore it is considered to be possible that the species may occur within avoided lands in these nominated areas.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *M. deanei* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.11.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Recovery Plan (NSW DECCW, 2010) and other key documents identifies the following key issues that are likely to have the greatest influence on the long-term viability of *M. deanei* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Inappropriate fire regimes and mechanical methods of bushfire fuel reduction
  - Inappropriate habitat disturbance from construction and maintenance of tracks and easements, unrestricted access, and rubbish dumping
  - Weed invasion

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to loss of 106.2 ha of mapped habitat within the nominated areas and transport corridors. No fragmentation of species habitat will occur.

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is low. The total area of potential habitat which will be impacted is a small proportion of available habitat for the species with only moderate confidence of the species presence in impacted areas.

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contain approximately 7,466.4 ha of potential habitat for *M. deanei.* For example, two of the proposed reserves in the Plan contain mapped habitat for the species (including 937.6 ha in the Georges River Koala Reserve, and 900.4 ha in the Gulguer Reserve investigation area. Note that the Georges River Koala Reserve area also contains two important populations of *M. deanei*).

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts of development corridors associated with inappropriate fire regimes and mechanical methods of bushfire fuel reduction, inappropriate habitat disturbance from construction and maintenance of tracks and easements, unrestricted access and rubbish dumping, and weed invasion have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan, and through a species-specific measure to minimise the impacts inappropriate habitat disturbance.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.11.9 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan (NSW DECCW, 2010) is to prevent the status of *M. deanei* from becoming critically endangered by reducing the further loss of populations and, by implementing in-situ management regimes aimed at maintaining representative populations of the species' across its natural range. Specific objectives include:

- Coordinate the recovery of *M. deanei*
- Protect known occurrences of *M. deanei* using land-use and conservation planning mechanisms
- To identify and minimise the threats operating at *M. deanei* sites
- To improve awareness of *M. deanei* amongst operational staff working within easements, walking tracks and fire trails
- To promote surveys, research and monitoring that will assist with the management of *M. deanei*
- To provide stakeholders with information that assist in conserving *M. deanei*
- To raise awareness about the threats to the species and involve the community in the recovery program
- To coordinate an ex-situ conservation program to safeguard genetic material from extinction

Implementation of the Plan will support a number of these strategies and will not prevent the achievement of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT THE IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to support the overall recovery of *Melaleuca deanei*. The Plan will not prevent implementation of any of the actions.

29.11.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-35 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *M. deanei*, there are no relevant Threat Abatement Plans.

Table 29-35: Relevant key Threatening Processes and associated Threat Abatement Plans for *M. deanei*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-36: Occurrence of *M. deanei* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	3	1
(IMPORTANT POPULATIONS)	(3)	(1)
HABITAT MAPPING (Ha)	14,395.2	1,607.3

Table 29-37: Avoidance of *M. deanei* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	905.2	1,416.2	0.0	0.0	2,321.4
HABITAT WITHIN EXCLUDED LANDS (ha)	192.2	378.9	0.0	0.0	571.1
HABITAT WITHOUT EXCLUDED LANDS (ha)	**713.0**	**1,037.3**	**0.0**	**0.0**	**1,750.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	629.9	915.3	0.0	0.0	1,545.2
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	88.3	88.2	0.0	0.0	88.3
AVOIDANCE FOR OTHER REASONS (ha)	37.7	61.2	0.0	0.0	98.9
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	5.3	5.9	0.0	0.0	5.6
TOTAL AVOIDANCE (ha)	**667.6**	**976.5**	**0.0**	**0.0**	**1,644.1**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**93.6**	**94.1**	**0.0**	**0.0**	**93.9**

Table 29-38: Direct impacts to *M. deanei* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	45.4	60.8	0.0	0.0	0.0	**106.2**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.12 *PERSOONIA BARGOENSIS* (BARGO GEEBUNG)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Persoonia bargoensis* is an erect, bushy shrub with small thin leaves and yellow tubular flowers. Fruits are pear-shaped, green and grow to 12mm long. Ranges from 0.6-2.5m tall. (DoEE, 2018f)
ECOLOGY	Flowers appear mainly in summer. Fruits hang on the plant for an indefinite period. Recruitment is solely from seed. This species is expected to live for up to 20 years. Disturbance, including fire, plays an important role in the germination of the seed bank. As a result, this species often appears along trail margins. Populations at sites which have been undisturbed for 10 years or so may not be representative of the potential population size of that site. This species is likely to be killed by fire. Frequent disturbance (such as regular track maintenance, slashing, and/or fire frequencies of less than 10–15-year intervals) are likely to result in a decline of a population of this species, as an adequate seedbank will not have time to develop between disturbance events. This species is pollinated by native bees. Populations within 500m are likely to be interbreeding. Urban development which discourages native bees from travelling between *P. bargoensis* populations and individuals is likely to result in increased isolation of populations and individuals. Seeds of this species are likely to be dispersed by birds and marsupials. Developments which prevent dispersal of seeds would also increase population isolation. (DoE, 2014g; DoEE, 2018f; NPWS, 2000a)
DISTRIBUTION AND HABITAT	Records are restricted to a small area south-west of Sydney on the western edge of the Woronora Plateau and the northern edge of the Southern Highlands. It is known to occur in the Burragorang, Cumberland and Sydney Cataract IBRA subregions (OEH, 2019a). Inhabits dry sclerophyll eucalypt woodland or forest. Occurs on the heavier, well-drained, gravelly soils of Hawkesbury Sandstone and Wianamatta Shale. (DoEE, 2018f)
POPULATIONS	As of 1999, the total number of individuals was likely to be less than 250. Populations at this time were small (often less than eight plants) and fragmented. (DoEE, 2018f)

SOS SITES	The following SOS sites for the species have been identified: • Wilton (proposed) • Bargo (proposed) • Hume Highway (proposed)
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Persoonia bargoensis* (DoE, 2014g) Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
SPECIES-SPECIFIC GUIDELINES	*Persoonia bargoensis* Environmental Impact Assessment Guidelines (NPWS, 2000a)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=56267

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		Yes	Yes	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS** **Knowledge based map (KBM).** Habitat maps were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned), elevation (between 0m and 450m), rock units (Hawkesbury Sandstone', 'Minchinbury Sandstone', 'Mount Hercules Sandstone Member', 'Razorback Sandstone Member') and soil units (Blacktown, Glenorie, Picton, Luddenham) within 80m of the edge of the sandstone geology. To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. These surveys either confirmed presence (known habitat) or absence (no longer considered potential habitat). The species was recorded in Wilton during surveys. **OUTSIDE THE NOMINATED AREAS** **Species distribution model (SDM).** Potential habitat outside the nominated areas was mapped using an SDM. The report notes that there 390 records of *P. bargoensis* with which to produce a model (generally, over 50 records are required to produce a reliable SDM). The approach to SDM mapping may over-predict habitat for the species. No targeted surveys as part of this project were undertaken outside the nominated areas.				
	RECORD SELECTION				

POPULATION MAPPING	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset. **BIONET RECORD DOWNLOAD DATE** The initial assessment of *P. bargoensis* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *P. bargoensis* were downloaded in September 2019. **POPULATION DEFINITION** Biological populations were defined using the records dataset and available information about the nature of the species. All recorded plants were mapped as a single population as occurrence of the species within the Plan Area spans 20 km, and genetic flow (fruit dispersal by birds and pollination) could potentially move across the population within the life span of each plant (expected to be 20 years (OEH, 2019a)). **IMPORTANT POPULATION CRITERIA** Populations of *P. bargoensis* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. Populations of *P. bargoensis* were considered important within the Strategic Assessment Area because they met one or more of the following criteria: • A large population (number of individuals) • Only known population of this species

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-15 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-40 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *P. bargoensis* in the Strategic Assessment Area. **Records** *P. bargoensis* occurs as a single important population in the Strategic Assessment Area. The population spans from Bargo to Picton in the north-west, through to Appin in the east, and is bounded by the Strategic Assessment Area boundary in the south. This population is large and comprises 271 BioNet records. **Potential habitat** The baseline mapping for this assessment has mapped 12,293 ha of potential habitat within the Strategic Assessment Area. Mapped habitat is located in the southern portion of the assessment area, aligning with the location of known records. Potential habitat occurs within Wilton and GMAC. Within these nominated areas, potential habitat is generally associated with vegetation along riparian corridors as the majority of remaining land is cleared.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.12.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 2,373.3 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 2,289.8 ha (96.5 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,695 ha was avoided for biodiversity purposes
- 594.8 ha was avoided for other reasons

A breakdown of avoidance across each nominated area is provided in Table 29-41.

It is important to note that the avoidance calculations in Table 29-41, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-41 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

It is noted that there is a species-specific commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure to *P. bargoensis* on non-certified land.

29.12.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.12.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to impacts to mapped potential habitat. A summary of these impacts is provided in Table 29-42.

LOSS OF POTENTIAL HABITAT

Approximately 83.5 ha of potential habitat will be impacted as a result of the implementation of the Plan. This represents 0.7 per cent of potential habitat within the Strategic Assessment Area. The loss of potential habitat is associated with urban development in Wilton and GMAC. In both cases, direct impacts relate to the fringes of habitat areas.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as likely. The proximity of impacted habitat to multiple known records of the species suggests that it is likely that the species would be present within habitat areas
- The consequence of impacts to the species (if they did occur) has been categorised as minor. There will be a loss of <1 per cent of mapped potential habitat (vulnerable species), with high confidence that the species occurs in the impact area

29.12.4 FRAGMENTATION OF HABITAT

The placement of urban capable land and transport corridors within the Strategic Assessment Area will not lead to fragmentation of records or habitat of *P. bargoensis*, as it will not lead to the removal of habitat which links other areas of habitat or records together. All impacts to habitat of *P. bargoensis* are to the edges of mapped habitat or already fragmented patches.

Therefore, there is no residual adverse risk of fragmentation as a result of loss of potential habitat under the Plan.

29.12.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for *P. bargoensis.*

It is noted that a total of 331.8 ha of potential habitat for *P. bargoensis* is contained within the proposed Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the potential indirect impacts to the species that may occur as a result of development under the Plan. It also outlines if the generic management strategies in the Plan will be adequate for addressing indirect impacts, or if species-specific commitments are necessary.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.12.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *P. bargoensis* (DoE, 2014g) (and other key documents) identifies a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in key species documents) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes and fire maintenance activities
- Inappropriate habitat disturbance associated with maintenance activities, illegal dumping, and recreational activities
- Infection by *Phytophthora cinnamomi*

Inbreeding depression due to small and scattered populations and lack of genetic diversity, feral European honeybees making effective pollination unlikely, grazing by domestic animals and subsidence associated with underground coal extraction have also been identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. bargoensis* are discussed below for each identified indirect impact.

It is noted that a total of 331.8 ha of potential habitat for *P. bargoensis* is contained within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES AND MAINTENANCE ACTIVITIES

P. bargoensis plants are killed by fire, with subsequent generations germinating from seeds stored within the soil. A minimum interval of approximately 10-15 years between fire events is required to enable the development of a suitable seed bank to ensure the species' persistence following a fire event.

However, it is also noted that *P. bargoensis* relies upon disturbance events in order to successfully germinate. Therefore, occasional fire events are likely to be required to maximise the species' ability to recover and persist.

The ideal frequency of fire for the conservation purpose of *P. bargoensis* is unknown. It is noted that the Conservation Advice for the species identifies research into determining the optimal fire regime for regeneration of the species as a research priority (DoE, 2014g).

Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the following mechanisms:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Burning and slashing activities for hazard reduction purposes, and increased unnatural ignition sources, have increased the disturbance and fire frequency within the species' habitat and is considered a threat (OEH, 2019a). Increased fire risk poses a threat to the long-term persistence of *P. bargoensis* within the Plan Area, as frequent fires would negatively impact upon the species' ability to successfully reproduce.

The areas which are most at risk from inappropriate fire regimes are those in close proximity to areas of development. This includes known populations and mapped habitat for the species within and near Wilton and the southern portion of GMAC.

For *P. bargoensis,* a species-specific measure relating to fire management is appropriate given its sensitivity to inappropriate fire regimes, and the fact that the species is only known from the area within and around Wilton and GMAC, significantly increasing the level of risk.

Appendix E of the Plan includes a species-specific measure to consult with land managers of containing known habitat or populations of *P. bargoensis* to mitigate indirect impacts from fire during construction and operation of the development, taking into account guidance in the Fire Management Strategy. This measure applies to both GMAC and Wilton and will be implemented via consultation with local councils and other public agencies, and through the Fire Management Strategy.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. bargoensis* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *P. bargoensis*. While these APZs are

designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to *P. bargoensis* from altered fire regimes as a result of development. This is because:

- There is a species-specific measure to protect the species from impacts associated with altered fire regimes
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *P. bargoensis* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *P. bargoensis* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas (it is noted there is 5,222.1 ha of potential habitat for *P. bargoensis* mapped within the SCA)

INAPPROPRIATE HABITAT DISTURBANCE ASSOCIATED WITH MAINTENANCE ACTIVITIES, ILLEGAL DUMPING AND RECREATIONAL ACTIVITIES

A large proportion of the species occurs on road verges, suggesting that *P. bargoensis* may be dependent on disturbance, and that the species may benefit from reduced competition and increased light available on disturbance margins. As a result, most known sites of the species are managed by relevant infrastructure authorities (including TfNSW, Wollondilly Council, and Transgrid) (DoE, 2014g).

P. bargoensis is also threatened by illegal dumping, recreational activities and vehicle use within areas of the species' habitat (OEH, 2019a). The areas which are most at risk of impacts include those in close proximity to development, particularly around Wilton and the southern portion of GMAC.

Appendix E of the Plan includes a species-specific measure to consult with land managers of land containing known populations or habitat for *P. bargoensis* to mitigate indirect impacts from habitat disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and weed control, and managing rubbish dumping. This measure will be implemented via consultation with local councils and other public agencies and applies to Wilton and GMAC.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. This includes 331.8 ha of potential habitat for *P. bargoensis* that is mapped within the proposed Georges River Koala Reserve
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *P. bargoensis* from inappropriate habitat disturbance as a result of development. This is because:

- A species-specific measure will require consultation with land managers to ensure protection of *P. bargoensis* from inappropriate habitat disturbance
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas (it is noted there is 5,222.1 ha of potential habitat for *P. bargoensis* mapped within the SCA)
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

INFECTION BY PHYTOPHTHORA CINNAMOMI

P. bargoensis is threatened by exposure to *Phytophthora cinnamomi,* a soil-borne water mould which is fatal to many *Persoonia* species.

Development within GMAC and Wilton has the potential to increase the spread of *P. cinnamomi* through increased site visitation rates and earthworks activities conducted during construction works.

Appendix E of the Plan includes a species-specific measure to incorporate best practice site hygiene protocols to manage the potential spread of pathogens, such as *P. cinnamomi* and myrtle rust adjacent to potential habitat for *P. bargoensis.* This measure will be implemented through the DCP template, Mitigation Measures Guidelines, and Cumberland Plain Conservation Plan Guidelines for Infrastructure Development and applies to Wilton and GMAC.

The Plan incorporates a range of general measures to manage the risks associated with *Phytophthora cinnamomi*. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to *P. bargoensis* from *Phytophthora cinnamomi* because:

- Development controls will be put in place to address potential impacts associated with construction
- It supports a landscape scale approach to the issue across the Cumberland subregion

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.12.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

Three records of *P. bargoensis* occur within avoided land in Wilton. To minimise potential impacts to these populations, the Plan includes a species-specific commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure on non-certified land to *P. bargoensis*. Further, the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development requires that avoidance of impacts to *P. bargoensis* be prioritised with regards to development of essential infrastructure.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect *P. bargoensis* from impacts from essential infrastructure. These include:

- Commitment 2.2, which specifically prioritises avoidance of impacts to *P. bargoensis*
- A measure in the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, which requires that avoidance of impacts to *P. bargoensis* be prioritised

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *P. bargoensis* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.12.8 POTENTIAL IMPACTS FROM TUNNELS

There is a total of 0.1 ha of potential habitat for *P. bargoensis* mapped within the tunnel footprint under the Plan. However, there are no records of *P. bargoensis* in the locality; it is noted that the tunnel footprints are over 10 km north of the northernmost known record of this species, suggesting that the tunnels are likely to occur outside of the extent of occurrence of this species. It is therefore considered to be unlikely that the development of tunnels under the Plan will negatively impact *P. bargoensis.*

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.12.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014g) (and other key documents) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *P. bargoensis* in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts including:
  - Inappropriate fire regimes and fire maintenance activities
  - Inappropriate habitat disturbance associated with maintenance activities, illegal dumping and recreational activities
  - Infection by *Phytophthora cinnamomi*

HABITAT LOSS

As outlined above, the Plan will lead to impacts to potential habitat.

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is low. The total area of potential habitat which will be impacted is a small proportion of the total habitat available for the species, and there will be no other direct impacts (such as impacts to known records or fragmentation) under the Plan.

It is noted that the Plan includes a species-specific commitment (Commitment 2.2) to prioritise the avoidance of impacts from essential infrastructure on non-certified land to *P. bargoensis.*

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contain approximately 5,222.1 ha of potential habitat for *P. bargoensis.* For example, one of the proposed reserves in the Plan contains mapped habitat for the species (331.8 ha in the Georges River Koala Reserve).

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes and fire maintenance activities, inappropriate habitat disturbance associated with maintenance activities, illegal dumping and recreational activities and infection by *Phytophthora cinnamomi* have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan, and through a range of species-specific measures to protect *P. bargoensis* from indirect impacts associated with development under the Plan.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.12.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.12.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-39 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15. The Plan is not inconsistent with any of the Threat Abatement Plans.

Table 29-39: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. bargoensis*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus *(Phytophthora cinnamomi*)	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-40: Occurrence of *P. bargoensis* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	12,293.0	1,152.2

Table 29-41: Avoidance of *P. bargoensis* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	1,274.5	1,850.4	0.0	<0.1	3,124.9
HABITAT WITHIN EXCLUDED LANDS (ha)	252.1	499.5	0.0	0.0	751.6
HABITAT WITHOUT EXCLUDED LANDS (ha)	**1,022.4**	**1,350.9**	**0.0**	<0.1	**2,373.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	715.5	979.6	0.0	0.0	1,695.0
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	70.0	72.5	0.0	0.0	71.4
AVOIDANCE FOR OTHER REASONS (ha)	269.8	324.9	0.0	0.0	594.8
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	26.4	24.1	0.0	0.0	25.1
TOTAL AVOIDANCE (ha)	**985.3**	**1,304.5**	**0.0**	**0.0**	**2,289.8**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**96.4**	**96.6**	**0.0**	**0.0**	**96.5**

Table 29-42: Direct impacts to *P. bargoensis* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	37.1	46.4	0.0	0.0	0.0	**83.5**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.13 *POMADERRIS BRUNNEA* (RUFOUS POMADERRIS)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Pomaderris brunnea* is a compact shrub with hairy stems, leaves with toothed margins and small yellowish or cream clustered flowers. Grows from 1-4 m in height. (DoEE, 2018f; OEH, 2019c)
ECOLOGY	Limited information is available for the ecology of this species. Flowers between September and October. Expected to live for 10-20 years. Minimum time for the plant to produce seeds is approximately 4-6 years. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	Endemic to south-eastern Australia. Occurs in eastern NSW in the Sydney Basin, NSW North Coast and New England Tableland IBRA bioregions and in eastern Victoria. Inhabits moist woodland or forest on clay and alluvial soils of flood plains and creek lines. (Sutter, 2011) The Strategic Assessment Area is one of the core locations for the species.
POPULATIONS	As of 2011, sixteen populations of about 1,000 individuals had been recorded. However, at this time, records for some occurrences were over 30 years old, and it was not known if the species was still extant at all sites. (Sutter, 2011)
SOS SITES	The following SOS sites for the species have been proposed: • Oakwood property • Gundungarra Reserve – Spring Farm • Wirrimbirra Wildlife Sanctuary • Upper Nepean SCA
RELEVANT PLANS AND POLICIES	National Recovery Plan for Rufous Pomaderris (*Pomaderris brunnea*) (Sutter, 2011)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species

SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16845

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">No</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>Yes</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report available for this species.</td></tr>
<tr><td rowspan="4">HABITAT MAPPING</td><td colspan="5">WITHIN THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Knowledge based map (KBM). Potential habitat polygons were generated for this species using BioNet PCT associations, vegetation condition (intact, thinned), waterways (mapping restricted to 100 m around waterways), soil type (Blacktown, Lucas Heights) and elevation (up to 450 m).
To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. These surveys either confirmed presence (known habitat) or absence (no longer considered potential habitat). The species was recorded during surveys.</td></tr>
<tr><td colspan="5">OUTSIDE THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. Significant areas of habitat have been mapped and it is considered to be highly conservative mapping.
No targeted surveys as part of this project were undertaken outside the nominated areas.</td></tr>
<tr><td rowspan="4">POPULATION MAPPING</td><td colspan="5">RECORD SELECTION</td></tr>
<tr><td colspan="5">Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.</td></tr>
<tr><td colspan="5">BIONET RECORD DOWNLOAD DATE</td></tr>
<tr><td colspan="5">The initial assessment of P. brunnea was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020.
Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records.
The BioNet records used for this assessment of P. brunnea were downloaded in October 2020.</td></tr>
</table>

	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Records within 1 km of one another are considered a single population.
	IMPORTANT POPULATION CRITERIA
	Populations of *P. brunnea* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. Populations of *P. brunnea* were considered important because they met one or more of the following criteria: • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program • A population within a conservation reserve • A large population

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-21 for a map of records and habitat across the Strategic Assessment Area.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-44 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *P. brunnea* in the Strategic Assessment Area.
	Records
	A total of 23 populations have been mapped within the Strategic Assessment Area. They occur from Camden, southeast into GMAC, on the east of GMAC, and around Bargo. Ten are mapped as important and 13 are not. Four populations are either wholly or partly located in existing conservation reserves.
	Of the four nominated areas, only GMAC contains known records of *P. brunnea*. These are located as follows:
	• Important populations:
	  ○ Population 469 – one record within the nominated area in an existing conservation reserve. The population occurs in excluded land
	  ○ Population 586 - occurs within vegetation associated with Ousedale Creek, in the centre of southern GMAC, partially in land avoided for biodiversity and partially in excluded land. This population was detected during site surveys conducted in 2018 for this strategic assessment
	  ○ Population 587 - occurs within the southern boundary of GMAC, in land avoided for biodiversity purposes. This population was detected during site surveys conducted in 2018 for this strategic assessment
	• Non-important populations:
	  ○ Population 468 – one record on the western boundary of the nominated area, which occurs in excluded land
	  ○ Population 470 – one record in the centre of the nominated area. The population occurs in land avoided for biodiversity purposes
	  ○ Population 471 - three records on the western boundary of the nominated area. Two records occur in land avoided for biodiversity, the other occurs in avoided lands
	  ○ Populations 513 - 15 records on the easter boundary of the nominated area partially within land avoided for biodiversity and land avoided for other purposes

- Population 515 – four records on the eastern boundary of the nominated area in land avoided for biodiversity

There are no records of *P. brunnea* within Wilton, GPEC or WSA.

Outside of the nominated areas, populations are located as follows:

- Important populations:
  - Population 73 - Occurs along the Nepean River near Spring Farm. This population partially occurs within the Gundungarra Biobanking Agreement site
  - Population 177 - Occurs within the south of the Strategic Assessment Area, and is partially located in a site protected by a conservation agreement
  - Population 465 - Occurs adjacent to the Nepean River within the footprint of the proposed OSO tunnel, within a site protected by a Registered Property Agreement
  - Population 510 - A record within the St Marys Tower Biobanking Agreement, just outside the north-eastern border of Wilton
  - Population 615 – A record west of the Wilton border
- Non-important populations include:
  - A number of populations in the south of the Strategic Assessment Area
  - One population near Douglas Park, between Wilton and GMAC, near the Nepean River and Hume Motorway
  - A number of populations in the vicinity of Menangle Park and Spring Farm (near important population 73), outside of the western boundary of GMAC

Potential habitat

The baseline mapping for this assessment has mapped 26,076.2 ha of known and potential habitat within the Strategic Assessment Area.

Due to the broad habitat associations in the model, potential habitat has been identified widely across the Strategic Assessment Area, with habitat primarily occurring as thin corridors associated with drainage lines within the region. It is noted that the area to the west of GMAC, between Spring Farm and Menangle has been identified as a more substantial patch of mapped potential habitat.

Habitat is not mapped within GPEC and WSA because the species is not a candidate species credit species in those nominated areas.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.13.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 952.7 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 913.7 ha (95.9 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 730.1 ha was avoided for biodiversity purposes
- 183.6 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 29-45.

It is important to note that the avoidance calculations in Table 29-45, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-45 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.13.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

It is noted that the Plan includes a species-specific commitment (Commitment 4.2) to avoid and minimise impacts to *P. brunnea* as a result of tunnel construction activities in transport corridors.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.13.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to a loss of potential habitat and fragmentation of habitat. A summary of these impacts is provided in Table 29-46.

LOSS OF POTENTIAL HABITAT

Approximately 206.8 ha of potential habitat for the species will be lost. This is 0.8 per cent of mapped potential habitat across the Strategic Assessment Area. The loss of potential habitat occurs across Wilton, GMAC, and transport corridors in the south of the Strategic Assessment Area. The majority of impacts to potential habitat occur due to transport outside the nominated areas.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as likely. The presence of records of the species within the vicinity of impacted habitat suggests that it is likely the species would be present within impacted areas
- The consequence of impacts to the species (if they did occur) has been categorised as minor. There will be a loss of <1 per cent of mapped potential habitat (vulnerable species), with high confidence that the species occurs in the impact area

29.13.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The development of the OSO to the south of Camden Park will fragment mapped potential habitat for *P. brunnea*.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of fragmentation is considered to be low. This is because:

- The likelihood of fragmentation has been categorised as possible. This is because:
    - The likelihood that development presents a barrier to dispersal of the species is likely. Limited information is available regarding the reproductive and dispersal ecology of *P. brunnea*, and therefore a precautionary

approach has been taken and it is thought to be likely that the development of the OSO would fragment habitat for the species

- The type of fragmentation (as defined in the risk assessment approach in Section 29.3) is impact to habitat connected to a population. This is because there are known records located on mapped potential habitat which is fragmented by the OSO development

- The consequence of fragmentation has been categorised as moderate. This is because the area to be fragmented is connected to a known population of the species and is of moderate size

29.13.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for *P. brunnea.*

It is noted that a total of 1,179.6 ha of potential habitat for *P. brunnea* is contained within three of the Plan's proposed reserves. These include:

- 614 ha of mapped habitat in the Georges River Koala Reserve
- 40.9 ha within the Confluence Reserve investigation area
- 524.7 ha of mapped habitat in the Gulguer Reserve investigation area

Further, three important populations of *P. brunnea* are located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the potential indirect impacts to the species that may occur as a result of development under the Plan. It also outlines if the generic management strategies in the Plan will be adequate for addressing indirect impacts, or if species-specific commitments are necessary.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.13.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan (Sutter, 2011) (and other key documents) for *P. brunnea* identify a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in key species documents) are considered relevant to implementation of the Plan:

- Weed invasion
- Disturbance from trampling and recreational vehicle use
- Stormwater run-off
- Altered fire regimes

Sand extraction, browsing by cattle and timber harvesting have also been identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. brunnea* are discussed below for each identified indirect impact.

It is noted that a total of 1,179.6 ha of potential habitat for *P. brunnea* is contained within three of the Plan's proposed reserves, and three important populations of the species are located within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

WEED INVASION

P. brunnea is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development within the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

P. brunnea is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include development within Wilton and GMAC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *P. brunnea*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *P. brunnea* from the increased risk of weeds associated with development. This is because:

- The proposed Georges River Koala Reserve (Commitment 10) intercepts mapped potential habitat and three known populations of *P. brunnea.* Protection of this reserve and management for conservation purposes will contribute to long-term protection of known populations and habitat of *P. brunnea*
- There are commitments (Commitment 16 and Commitment 23) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

DISTURBANCE FROM TRAMPLING AND RECREATIONAL VEHICLE USE

Habitat degradation through unrestricted public access and rubbish dumping has been identified as a key threat. Development within the nominated areas (particularly Wilton and GMAC) may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat. In particular, populations at risk include important populations 586 and 587, and non-important populations 470, 471, each of which occur directly

adjacent to urban capable land within GMAC. It is noted that each of these populations occur on excluded lands, land avoided for biodiversity, or avoided land for other purposes.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including *P. brunnea* populations and mapped potential habitat within the Georges River Koala Reserve to be established under Commitment 10)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *P. brunnea* from inappropriate habitat disturbance as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

STORMWATER RUN-OFF

Stormwater runoff is identified as a threat to *P. brunnea*. The areas that are most at risk include populations which occur adjacent to urban capable development within GMAC.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application

The package of measures in the Plan is expected to adequately manage the risk to *P. brunnea* from stormwater runoff because development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to biodiversity values, including potential habitat for *P. brunnea.*

ALTERED FIRE REGIMES

The sensitivity of *P. brunnea* to fire is unknown, although the species is known to occur in moist habitats where fire is infrequent and which may be sensitive to fire, and other *Pomaderris* species do not resprout after fire. As *P. brunnea* requires 4-6 years to reach maturity and produce seed, it is considered that a fire interval of less than 10 years would be detrimental to the species (Sutter, 2011).

Increased human activity within the nominated areas has the potential to impact the risk of fire to habitat areas supporting the species, through the following mechanisms:

- Arson and accidental lighting of fires
- The application of fire by authorities to manage fire risk

The areas which are most at risk of increased fire frequency are where the species occurs in proximity to development under the Plan and includes known populations and mapped potential habitat within GMAC.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. brunnea* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *P. brunnea*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to *P. brunnea* from altered fire regimes as a result of development. This is because:

- The proposed Georges River Koala Reserve (Commitment 10) intercepts mapped potential habitat and three known populations of *P. brunnea.* Protection of this reserve and management for conservation purposes will contribute to long-term protection of known populations and habitat of *P. brunnea*
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *P. brunnea* which is located adjacent to urban capable lands

- Fire management authorities will be engaged to ensure they understand the requirements of *P. brunnea* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.13.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The species has been recorded within avoided lands in GMAC. There is a total of six populations located partially or wholly within avoided within GMAC. Of these populations:

- Three occur within lands avoided for biodiversity
- One occurs partially within excluded lands and lands avoided for biodiversity
- Two occur partially within lands avoided for biodiversity and land avoided for other purposes

Of these, two populations (515 and 513) are located within the footprint of the proposed Georges River Koala Reserve and will be managed for conservation purposes. The remaining four populations occur either entirely or partially within avoided land adjacent to urban capable development.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guideline for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guideline for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design

- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *P. brunnea* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.13.8 POTENTIAL IMPACTS FROM TUNNELS

Both the Metro Rail Future Extension and the OSO tunnels intercept mapped potential habitat for *P. brunnea.* In total, 116.8 ha of potential habitat for *P. brunnea* occurs within the two tunnel footprints.

The Metro Rail Future Extension has a total of 64.1 ha of mapped potential habitat for *P. brunnea* within the impact footprint. This habitat occurs mostly as small, scattered patches which are not associated with known records of the species. The largest area of impacted habitat is located in association with Narellan Creek the vicinity of Harrington Park, in an area which is already extensively cleared and developed. The potential habitat values of this locality for *P. brunnea* are considered to be marginal.

The OSO tunnel intercepts approximately 52.7 ha of potential habitat for *P. brunnea* which is associated with an important population of the species (population 465), which is wholly located in a conservation reserve (a Registered Property Agreement site). This is a large population, comprising 22 records of the species (it is noted that most known populations of the species are small).

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

The Plan includes species-specific measures to protect *P. brunnea* from impacts associated with tunnels. These include:

- A commitment (Commitment 4.2) to avoid and minimise impacts to *P. brunnea* associated with tunnel construction activities
- A measure in Appendix E of the Plan to manage key threats to the species. This measure applies to the OSO tunnel and will be implemented via the State Significant Infrastructure assessment and approval process. Key threats which will be managed include:
    - Hydrological disturbance
    - Spread of weeds
    - Spread of infection/disease
    - Soil erosion and sedimentation
    - Ground settling or subsidence

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.13.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Recovery Plan identifies the following key issues that are likely to have the greatest influence on the long-term viability of the species in relation to implementation of the Plan

- Habitat loss
- Indirect impacts including:
  - Weed invasion
  - Disturbance from trampling and recreational vehicle use
  - Stormwater run-off
  - Altered fire regimes

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to:

- Loss of 206.8 ha of mapped habitat within the nominated areas and transport corridors
- Potential fragmentation of habitat in one location

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is low. The total area of potential habitat which will be impacted is a small proportion of available habitat for the species. Fragmentation of a moderate area of mapped potential habitat connected with species' records may also occur. It is noted that no known records of the species are directly impacted or fragmented from other known records.

It is noted that *P. brunnea* occurs within the footprint of the proposed OSO and Metro Rail Future Extension tunnels. The Plan contains a species-specific commitment (Commitment 4.2) to avoid and minimise impacts to *P. brunnea* as a result of tunnel construction activities in transport corridors, which is considered to protect the individuals within the tunnel footprint from direct impacts.

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contain 6,954.3 ha of potential habitat for *P. brunnea.* It is also recognised that three known populations of the species occur within the proposed footprint of the Georges River Koala Reserve, which will be managed for conservation purposes and is expected to deliver benefits for these populations

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts of development corridors associated with weed invasion, disturbance from trampling and recreational vehicle use, stormwater run-off and altered fire regimes have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan. In addition, any potential indirect impacts associated with the construction of tunnels will be managed and mitigated through a species-specific measure in Appendix E of the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.13.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan (Sutter, 2011) is to minimise the probability of extinction of *P. brunnea* in the wild and to increase the probability of populations becoming self-sustaining in the long-term. Specific objectives include:

- Determine current status and threats
- Determine habitat requirements
- Protect and manage populations on public and private land
- Monitor response of populations to active management
- Identify key biological functions
- Establish a population in cultivation
- Build community support for conservation

Implementation of the Plan will support a number of these strategies and will not prevent the achievement of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT THE IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to support the overall recovery of *P. brunnea*. The Plan will not prevent implementation of any of the actions.

29.13.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-43 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *P. brunnea,* there are no relevant Threat Abatement Plans.

Table 29-43: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. brunnea*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-44: Occurrence of *P. brunnea* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	23	4
(IMPORTANT POPULATIONS)	(10)	(4)
HABITAT MAPPING (Ha)	26,076.2	2,555.8

Table 29-45: Avoidance of *P. brunnea* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	528.1	757.3	0.0	<0.1	1,285.5
HABITAT WITHIN EXCLUDED LANDS (ha)	84.6	248.2	0.0	<0.1	332.8
HABITAT WITHOUT EXCLUDED LANDS (ha)	**443.6**	**509.1**	**0.0**	**0.0**	**952.7**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	322.2	407.9	0.0	0.0	730.1
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	72.6	80.1	0.0	0.0	76.6
AVOIDANCE FOR OTHER REASONS (ha)	104.4	79.2	0.0	0.0	183.6
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	23.5	15.6	0.0	0.0	19.3
TOTAL AVOIDANCE (ha)	**426.6**	**487.1**	**0.0**	**0.0**	**913.7**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**96.2**	**95.7**	**0.0**	**0.0**	**95.9**

Table 29-46: Direct impacts to *P. brunnea* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	17.0	22.0	0.0	0.0	167.9	**206.8**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

SPECIES AT VERY LOW RISK OF DIRECT IMPACTS

29.14 *ACACIA BYNOEANA* (BYNOE'S WATTLE)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	A semi-prostrate shrub with narrow leaves and cream to yellow flowers. It grows to 0.2-1 m tall. (DoEE, 2018f)
ECOLOGY	Flowers from September to March. Seedpods occur from September to January. Pollination is likely to be carried out by small native bees and wasps. Seed dispersal is likely to be by ants. Seeds are likely to remain viable for many years, which can lead to the development of a persistent soil-stored seed bank in the absence of cues for germination. The species may also reproduce vegetatively (Douglas, 2019b). This species may appear in response to disturbance. It is not always apparent, and can be cryptic and difficult to detect (particularly when not in flower) (Douglas, 2019b).
DISTRIBUTION AND HABITAT	Records occur in central-eastern NSW. They range from the Hunter District in the north to the Southern Highlands in the south and the Blue Mountains in the west. It is known to occur in the Cumberland IBRA subregion (OEH, 2019b). Inhabits heath or dry sclerophyll forests on sandy soils. It is recorded in open and sometimes slightly disturbed sites such as trail margins, edges of roadside, grading spoil mounds and in recently burnt patches (OEH, 2017a).
POPULATIONS	As of 2006, populations were known in around 113 locations and most were small in size (Douglas, 2019b). A natural population is considered at a critically low level if it contains less than 50 mature individuals (DoE, 2013a).
SOS SITES	The following SOS sites for the species have been proposed: • Dora Creek • Eastern Yengo • Castlereagh • Dharawal • Colymea SCA

RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Acacia bynoeana* (Bynoe's wattle) (DoE, 2013a)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=8575

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		Yes	Yes	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	Yes (Douglas, 2019b). Available at Supporting Document C				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS** **Expert report polygons**. Potential habitat polygons were generated based on the occurrence of PCTs 725, 883, 1081, 1181 and 1395, with the application of riparian exclusion buffers to account for the fact that wetter and sometimes more thickly vegetated areas associated with drainage lines are unlikely habitat. To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. In some areas which were surveyed, no suitable habitat was identified for the species, and these areas were removed from the habitat mapping. If suitable habitat was determined to be present by surveys, then the area was retained within the habitat map, regardless of whether the species was detected on site during the survey. It is noted that there are multiple areas which were surveyed which did not identify individuals of this species as being present which have been retained in the habitat mapping. However, it was not possible to access and survey all areas of potential habitat within the nominated areas. Any remaining potential habitat is considered precautionary and does not necessarily equate with actual habitat. Douglas (Douglas, 2019b) notes that the species is naturally rare and patchily distributed, which means that it is unlikely that a large percentage of the potential habitat would actually support the species, even though it can sometimes be locally abundant in favourable conditions. **OUTSIDE THE NOMINATED AREAS** **Species distribution model (SDM).** Potential habitat outside the nominated areas was mapped using an SDM. The report for this process (Supporting Document F) notes that the model for the species predicts more potential habitat than would be expected based on soils and PCTs alone. The mapping is therefore considered to be highly precautionary. No targeted surveys as part of this project were undertaken outside the nominated areas.				

POPULATION MAPPING	**RECORD SELECTION** Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset. **BIONET RECORD DOWNLOAD DATE** The initial assessment of *A. bynoeana* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *A. bynoeana* were downloaded in September 2019. **POPULATION DEFINITION** Biological populations were defined using the records dataset and available information about the nature of the species. It should be noted that limited information is available on the dispersal distance of *A. bynoeana*. However, the recovery plan for *A. pubescens* notes that dispersal over a distance of 300 m is considered likely for Acacia spp. (NSW NPWS, 2003). Based on this, plants within 300 m of each other were defined as one population. **IMPORTANT POPULATION CRITERIA** Populations of *A. bynoeana* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. Populations were considered important because they met one or more of the following criteria: • They are relatively large in size (number of individuals), in the context of known information regarding species ecology and population characteristics • They occur within a conservation reserve • They are part of an SOS site

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-1 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-48 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *A. bynoeana* in the Strategic Assessment Area. **Records** The species is known to occur in three main locations in the Strategic Assessment Area: • To the north of GPEC where there are a significant number of populations • Just to the north-east of GMAC • And within Wilton where it occurs in the conservation area for the previously approved Bingara Gorge development (EPBC 2014/7400) In total there are 44 populations within the Strategic Assessment Area. Of these populations, 36 are considered important, and 12 are wholly or partly located in existing conservation reserves.

It is important to note that surveys undertaken for the strategic assessment within the nominated areas did not record the species.

Potential habitat

The baseline mapping for the assessment mapped approximately 31,541.6 ha of known and potential habitat within the Strategic Assessment Area. 2,433.6 ha of this occurs within protected lands.

As a general trend, habitat within the Strategic Assessment Area is located in the north and south of the assessment area, with scattered areas towards the eastern and western edges.

Specifically, potential habitat for *A. bynoeana* is located:

- In the Londonderry area to the north of GPEC, where a large patch occurs in the area incorporating Agnes Banks, Wianamatta Nature Reserve, Castlereagh, and Windsor Downs nature reserves and the Waste Assets Management Corporation stewardship on The Northern Road
- In moderate patches to the north of the Londonderry area, including localities such as Scheyville, Freemans Reach, and North Richmond
- Within the Wianamatta Regional Park and Ropes Crossing, located within GPEC
- In moderate to large, connected areas occurring in the southern and south-eastern region of the Strategic Assessment Area, including areas around Buxton, Tahmoor and Bargo, Wilton, Douglas Park, vegetation corridors near Appin, and the Kentlyn/Minto Heights region
- In small to moderate patches near Gulguer Nature Reserve in the west of the Strategic Assessment Area
- In small, scattered patches near Kemps Creek, from the mid-east to the east of the Strategic Assessment Area, with some habitat occurring within WSA

Mapped potential habitat is relatively limited within GPEC, WSA and the northern half of GMAC, compared with Wilton and the southern half of GMAC where it is associated with most of the remnant vegetation.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.14.1 NOMINATED AREAS

The baseline mapping for the assessment mapped 2,635.3 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 2,201 ha (83.5 per cent) was avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,061.3 ha was avoided for biodiversity purposes
- 139.7 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 29-49.

It is important to note that the avoidance calculations in Table 29-49, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', were calculated without including excluded lands as these lands are not covered by the Plan. Table 29-49 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.14.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.14.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to the loss of potential habitat for the species. However, it will not result in direct impacts to any known populations. A summary of these impacts is provided in Table 29-52.

LOSS OF POTENTIAL HABITAT

Approximately 437.8 ha of potential habitat for the species will be lost as a result of the implementation of the Plan (433.5 ha within the nominated areas and 3.5 ha within transport corridors outside the nominated areas). This habitat occurs predominantly within Wilton and GMAC and represents 1.4 per cent of mapped potential habitat across the Strategic Assessment Area.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential habitat is considered to be very low. This is because:

- The likelihood of actual impacts occurring to the species has been categorised as possible. There will be no impacts to known populations, and there is moderate confidence that the species could occur in the potential habitat to be impacted. As outlined in the Approach to Baseline Data section above, the potential habitat mapping is considered precautionary and does not necessarily equate with actual habitat
- The consequence of any impacts to the species (if they did occur) has been categorised as negligible. There will be loss of <2 per cent of mapped potential habitat in the Strategic Assessment Area, with moderate confidence of the species' occurrence in impacted areas. There are no impacts to known populations.

29.14.4 FRAGMENTATION OF HABITAT

The placement of urban capable land and transport corridors within the Strategic Assessment Area will not lead to fragmentation of records or habitat of *A. bynoeana*, as it will not lead to the removal of habitat which links other areas of habitat or records together. All impacts to habitat of *A. bynoeana* are to already fragmented patches.

Therefore, there is no residual adverse risk of fragmentation as a result of loss of potential habitat under the Plan.

29.14.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *A. bynoeana*.

It is noted that a total of 1,259.7 ha of potential habitat for *A. bynoeana* is contained within three of the Plan's proposed reserves. These include:

- 907.5 ha of mapped habitat in the Georges River Koala Reserve
- 26.9 ha within the Confluence Reserve investigation area
- 325.3 ha of mapped habitat in the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.14.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (and other key documents) for *A. bynoeana* identifies a range of threats to the species (DoE, 2013a). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Inappropriate habitat disturbance
- Weed invasion
- Inappropriate fire regimes

Browsing by native and introduced herbivores has also been identified as a key threat. However, this is not considered relevant to the implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures *A. bynoeana* are discussed below for each identified indirect impact.

It is noted that a total of 1,259.7 ha of potential habitat for *A. bynoeana* is contained within three of the Plan's proposed reserves. The establishment of conservation reserves for known habitat of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE HABITAT DISTURBANCE

Disturbance to the species can occur:

- During road, trail, and powerline maintenance
- By recreational vehicles, horse riding and pedestrian use on the margins of trails where the species can occur (DoE, 2013a)

Activities associated with maintenance are likely to be a current issue for the species where known records occur outside the nominated areas (particularly to the north of GPEC). It is considered unlikely that activities approved under the Plan would exacerbate this threat.

Disturbance due to recreational use of natural areas may increase due to development within the nominated areas. Populations of *A. bynoeana* considered most at risk of this threat are those that occur on:

- Public land, as these areas are accessible without the deterrent that comes with trespassing. Populations occur on the following public land managed for conservation: Castlereagh Nature Reserve, Wianamatta Nature Reserve and possibly Agnes Banks Nature Reserve (there is one historical record of the species in this reserve, yet detailed surveys for associated species in recent years have failed to detect the species (Douglas, 2019b)). While access is potentially an issue in all these areas, the reserves are all managed for conservation purposes and have measures to control the impacts of public visitation

- An area of freehold land to the north of GPEC which is often mistaken for Crown land. This area contains a number of access tracks, and issues associated with rubbish dumping have been recorded for the site

In addition, some habitat for the species (around Populations 82 and 239) is subject to approval conditions to protect and manage it from indirect impacts, under a previous EPBC Act referral (EPBC 2014/7400). Conditions of approval include:

- Preparation of an environment management plan for the approval of the Commonwealth to address indirect impacts, which includes the following measures:
  - Fencing and signage to restrict access in the areas
  - Provision of bins to reduce littering

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (1,259.7 ha of potential habitat for *A. bynoeana* is contained within three of the Plan's proposed reserves, which includes 907.5 ha of mapped habitat in the Georges River Koala Reserve)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *A. bynoeana* from inappropriate habitat disturbance as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

WEED INVASION

A. bynoeana is threatened with invasion and competition by weeds. The species is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include:

- The southern end of Shanes Park where the M7/Ropes Crossing Link occurs adjacent to potential habitat areas
- The north-eastern section of Wianamatta Regional Park, where the Outer Sydney Orbital corridor within GPEC occurs near potential habitat
- Within Wilton at Bingara Gorge (noting this area is subject of a previous EPBC Act approval (EPBC 2014/7400) which includes weed control requirements to protect the species)
- North-east and south-east of GMAC

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *A. bynoeana*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

These measures are expected to adequately manage the potential threat to *A. bynoeana* from weed invasion.

INAPPROPRIATE FIRE REGIMES

Altered fire regimes are an identified potential threat to *A. bynoeana* (DoE, 2013a). Increased human activity within the nominated areas has the potential to increase the risk of fire within adjacent areas of habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development and roads.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *A. bynoeana* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *A. bynoeana*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within

the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

These measures are considered to adequately mitigate the threat to potential habitat for the species.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.14.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

A. bynoeana records occur within Wilton wholly within excluded lands. No records of the species occur within other nominated areas.

Mapped potential habitat for *A. bynoeana* occurs within avoided lands in all nominated areas, with the majority of habitat in avoided areas occurring in Wilton and GMAC. The development of essential infrastructure within avoided lands therefore has some potential to impact upon mapped habitat for *A. bynoeana*. It is noted that habitat which has the highest potential to be impacted would be habitat occurring at the edge of the urban capable lands and transport corridors, and therefore would likely constitute more marginal habitat with greater exposure to edge effects.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
  - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
  - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts

- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *A. bynoeana* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.14.8 POTENTIAL IMPACTS FROM TUNNELS

There is a total of 3.8 ha of potential habitat for *A. bynoeana* within the footprints of the Metro Rail Future Extension and OSO tunnels. No records of the species occur within or in the vicinity of the tunnel footprints. Given the small area of mapped potential habitat within the footprint and the absence of records, it is considered unlikely that *A. bynoeana* is present in the locality of the tunnel developments.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.14.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2013a) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *A. bynoeana* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Inappropriate habitat disturbance
  - Weed invasion
  - Inappropriate fire regimes

HABITAT LOSS AND FRAGMENTATION

The risk of residual adverse impacts to the species from habitat loss and fragmentation under the Plan is very low. Although the Plan authorises the clearing of 437.8 ha of potential habitat, the mapping for this species is highly precautionary and the impacts relate to 1.4 per cent of the mapped habitat in the Strategic Assessment Area. The vast majority of mapped habitat in the nominated areas was avoided in the design of the urban capable lands. There will be no impacts to known populations or fragmentation of potential habitat. This clearing is not expected to influence the long-term viability of the species.

While specific offsets for this species are not considered necessary, the Plan includes broader commitments and actions that are likely to benefit the species. In particular, the SCA contains approximately 6,321.6 ha of mapped potential habitat for the species. Although the final extent of potential habitat that will be secured in these areas is unclear, the opportunity to secure large, well connected, and high-quality vegetation that provides potential habitat makes it likely that the conservation program will deliver benefits for this species. For example, 1,259.7 ha of potential habitat for *A. bynoeana* is contained within three of the Plan's proposed reserves, including 907.5 ha of mapped habitat in the Georges River Koala Reserve.

The process of protecting land in the Strategic Assessment Area is likely to support a priority action from the Conservation Advice to increase the area of habitat for the species that is secured and managed for conservation.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate habitat disturbance, weed invasion, and inappropriate fire regimes will be managed and mitigated through the generic management strategies in the Plan, and through an existing EPBC Act approval in the Bingara area.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

There will be no direct impacts to known populations. There are large areas of potential habitat (31,541.6 ha) and impacts to this are relatively minor (437.8 ha). There will be no fragmentation of potential habitat.

Potential indirect impacts are addressed through management measures in the Plan and a previous EPBC Act approval.

Collectively these will ensure that the implementation of the Plan does not adversely influence the long-term viability of *A. bynoeana*.

29.14.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.14.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-47 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *A. bynoeana*, there are no relevant Threat Abatement Plans.

Table 29-47: Relevant key Threatening Processes and associated Threat Abatement Plans for *A. bynoeana*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-48: Occurrence of *A. bynoeana* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	44	12
(IMPORTANT POPULATIONS)	(36)	(12)
HABITAT MAPPING (Ha)	31,541.6	2,433.6

Table 29-49: Avoidance of *A. bynoeana* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	1,462.0	1,761.0	38.8	130.5	3,392.3
HABITAT WITHIN EXCLUDED LANDS (ha)	221.7	426.6	1.3	107.3	756.9
HABITAT WITHOUT EXCLUDED LANDS (ha)	**1,240.3**	**1,334.3**	**37.5**	**23.2**	**2,635.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	945.7	1,090.1	25.1	0.4	2,061.3
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	76.2	81.7	66.8	1.9	78.2
AVOIDANCE FOR OTHER REASONS (ha)	54.3	85.4	0.1	0.0	139.7
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	4.4	6.4	0.3	0.0	5.3
TOTAL AVOIDANCE (ha)	**1,000.0**	**1,175.4**	**25.2**	**0.4**	**2,201.0**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**80.6**	**88.1**	**67.1**	**1.9**	**83.5**

Table 29-50: Direct impacts to *A. bynoeana* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	240.3	158.9	12.3	22.8	3.5	**437.8**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.15 *ACACIA PUBESCENS* (DOWNY WATTLE, HAIRY-STEMMED WATTLE)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Acacia pubescens* is a weeping, spreading shrub with brilliant yellow flowers, bipinnate leaves and hairy branchlets. It grows approximately 1-5 m tall. (TSSC, 2016a)
ECOLOGY	Flowers between August and October. Pods mature between October and December. Plants first flower when they are around 3-5 years old. The species is pollinated by insects (most likely small native bees and wasps) and birds (Douglas, 2019c). Recruitment is often by vegetative means, and this can reduce the genetic diversity of a population. The percentage of seed fall may be low, possibly due to predation when on the plant. The species is likely to have high seed dormancy and a long-lived persistent soil seed bank. Regeneration can occur following fire, however, severe fires kill the stems. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	Records are restricted to the Sydney district predominantly in the Cumberland subregion (NSW NPWS, 2003) The species inhabits open woodland and forest in a variety of plant communities (Cooks River/Castlereagh Ironbark Forest, Shale Gravel Transition Forest, and Cumberland Plain Woodland). It occurs on alluviums, shales and at the intergrade between shales and sandstones. (DoEE, 2018f)
POPULATIONS	As of 2003, there were 116 known populations of this species. At that time, just over half of those known populations contained fewer than 20 stems (NSW NPWS, 2003). Populations should be considered viable unless there is evidence to the contrary. This is because most recruitment is from vegetative reproduction and small population sizes are not necessarily relevant in the assessment of viability (NSW NPWS, 2003). Assessment of all BioNet records of the species indicates that over 90 per cent of known records occur within the Cumberland subregion. Therefore, for the purposes of this assessment, *A. pubescens* is considered to be an endemic species to the region.
SOS SITES	The following SOS sites for the species have been identified: • Mountain Lagoon • Hawkesbury

	• Bankstown-Liverpool
RELEVANT PLANS AND POLICIES	Conservation Advice *Acacia pubescens* Downy Wattle (TSSC, 2016a) Downy Wattle (*Acacia pubescens*) Recovery Plan (NSW NPWS, 2003)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=18800

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	Yes	Yes	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	Yes (Douglas, 2019c). Available at Supporting Document C				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Expert report polygons. Potential habitat polygons were generated based on the occurrence of PCTs 724, 725, 835, 849, 883, 1081, and 1395, with the application of riparian exclusion buffers to account for the fact that wetter and sometimes more thickly vegetated areas associated with drainage lines are unlikely habitat. All condition classes of vegetation for this species were considered to be suitable habitat as this species is able to occur in quite disturbed habitats. The species may also occur in sites which are so modified that they would not be mapped as native vegetation community. To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. In some areas which were surveyed, no suitable habitat was identified for the species, and these areas were removed from the habitat mapping. If suitable habitat was determined to be present by surveys, then the area was retained within the habitat map, regardless of whether the species was detected on site during the survey. It is noted that there are multiple areas which were surveyed which did not identify individuals of this species as being present which have been retained in the habitat mapping. However, it was not possible to access and survey all areas of potential habitat within the nominated areas. Douglas (Douglas, 2019c) notes that any remaining potential habitat is considered precautionary and does not necessarily equate with actual habitat. The species is naturally rare and patchily distributed, which means that it is unlikely that a large percentage of the potential habitat would actually support the species. It can sometimes be locally abundant in favourable conditions.				
	OUTSIDE THE NOMINATED AREAS				
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. The report for this process (Supporting Document F) notes that the model for the				

	species predicts more potential habitat than would be expected based on soils and PCTs alone. The mapping is considered to be highly precautionary. No targeted surveys as part of this project were undertaken outside the nominated areas.
POPULATION MAPPING	**RECORD SELECTION** Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset. **BIONET RECORD DOWNLOAD DATE** The initial assessment of *A. pubescens* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *A. pubescens* were downloaded in September 2019. **POPULATION DEFINITION** Biological populations were defined using the records dataset and available information about the nature of the species. The recovery plan for *A. pubescens* notes that dispersal over a distance of 300 m is considered likely for Acacia spp. (NSW NPWS, 2003). Based on this, plants within 300 m of each other have been defined as one population. **IMPORTANT POPULATION CRITERIA** Populations of *A. pubescens* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. Populations were considered important because they met one or more of the following criteria: • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program • A large population • Is associated with a commitment made under the Sydney Growth Centres conservation program • A population within a conservation area

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-2 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-52 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *A. pubescens* in the Strategic Assessment Area. **Records** Known records for *A. pubescens* are distributed across two core areas which have been identified for site management under the NSW Saving our Species (SOS) program: • One area associated with the Hawkesbury SOS site in the north-east of the Strategic Assessment Area, including Windsor Downs, Pitt Town, and Scheyville National Park

- The second associated with the Bankstown-Liverpool SOS site, comprising an area that straddles the central-east boundary of the Strategic Assessment Area around Lansdowne

Scattered records occur more broadly, but still within the region of these two core areas. There are also a small number of outlier populations outside and to the west of the Strategic Assessment Area, at Mountain Lagoon in the north-west and The Oaks in the south-west.

There are a total of 97 important populations within the Strategic Assessment Area, of which 13 either wholly or partly occur within existing protected areas as shown in Table 29-52. None of these important populations occur within the nominated areas.

One of these populations is located at Kemps Creek just outside the southern boundary of WSA. This population has been identified as important because it is the subject of a commitment made under the Sydney Growth Centres Program.

The remaining 96 populations within the Strategic Assessment Area have been identified as important because they are all associated with the Saving our Species sites across the two core areas described above.

A further 8 non-important populations have been mapped within the Strategic Assessment Area. These populations broadly occur around Minchinbury within GPEC and further south within the Austral and Hoxton Park areas, outside of the nominated areas.

Potential habitat

The baseline mapping for this assessment has mapped approximately 36,224.2 ha of known and potential habitat within the Strategic Assessment Area as shown in Table 29-52. The majority of this habitat is associated with the two core areas for the species and mostly occurs outside of the nominated areas.

Within the nominated areas, potential habitat has been identified:

- Within GPEC and WSA, where potential habitat areas align closely with patches of remnant vegetation. This potential habitat is within the western extent of the core area associated with the Bankstown-Liverpool SOS site
- Within GMAC, where potential habitat areas again align closely with patches of remnant vegetation. A small proportion of this occurs within the northern section of the nominated area which forms part of the southern extent of the Bankstown-Liverpool SOS site. However, the majority of this potential habitat occurs within the southern half of the nominated area approximately 22 km south of this core area in a locality where the species has not previously been recorded
- Within Wilton, where potential habitat is not just associated with remnant patches of vegetation but has been mapped more broadly in a number of areas. However, it is noted that this area is well outside the core range of *A. pubescens* in areas where (according the expert report) the species is not known from or likely to occur (Douglas, 2019c)

It is relevant to note that surveys throughout remnant vegetation within GMAC and Wilton undertaken as part of this assessment did not detect the species. This, combined with the fact that the majority of potential habitat mapped within these areas is outside the species' core range, suggests that *A. pubescens* is unlikely to occur within mapped potential habitat within southern GMAC and Wilton.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.15.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 3,887.6 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 2,566.2 ha (66 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,320.9 ha was avoided for biodiversity purposes

- 245.4 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 29-53.

It is important to note that the avoidance calculations in Table 29-53, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including 'excluded lands' as these lands are not covered by the Plan. Table 29-53 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.15.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.15.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will not lead to any direct impacts to known populations. However, it will lead to a loss of potential habitat. A summary of these impacts is presented in Table 29-54.

LOSS OF POTENTIAL HABITAT

Approximately 1,377.6 ha of potential habitat for the species will be lost as a result of the implementation of the Plan (1,321.4 ha within the nominated areas and 56.2 ha within transport corridors outside the nominated areas). This habitat occurs in the following areas:

- Within GPEC and WSA, at the western extent of the core area for the species associated with the Bankstown-Liverpool SOS site
- Potential habitat within Wilton and the southern section of GMAC

This habitat represents 3.8 per cent of mapped potential habitat across the Strategic Assessment Area.

RISK OF RESIDUAL ADVERSE IMPACTS

The risk of residual adverse impacts occurring to the species as a result of the loss of potential habitat is considered to be very low. This is because:

- The likelihood of actual impacts occurring to the species has been categorised as unlikely. There will be no impacts to known populations, and there is low confidence that the species could occur in the potential habitat to be impacted. The habitat which is to be impacted within GPEC and WSA consists of small, scattered, and isolated patches which are considered unlikely to support the species. Impacted potential habitat within GMAC and Wilton is located outside of the core range of the species, and the species has never been recorded in these localities
- The consequence of any impacts to the species (if they did occur) has been categorised as minor. There will be loss of between 2-5 per cent of mapped potential habitat in the Strategic Assessment Area with low confidence of the species' occurrence in impacted habitat (endemic species). Species mapping for this assessment is highly precautionary, with much impacted habitat being mapped beyond the known range of the species, suggesting the

species is unlikely to occur in these localities, and as such there is low confidence of species presence in impacted habitat

29.15.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The placement of urban capable land and transport corridors within the Strategic Assessment Area will lead to fragmentation of a small area of potential habitat with no associated records. This habitat is located to the south of WSA in the vicinity of Cobbitty, which will be fragmented as a result of the development of the OSO.

RISK OF RESIDUAL ADVERSE IMPACTS

The risk of residual adverse impacts occurring to the species as a result of the loss of fragmentation is considered to be very low. This is because:

- The likelihood of fragmentation has been categorised as unlikely. This is because:
  - The likelihood that development presents a barrier to dispersal of the species is possible. *A. pubescens* is pollinated by insects and birds, and it is thought that individuals of the species within 300 m of each other are likely to be within the same population, suggesting that the species has the capacity to breed with and/or disperse up to 300 m from adult plants. While detailed planning for development within the transport corridors has not yet been completed, it is anticipated that the width of the OSO will be less than 300 m. The OSO is further thought to have potential to deter movement of pollinators and/or seed dispersers between adult plants.
  - The type of fragmentation is impact to mapped habitat only. This is because there are no known records on, or in the vicinity of, mapped potential habitat which is impacted by the OSO near Cobbitty.
- The consequence of fragmentation has been categorised as negligible. This is because the area to be fragmented consists of a small area of potential habitat with no associated records.

29.15.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *A. pubescens.*

It is noted that a total of 471.7 ha of potential habitat for *A. pubescens* is contained within three of the Plan's proposed reserves. These include:

- 287.6 ha of mapped habitat in the Georges River Koala Reserve
- 173.5 ha within the Confluence Reserve investigation area
- 10.6 ha of mapped habitat in the Gulguer Reserve investigation area

Further, a non-important population of *A. pubescens* is located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.15.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (TSSC, 2016a) and Recovery Plan (NSW NPWS, 2003) (and other key documents) for *A. pubescens* identify a range of threats to the species. Where these threats are relevant to the implementation of the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Inappropriate habitat disturbance through illegal track creation and maintenance activities
- Weed invasion
- Inappropriate fire regimes

Hybridisation with non-naturally occurring bipinnate wattles within natural range and impacts to individuals from an unknown disease was also identified as a key threat. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the threat across the Strategic Assessment Area.

However, it is considered unlikely that these indirect impacts will adversely affect the majority of populations of the species within or surrounding the Strategic Assessment Area for the following reasons:

- All populations within the nominated areas (population 485, 486, and 487 in GPEC and population 474 in GMAC) are non-important populations which are within landscapes which are already highly developed. These populations would be subject to a range of threatening processes from the existing urban environment and are unlikely to be affected by development under the Plan
- The important populations associated with the Bankstown-Liverpool SOS site occur approximately 6 km east of the nearest development within WSA and are also in a landscape which is highly developed which is subject to existing threatening processes. Development under the Plan is unlikely to affect these populations
- The important populations associated with the Hawkesbury SOS site occur some distance from proposed development under the Plan (over 8 km from the nearest transport corridor outside of the nominated areas and over 12 km to the nearest urban capable land within GPEC) and a number of these populations are already managed for conservation within the Scheyville National Park

The only important population which has potential to be indirectly impacted by development under the Plan is population 479. This important population that forms part of a commitment under the Sydney Growth Centres Program which requires field validation of the records before habitat associated with the population will be protected.

A brief survey of the locality of Kemps Creek was undertaken in mid-November of 2018, as described in the expert report for this species. While no new records of the species were reported, it was considered possible that the species may occur on disturbance margins which were not traversed, or that the species may be restricted to seed bank at that location. Overall, the remnant habitat of this locality was largely unmanaged and degrading due to several threats at the time of survey. It is recognised that *A. pubescens* is relatively tolerant of significant disturbance and can persist as a long-lived seedbank or as root suckers, and therefore the species may persist in disturbed areas. It is recommended that the management of habitat at Kemps Creek under this program be improved. It is considered that improved and ongoing management of habitat at Kemps Creek will provide protection of *A. pubescens* within this locality from impacts associated with indirect impacts.

A small non-important population (population 487) has potential to be indirectly impacted by development under the Plan. The following sections outline the control measures under the Plan to manage indirect impacts to *A. pubescens*.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures *A. pubescens* are discussed below for each identified indirect impact.

It is noted that a total of 471.7 ha of potential habitat for *A. pubescens* is contained within three of the Plan's proposed reserves, and a non-important population of the species is located within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE HABITAT DISTURBANCE

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including 471.1 ha of potential habitat for *A. pubescens* that is contained within three of the Plan's proposed reserves. This includes 287.6 ha of mapped habitat in the Georges River Koala Reserve)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *A. pubescens* from inappropriate habitat disturbance as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands (including mapped potential habitat for *A. pubescens* within conservation reserves) will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

WEED INVASION

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *A. pubescens*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches

- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *A. pubescens* from the increased risk of weeds associated with development. This is because:

- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

INAPPROPRIATE FIRE REGIMES

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *A. pubescens* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *A. pubescens*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to *A. pubescens* from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat for *A. pubescens* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *A. pubescens* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.15.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

A. pubescens records occur within GMAC and GPEC wholly within excluded lands. No records of the species occur within other nominated areas.

Mapped potential habitat for *A. pubescens* occurs within avoided lands in all nominated areas, with the majority of habitat in avoided areas occurring in Wilton and GMAC. The development of essential infrastructure within avoided lands therefore has some potential to impact upon mapped habitat for *A. pubescens*. It is noted that habitat which has the highest potential to be impacted would be habitat occurring at the edge of the urban capable lands and transport corridor, and therefore would likely constitute more marginal habitat with greater exposure to edge effects.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *A. pubescens* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.15.8 POTENTIAL IMPACTS FROM TUNNELS

There is a total of 67.8 ha of mapped potential habitat for *A. pubescens* within the footprints of the Metro Rail Future Extension and OSO tunnels, which occurs as small and fragmented habitat patches. No records of the species occur within or in the vicinity of the tunnel footprints. Given the relatively small area and fragmented nature of mapped

potential habitat within the footprint and the absence of records, it is considered unlikely that *A. pubescens* is present in the locality of the tunnel developments.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under Commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.15.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (TSSC, 2016a) identifies the following key issues that are likely to be the highest risk threat to the long-term viability of *A. pubescens* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Weed invasion
  - Habitat disturbance through illegal track creation and maintenance activities
  - Inappropriate fire regimes

HABITAT LOSS AND FRAGMENTATION

The risk of residual adverse impacts to the species from habitat loss and fragmentation under the Plan is very low. Although the Plan authorises the clearing of 1,377.6 ha of potential habitat, the mapping for this species is highly precautionary and these impacts relate to approximately 3.8 per cent of the mapped habitat in the Strategic Assessment Area. The majority of mapped habitat in the nominated areas was avoided in the design of the urban capable lands. There will be no impacts to known populations, and the risk of fragmentation is very low. Direct impacts are not expected to negatively impact the long-term viability of the species.

While specific offsets for this species are not considered necessary, the Plan includes broader commitments and actions that are likely to benefit the species. In particular, the SCA contains approximately 3,781.3 ha of mapped potential habitat for the species. Although the final extent of potential habitat that will be secured in these areas is unclear, the opportunity to secure large, well-connected, and high-quality vegetation that provides potential habitat makes it likely that the conservation program will deliver benefits for this species. For example, 471.7 ha of potential habitat for *A. pubescens* is contained within three of the Plan's proposed reserves, including 287.6 ha in the Georges River Koala Reserve.

The process of protecting land in the Strategic Assessment Area is likely to support a priority action from the Conservation Advice to prevent further loss of habitat.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate habitat disturbance, weed invasion, and inappropriate fire regimes will be managed and mitigated through the generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

There will be no direct impacts to known populations. There are large areas of potential habitat (36,224.2 ha) and impacts to this are relatively minor (1,377.6 ha). The risk of fragmentation is very low.

Potential indirect impacts are addressed through management measures in the Plan.

This will ensure that the implementation of the Plan does not adversely influence the long-term viability of *A. pubescens*.

29.15.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan is to prevent the status of *A. pubescens* from becoming endangered, by reducing habitat loss and by implementing management regimes aimed at maintaining representative populations across the species' range (NSW NPWS, 2003).

Recovery plan strategies have been identified to support the overall objective. They are:

- To ensure that a representative sample of *A. pubescens* populations occurring on public and private lands are protected from habitat loss and managed for conservation;
- To reduce the impacts of threats at sites across the species' range;
- To ensure that any planning and management decisions that are made which affect the species, are made in accordance with the recovery objectives of this plan;
- To understand the biology, ecology, health and distribution of the species including the range of genetic variation;
- To develop the awareness and involvement of the broader community in the species and its conservation; and
- To re-assess the conservation status of the species.

Implementation of the Plan will support a number of these strategies by including development controls that manage and control the risks of potential indirect impacts consistent with actions in the Conservation Advice and will not prevent the achievement of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT THE IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to support the overall recovery of *A. pubescens*. The Plan will not prevent implementation of any of the actions.

29.15.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-51 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *A. pubescens*, there are no relevant Threat Abatement Plans.

Table 29-51: Relevant key Threatening Processes and associated Threat Abatement Plans for *A. pubescens*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-52: Occurrence of *A. pubescens* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	105	13
(IMPORTANT POPULATIONS)	(97)	(13)
HABITAT MAPPING (Ha)	36,224.2	2,875.0

Table 29-53: Avoidance of *A. pubescens* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	1,701.8	2,353.3	667.7	2,637.2	7,360.1
HABITAT WITHIN EXCLUDED LANDS (ha)	238.3	885.5	86.1	2,262.6	3,472.5
HABITAT WITHOUT EXCLUDED LANDS (ha)	**1,463.5**	**1,467.8**	**581.6**	**374.7**	**3,887.6**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	965.9	1,075.3	189.6	90.0	2,320.9
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	66.0	73.3	32.6	24.0	59.7
AVOIDANCE FOR OTHER REASONS (ha)	69.4	126.3	35.6	14.1	245.4
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	4.7	8.6	6.1	3.8	6.3
TOTAL AVOIDANCE (ha)	**1,035.3**	**1,201.6**	**225.2**	**104.1**	**2,566.2**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**70.7**	**81.9**	**38.7**	**27.8**	**66.0**

Table 29-54: Direct impacts to *A. pubescens* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	428.2	266.2	356.5	270.6	56.2	**1,377.6**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.16 *ALLOCASUARINA GLAREICOLA*

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Allocasuarina glareicola* is an erect, smooth-barked shrub with cones that grows to approximately 2 m tall (DoEE, 2018f; OEH, 2018b)
ECOLOGY	The species is monoecious or dioecious and flowers around October each year. The time taken for the plants to flower and set seed is not known. Regeneration is commonly by suckers. Root suckers can appear up to 3 m from the parent plant, where clumps of up to hundreds of stems may be a single individual. Seedling recruitment has only been observed at one site. The species is wind pollinated which means the distance between individuals may be a critical factor in enabling pollination and seed set. (DoEE, 2018f; OEH, 2018b)
DISTRIBUTION AND HABITAT	Records are primarily restricted to the Castlereagh and Londonderry areas of the Cumberland subregion, with an outlier population found in Liverpool (Holsworthy Military Area). The total extent of occurrence (EOO) of the species is approximately 27 km^2. Inhabits Castlereagh woodland and open woodland (with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla*, and *Melaleuca decora*). It occurs on strongly acidic soils with low fertility. (DoEE, 2018f; OEH, 2018b)
POPULATIONS	There were 457 clumps of *A. glareicola* known in 1996. The largest population, which consisted of 405 clumps, is likely to have reduced due to the expansion of an adjacent rubbish tip. (DoEE, 2018f) Assessment of all BioNet records of the species indicates that over 90 per cent of known records occur within the Cumberland subregion. Therefore, for the purposes of this assessment, *A. glareicola* is considered to be an endemic species to the region. It is further noted that this species has been identified as an SAII species under the BCAR process. Refer to Chapter 25 for further information.
SOS SITES	The following SOS sites for the species have been proposed: • East of Agnes Banks Nature Reserve • Castlereagh Nature Reserve • Wianamatta Nature Reserve • Heathcote Rd

RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Allocasuarina glareicola* (DEWHA, 2008a)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=21932

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	Yes
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Potential habitat polygons were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned) and soils including Blacktown, Agnes Banks, Berkshire Park and Gymea. Potential habitat was confined to within GPEC, as there are no records in Wilton and GMAC, and no records or suitable habitat in WSA, suggesting the species is unlikely to be present in those areas. To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. It was not possible to access and survey all areas of potential habitat within the nominated areas. However, the species was not observed as part of surveys conducted through sections of suitable habitat in urban capable land and transport corridors.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). Potential habitat polygons were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned), elevation (below 50 m), geographic restrictions (species is primarily restricted to the Richmond (NW Cumberland subregion) district, but with an outlier population found at Voyager Point, Liverpool), and patch size (>40 ha, based on exclusion of small patches of vegetation not meeting the known geographic extent of the species).				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				

	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *A. glareicola* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *A. glareicola* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Biological populations were defined based on clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollination
	IMPORTANT POPULATION CRITERIA
	All populations of *A. glareicola* were considered important as the species is endangered

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-3 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	A total of 10 populations (from 36 BioNet records) have been mapped within the Strategic Assessment Area. All populations are considered important, and one population is wholly or partly located in an existing conservation reserve. Of these: • Nine are located within the Londonderry area, including a large population (Population 3) within the Castlereagh Nature Reserve to the north of GPEC • One (Population 1) is located within a rail corridor along Hobart St in St Marys The outlier population that has been recorded within the Holsworthy Military Area is outside the Strategic Assessment Area. The baseline mapping for this assessment has mapped approximately 4,431.9 ha of known and potential habitat within the Strategic Assessment Area. This potential habitat is primarily associated with the vegetation in the Londonderry area. In addition to this, there are: • Three moderate sized patches of potential habitat – one associated with Shanes Park and Wianamatta Regional Park, one near Kemps Creek, and one in the Holsworthy area • Scattered and more isolated patches of potential habitat within each of the nominated areas, including a number of patches in GPEC and fewer, smaller patches in GMAC and Wilton It is important to note that surveys of the Outer Sydney Orbital for this project within the Wianamatta Regional Park did not identify the species, and it had not previously been recorded in the Park. A breakdown of occurrence for *A. glareicola* in the Strategic Assessment Area is provided in Table 29-56.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.16.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 32.3 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 14.9 ha (46.1 per cent) of this has been avoided as part of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 14.8 ha was avoided for biodiversity purposes
- 0.1 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 29-57.

It is important to note that the avoidance calculations in Table 29-57, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-57 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.16.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.16.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will not lead to any direct impacts to known populations or fragmentation of habitat. However, it will lead to the loss of potential habitat.

LOSS OF POTENTIAL HABITAT

The Plan will lead to the loss of 17.4 ha of potential habitat. This represents a very small percentage of the mapped potential habitat across the Strategic Assessment Area. These impacts relate to urban development in GPEC, near Orchard Hills, in addition to small areas of habitat near Shanes Park within the footprint of the M7/Ropes Crossing Link Road major transport corridor.

A summary of these impacts is provided in Table 29-58.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of direct impacts to mapped habitat are considered to be very low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as unlikely. While there will be direct impacts to potential habitat within the vicinity of Orchard Hills and Shanes Park, there is low confidence that the species will occur in the impact area because:
    - With regards to the habitat near Orchard Hills, a small section of suitable habitat within urban capable land which could be accessed as part of this biodiversity certification process was surveyed and the species was not observed. It is generally considered unlikely that suitable habitat in this area contributes to the ongoing survival or viability of the species more broadly
    - With regards to habitat near Shanes Park, extensive surveys were undertaken across substantial areas of the footprint of the M7/Ropes Crossing Link Road within this locality, and the species was not detected. While the specific area of mapped habitat was not surveyed, the absence of the species in adjacent areas suggests that it is unlikely to occur. Further, there are no known records of the species in proximity to this habitat
- The consequence of impacts to the species (if they did occur) has been categorised as negligible. There will be a loss of <0.5 per cent of mapped potential habitat (endemic species, SAII species), with low confidence that the species occurs in the impact area

29.16.4 FRAGMENTATION OF HABITAT

The placement of urban capable land and transport corridors within the Strategic Assessment Area will not lead to fragmentation of records or habitat of *A. glareicola*, as it will not lead to the removal of habitat which links other areas of habitat or records together. All impacts to habitat of *A. glareicola* are to already fragmented patches.

Therefore, there is no residual adverse risk of fragmentation as a result of loss of potential habitat under the Plan.

29.16.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *A. glareicola*.

It is noted that a total of 2.1 ha of potential habitat for *A. glareicola* is contained within the Gulguer Reserve investigation area.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.16.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *A. glareicola* identifies a range of threats to the species (DEWHA, 2008a). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Habitat degradation from rubbish dumping and unrestricted access
- Weed invasion

- Inappropriate fire regimes

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures *A. glareicola* are discussed below for each identified indirect impact.

It is noted that a total of 2.1 ha of potential habitat for *A. glareicola* is contained within the Gulguer Reserve investigation area. The establishment of conservation reserves for known habitat of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

HABITAT DEGRADATION

Habitat degradation through unrestricted public access and rubbish dumping have been identified as a key threat to *A. glareicola* (DEWHA, 2008a). Development within GPEC and WSA may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

Populations of *A. glareicola* considered most at risk of this threat are those that occur on:

- Public land, as these areas are accessible without the deterrent that comes with trespassing. Only one recorded population, labelled Population 3, occurs on public land, within the Castlereagh Nature Reserve. This population comprises 11 of the 36 records for the species within the Strategic Assessment Area, making it one of the most significant known occurrences. Impacts associated with public access are an identified threat to the biodiversity of the Castlereagh Nature Reserve and restrictions, signage and management measures (such as rationalising the network of management trails) are already in place to address potential impacts (NSW NPWS, 1999). Assuming this management continues and adapts to potential increasing visitation over the life of the Plan, the risk to *A. glareicola* from disturbance in this area is expected to be adequately addressed
- An area of freehold land to the north of GPEC which is often mistaken for Crown land, contains several access tracks, and issues associated with rubbish dumping have been recorded for the site

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. Note that there is 4,431.9 ha of potential habitat for *A. glareicola* within the SCA
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

WEED INVASION

A. glareicola is threatened with invasion and competition by weeds, with African lovegrass *(Eragrostis curvula)*, Whisky grass (*Andropogon virginicus*), *Pennisetum clandestinum*, *Ricinus communis* and Asparagus fern considered to be the main competitors. These weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development within the northern half of the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *A. glareicola*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

INAPPROPRIATE FIRE REGIMES

A. glareicola can regenerate following fire. However, plants may be damaged and fruit production and seed set prevented by too frequent fires (DEWHA, 2008a). Increased human activity within the nominated areas increases the risk of fire to habitat areas supporting the species.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *A. glareicola* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *A. glareicola*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

Mapped habitat does not occur within the tunnel footprints and the species is not at risk from impacts in those locations.

29.16.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

A small area of species habitat has been mapped within avoided lands in GPEC. Given the limited extent of habitat, impacts to habitat are considered unlikely due to essential infrastructure.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *A. glareicola* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.16.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008a) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *A. glareicola* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Habitat degradation from rubbish dumping and unrestricted access
  - Weed invasion
  - Inappropriate fire regimes

HABITAT LOSS AND FRAGMENTATION

Given the very low risk to the species associated with habitat loss and fragmentation, implementation of the Plan will not adversely influence the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with habitat degradation, weed invasion, and inappropriate fire regimes will be managed and mitigated through a number of commitments and actions in the Plan. Indirect impacts will not adversely influence the long-term viability of the species.

CONCLUSION

The limited scale of direct and indirect impacts to the species will ensure that implementation of the Plan does not adversely influence the long-term viability of the species.

29.16.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.16.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-55 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *A. glareicola*, there are no relevant Threat Abatement Plans.

Table 29-55: Relevant key Threatening Processes and associated Threat Abatement Plans for *A. glareicola*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-56: Occurrence of *A. glareicola* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	10	1
(IMPORTANT POPULATIONS)	(10)	(1)
HABITAT MAPPING (Ha)	4,431.9	1,159.6

Table 29-57: Avoidance of *A. glareicola* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	0.0	0.0	200.0	200.0
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	0.0	0.0	167.7	167.7
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**0.0**	**32.3**	**32.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	0.0	14.8	14.8
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.0	45.7	45.7
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	0.0	0.1	0.1
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.0	0.3	0.3
TOTAL AVOIDANCE (ha)	**0.0**	**0.0**	**0.0**	**14.9**	**14.9**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**0.0**	**0.0**	**46.1**	**46.1**

Table 29-58: Direct impacts to *A. glareicola* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	0.0	17.4	0.0	**17.4**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.17 *MICROMYRTUS MINUTIFLORA*

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Micromyrtus minutiflora* is a slender spreading shrub. Grows to 2 m high. Flowers are solitary but can be abundant on plants and have small white petals. (DEWHA, 2008f)
ECOLOGY	Flowers sporadically from June to March. Response to disturbance (such as fire or mechanical disturbance) is uncertain. Regeneration may occur because of re-sprouting, or germination of seeds stored within the soil. (OEH, 2019g)
DISTRIBUTION AND HABITAT	Endemic to the western parts of the Cumberland Plain in the Richmond-Castlereagh area of the Sydney Region. The distribution overlaps with the following TECs: • Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • Cooks River/Castlereagh Ironbark Forest • Castlereagh Scribbly Gum and Agnes Banks Woodlands Grows in Scribbly Gum Woodland, Ironbark Forest, Shale Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments. (DEWHA, 2008f; OEH, 2019g)
POPULATIONS	As of 1997, there were over 1,160 individuals in the ADI Site, and 500 individuals present in Marsden Park. As of 2002, there were 11 population sites with approximately 1,800 individuals across the Blacktown, Hawkesbury, and Penrith Local Government Areas. Populations range from fewer than 50 plants to over 1,000. (DEWHA, 2008f) The 2016 fire in Wianamatta Nature Reserve has seriously affected the total known individuals and regeneration post fire has not yet been seen. This may have led to the loss of more than 60 per cent of the known individuals. Assessment of all BioNet records of the species indicates that over 90 per cent of known records occur within the Cumberland subregion. Therefore, for the purposes of this assessment, *M. minutiflora* is considered to be an endemic species to the region. It is further noted that this species has been identified as an SAII species under the BCAR process. Refer to Chapter 25 for further information.

SOS SITES	The following SOS site for the species has been identified: Wianamatta Nature Reserve
RELEVANT PLANS AND POLICIES	Approved conservation advice for *Micromyrtus minutiflora* (DEWHA, 2008f)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=11485

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	No	No	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Potential habitat polygons were generated using BioNet PCT associations, vegetation condition (intact, thinned, scattered trees) and elevation (up to 50 m). To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. The species was not recorded during surveys.				
	OUTSIDE THE NOMINATED AREAS				
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *M. minutiflora* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *M. minutiflora* were downloaded in October 2020.				

	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Populations were defined by clustered records connected by relatively intact and continuous vegetation and not separated by a distance of >1 km (approx.). This is based on the distance travelled by insect pollinators and potential unrecorded individuals.
	IMPORTANT POPULATION CRITERIA
	All populations of *M. minutiflora* were considered important within the Strategic Assessment Area because the species is identified as an SAII entity through the BC Act process.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-13 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	A total of 14 populations (from 455 BioNet records) have been mapped within the Strategic Assessment Area. All populations are considered important, and three populations are wholly or partly located in existing conservation reserves. The majority of the populations are located to the north of GPEC, and one population (Population 108) occurs within GPEC. The baseline mapping for this assessment has mapped approximately 36,704.5 ha of known and potential habitat within the Strategic Assessment Area. This habitat is primarily associated with the vegetation in the Londonderry area. In addition to this, there are: • Small, scattered areas of habitat to the north and south of the Londonderry Area, including scattered habitat within GPEC and WSA • Scattered areas of habitat across the southern areas of the Strategic Assessment Area, in the area bounded by Silverdale in the north-west, Camden in the centre north, Liverpool in the north-east and the Strategic Assessment Area boundary along the south. It is noted that there is no mapped habitat within Wilton and only very small and isolated areas of potential habitat within GMAC It is also noted that the southernmost record known for this species occurs near Mulgoa, and that no records of the species have ever been found within or south of Silverdale or Liverpool. Therefore, whilst potential habitat has been mapped for this species within the southern portion of the Strategic Assessment Area through the SDM mapping, it is considered unlikely that this mapped habitat would be occupied by the species. A breakdown of occurrence for *M. minutiflora* in the Strategic Assessment Area is provided in Table 29-60.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.17.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 69 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 37.3 ha (54 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands).

Of this:

- 37.1 ha was avoided for biodiversity purposes
- 0.2 ha was avoided for other reasons

A breakdown of avoidance across each nominated area is provided in Table 29-61.

It is important to note that the avoidance calculations in Table 29-61, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-61 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.17.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.17.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will not lead to direct impacts to known populations. However, it will lead to:

- A loss of potential habitat
- Fragmentation of potential habitat

LOSS OF POTENTIAL HABITAT

Approximately 170.1 ha of potential habitat will be lost. This is 0.5 per cent of mapped potential habitat across the Strategic Assessment Area. Habitat will be impacted:

- In several parts of the Outer Sydney Orbital corridor to the west of GMAC. Impacts in these areas account for the majority of the habitat to be lost (138.3 ha). It is noted that these areas are to the south of the known range of the species, and occur in habitat mapped through the SDM process which is considered to be very precautionary
- In small areas in GPEC and WSA

A summary of these impacts is provided in Table 29-62.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be very low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as unlikely. While there will be direct impacts to potential habitat, there is low confidence that the species will occur in the impact areas. This is because:
    - The majority of impacts occur beyond the known southern range of the species

  - Other impacts occur to small, fragmented patches of potential habitat that do not occur within the vicinity of records
- The consequence of impacts to the species (if they did occur) has been categorised as negligible. There will be a loss of approximately 0.5 per cent of mapped potential habitat (SAII, endemic species) with low confidence that the species occurs in the impact areas

29.17.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The Plan will lead to fragmentation of mapped habitat in the several parts of the Outer Sydney Orbital corridor to the west of GMAC.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of fragmentation is considered to be very low. This is because:

- The likelihood of fragmentation has been categorised as unlikely. This is because:
  - The likelihood that development is presents a barrier to dispersal of the species is possible. While there are uncertainties about the ecology of the species, it is possible that the Outer Sydney Orbital would present a barrier to pollination if the species were present in that area
  - The type of fragmentation is impact to mapped habitat only
- The consequence of fragmentation has been categorised as negligible. This is because the Plan will lead to fragmentation of mapped habitat in an area that the species is unlikely to occur

29.17.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *M. minutiflora*.

It is noted that a total of 749.5 ha of potential habitat for *M. minutiflora* is contained within three of the Plan's proposed reserves. These include:

- 27.4 ha of mapped habitat in the Georges River Koala Reserve
- 2 ha within the Confluence Reserve investigation area
- 720 ha of mapped habitat in the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.17.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *M. minutiflora* identifies a range of threats to the species (DEWHA, 2008f). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Habitat degradation

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *M. minutiflora* are discussed below for each identified indirect impact.

It is noted that a total of 749.5 ha of potential habitat for *M. minutiflora* is contained within three of the Plan's proposed reserves. The establishment of conservation reserves for known habitat of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES

The response of *M. minutiflora* to fire is unknown. However, altered fire regimes are an identified threat (DEWHA, 2008f) and a 2016 fire in the Wianamatta Nature Reserve (outside of the nominated areas to the north of GPEC) may have substantially affected the species. Increased human activity within the nominated areas increases the risk of fire to habitat areas supporting the species.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *M. minutiflora* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *M. minutiflora*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

WEED INVASION

M. minutiflora is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development within the northern half of the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

M. minutiflora is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include:

- Population 108 that occurs within GPEC
- The various populations to the north of GPEC

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *M. minutiflora*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

HABITAT DEGRADATION

Habitat degradation through unrestricted public access and rubbish dumping have been identified as a key threat to *M. minutiflora* (DEWHA, 2008f). Development within GPEC and WSA may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

Populations of *M. minutiflora* considered most at risk of this threat are those that occur on:

- Public land, as these areas are accessible without the deterrent that comes with trespassing. Populations occur on the following public land managed for conservation: Castlereagh Nature Reserve, Wianamatta Nature Reserve, Wianamatta Regional Park and Agnes Banks Nature Reserve. Potential impacts associated with public access are managed in all of these areas. Assuming this management continues and adapts to potential increasing visitation over the life of the Plan, the risk to *M. minutiflora* from disturbance is expected to be adequately addressed
- An area of freehold land to the north of GPEC which is often mistaken for Crown land, contains a number of access tracks, and issues associated with rubbish dumping have been recorded for the site. In the absence of tighter controls over access, there is potential for increased disturbance to occurrences of *M. minutiflora* on this site as a result of the Plan

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that a total of 749.5 ha of potential habitat for *M. minutiflora* is contained within three of the Plan's proposed reserves
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure

compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping

- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

29.17.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

Small areas of species habitat have been mapped within avoided lands in GPEC and WSA. Given the limited extent of habitat, impacts to habitat are considered unlikely due to essential infrastructure.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *M. minutiflora* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result

of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

29.17.8 POTENTIAL IMPACTS FROM TUNNELS

Mapped habitat occurs within the footprint of the Metro Rail Future Extension tunnel. However, as noted previously this habitat is beyond the known southern range of the species and it is not considered likely to be present.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species (if it was to be present) in the tunnel footprints from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.17.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008f) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *M. minutiflora* in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts including:
  - Inappropriate fire regimes
  - Weed invasion
  - Habitat degradation

HABITAT LOSS AND FRAGMENTATION

Given the very low risk to the species associated with habitat loss and fragmentation, implementation of the Plan will not adversely influence the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, weed invasion, and habitat degradation from increase public access and will be managed and mitigated through a number of commitments and actions in the Plan (see Chapter 15 for details). Indirect impacts will not adversely influence the long-term viability of the species.

CONCLUSION

The limited scale of direct and indirect impacts to the species will ensure that implementation of the Plan does not adversely influence the long-term viability of the species.

29.17.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.17.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-59 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *M. minutiflora* there are no relevant Threat Abatement Plans.

Table 29-59: Relevant key Threatening Processes and associated Threat Abatement Plans for *M. minutiflora*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-60: Occurrence of *M. minutiflora* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	14	3
(IMPORTANT POPULATIONS)	(14)	(3)
HABITAT MAPPING (Ha)	36,704.5	2,036.4

Table 29-61: Avoidance of *M. minutiflora* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	0.0	50.3	206.1	256.4
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	0.0	8.3	179.1	187.4
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**41.9**	**27.1**	**69.0**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	25.2	11.8	37.1
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	60.2	43.7	53.7
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	0.1	0.2	0.2
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.1	0.6	0.3
TOTAL AVOIDANCE (ha)	**0.0**	**0.0**	**25.3**	**12.0**	**37.3**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**0.0**	**60.3**	**44.3**	**54.0**

Table 29-62: Direct impacts to *M. minutiflora* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	16.6	15.1	138.3	**170.1**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.18 *PERSICARIA ELATIOR* (TALL KNOTWEED)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Persicaria elatior* is an erect herb up to 90 cm tall. Leaves are 3 cm to 11 cm long and 1cm to 3 cm wide. Stalked, glandular hairs are present on most parts of the plant. Flowers on long, narrow, spikes of up to 5 cm long. Pink flower-segments are less than 4 mm in length. Fruits are lens-shaped nuts approximately 2.5 mm long. (DEWHA, 2008g; DoEE, 2018f)
ECOLOGY	*P. elatior* germinates from seed following rain events, and lives for up to two years. Plants grow rapidly; flowering and seed set occurs within six months of germination. Flowering mostly occurs during summer, and profuse flowering has been observed. Plants die back during dry periods, and regenerate during wet periods. This species has been observed to take advantage of areas of soil which had been made bare by dry periods. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	This species has a patchy distribution along the south-eastern coastal regions of Australia, from south-east Queensland to south-east NSW. In NSW, the species occurs in the North Coast, Central Coast and South Coast Botanical Subdivisions, whilst it occurs in the Moreton Pastoral District in Queensland. The species has been recorded from a total of 15 sites across this area. *P. elatior* grows in damp places, such as along watercourses, streams, and lakes, in swamp forest, in coastal swampy areas and in disturbed areas. The species grows on sandy, alluvial soil. Associated plant species include *Melaleuca linearifolia, M. quinquenervia, Pseudognaphalium luteoalbum, Persicaria hydropiper,* and *Cyperus semifertilis*. The distribution of this species overlaps with the distribution of the following EPBC Act-listed threatened ecological community: Coastal Swamp Oak (*Casuarina Glauca*) Forest. (DEWHA, 2008g; DoEE, 2018f)
POPULATIONS	There is limited information regarding populations of this species. As of 2008, 12 specimens were recorded at Cornubia Wetland in Queensland. Population data is not available for other sites of this species. (DoEE, 2018f)
SOS SITES	The following SOS sites for the species have been identified: • Mallanganee (proposed)

	• Gibberagee (proposed) • Wanda wetlands (proposed) • Bevian swamp (proposed)
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Persicaria elatior* (Knotweed) (DEWHA, 2008g)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=5831

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	Yes	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Mapping within the nominated areas was prepared using the following parameters: BioNet PCT associations, vegetation condition (intact, thinned, scattered trees, derived native grassland) and habitat mapped within vegetation polygons occurring within 50 m of the following HydroAreas: Anabranch, Backwater, Billabong, Branch, Cowal, Creek, Pond, River, Stream, Swamp, Watercourse, Waterway. Habitat PCTs restricted to soils South Creek, Richmond, Freemans Reach, Berkshire Park and Upper Castlereagh.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). Mapping outside the nominated areas was prepared using the following parameters: BioNet PCT associations, vegetation condition (intact, thinned, scattered trees, derived native grassland) and habitat mapped within vegetation polygons occurring within 50 m of the following HydroAreas: Anabranch, Backwater, Billabong, Branch, Cowal, Creek, Pond, River, Stream, Swamp, Watercourse, Waterway.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *P. elatior* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in				

	mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *P. elatior* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. They were defined based on clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollination.
	IMPORTANT POPULATION CRITERIA
	Populations of *P. elatior* were considered important because they met one or more of the following criteria: A large population (number of individuals).

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-14 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	One important population of *P. elatior* has been mapped partially inside the Strategic Assessment Area. This population was recorded on the edge of a lake in moist soil. It comprises three BioNet records, two recorded from 2010 and one recorded from 1949. The 2010 records occur just outside the south-western boundary of the Strategic Assessment Area, in Thirlmere Lakes National Park. A "large number of plants" were noted in one of the 2010 records. The 1949 record is inaccurately mapped to the east of Picton, within the Strategic Assessment Area. The text descriptions of the record indicate this record should be placed at Thirlmere Lakes. The baseline mapping for this assessment has mapped 1,310.7 ha of potential habitat within the Strategic Assessment Area (see Table 29-64). Potential habitat has been mapped within the Strategic Assessment Area in the following localities: • Along the Nepean River and associated waterways between Douglas Park and Mulgoa, and between Emu Plains and Wilberforce • Along Wianamatta (South Creek) and associated waterways between Mulgrave and Kemps Creek • Along the Georges River and associated waterways near Liverpool Mapped habitat occurs within: • GPEC – 220.7 ha • WSA – 37.5 ha • GMAC – 7.1 ha

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.18.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 86 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 36.1 ha (42 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 11.4 ha was avoided for biodiversity purposes
- 24.7 ha was avoided for other reasons

A breakdown of avoidance across each nominated area is provided in Table 29-65.

It is important to note that the avoidance calculations in Table 29-65, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-65 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.18.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.18.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will not lead to direct impacts to known populations. However, it will lead to the loss of potential habitat and possible fragmentation.

LOSS OF POTENTIAL HABITAT

The Plan will lead to the loss of 50.3 ha of potential habitat. This represents 3.8 per cent of potential habitat mapped across the Strategic Assessment Area. The majority of habitat loss occurs within GPEC, where the footprint of the proposed Outer Sydney Orbital coincides with Wianamatta (South Creek) and associated waterways. It is noted that no records of this species have been recorded within or near to GPEC, and the Strategic Assessment Area more broadly appears unlikely to support records of the species.

A summary of these impacts is provided in Table 29-66.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of direct impacts to mapped habitat are considered to be very low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as unlikely. While there will be direct impacts to potential habitat, there is low confidence that the species will occur in the impact area. There are no confirmed records of the species within the Strategic Assessment Area, and it is considered that the habitat mapping is highly precautionary

- The consequence of impacts to the species (if they did occur) has been categorised as minor. There will be a loss of 3.8 per cent of mapped potential habitat, with low confidence that the species occurs in the impact area

29.18.4 FRAGMENTATION OF HABITAT

The footprint of the proposed Outer Sydney Orbital intersects mapped habitat along Wianamatta (South Creek) in GPEC.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of fragmentation is considered to be very low. This is because:

- The likelihood of fragmentation has been categorised as possible. This is because:
  - The likelihood that development would present a barrier to dispersal of the species is likely. While detailed planning for development within the transport corridors has not yet been completed, it is thought to be likely that the OSO will constitute a likely barrier to dispersal for the species
  - The type of fragmentation (as defined in the risk assessment approach in Section 29.3) is impact to mapped
- The consequence of fragmentation has been categorised as negligible. This is because the area to be fragmented relates to a small area of potential habitat with no associated records

29.18.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *P. elatior*.

It is noted that a total of 72.5 ha of potential habitat for *P. elatior* is contained within two of the Plan's proposed reserves. These include:

- 72.2 ha within the Confluence Reserve investigation area
- 0.3 ha of mapped habitat in the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.18.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *P. elatior* identifies a range of threats to the species (DEWHA, 2008g). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Hydrological changes to wetlands
- Damage to populations from road and track maintenance
- Weed invasion

However, it is considered unlikely that any of these potential impacts will adversely affect *P. elatior* within or surrounding the Strategic Assessment Area for the following reasons:

- There are no identified populations of this species within the Strategic Assessment Area
- The closest identified important population is located at Thirlmere Lakes National Park. This population is separated by approximately 7 km to the nearest urban capable land and is within an area already managed for conservation
- While potential habitat within and adjacent to GMAC, WSA, and GPEC may be subject to indirect impacts, the species has not been recorded in this area and it is therefore unlikely to be important to the viability of the populations in the region

It is worth noting that the Plan includes a range of measures that will protect biodiversity (e.g. protection of large areas of land, Fire Management Strategy, Weed Control Strategy, Pest Animal Control Implementation Strategy, development controls to manage changes to hydrology). These measures will benefit all biodiversity in the Cumberland subregion and may potentially relate to this species if it is present in the Strategic Assessment Area.

It is noted that a total of 72.5 ha of potential habitat for *P. elatior* is contained within two of the Plan's proposed reserves. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

Given the low likelihood of the species occurring within the Strategic Assessment Area, it is not considered likely that there will be additional risks due to essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.18.7 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008g) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *P. elatior* in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts including:
  - Hydrological changes to wetlands
  - Damage to populations from road and track maintenance
  - Weed invasion

HABITAT LOSS AND FRAGMENTATION

Given the very low risk to the species associated with habitat loss and fragmentation, implementation of the Plan will not adversely influence the long-term viability of the species.

INDIRECT IMPACTS

Indirect impacts associated with implementation of the Plan are not considered likely to be an issue for the species. However, there are a range of measures in the Plan that may provide a benefit to the species if it did exist in the Strategic Assessment Area.

CONCLUSION

The Plan will not lead to direct impacts to known populations of *P. elatior*. The Strategic Assessment Area does not appear to be a stronghold for the species and potential indirect impacts are addressed through management measures in the Plan.

Overall, implementation of the Plan will not adversely influence the long-term viability of *P. elatior*.

29.18.8 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.18.9 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-63 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *P. elatior*, there are no relevant Threat Abatement Plans.

Table 29-63: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. elatior*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-64: Occurrence of *P. elatior* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	0
(IMPORTANT POPULATIONS)	(1)	(0)
HABITAT MAPPING (Ha)	1,310.7	185.9

Table 29-65: Avoidance of *P. elatior* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	7.1	37.5	220.7	265.3
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	7.1	7.3	164.9	179.2
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**30.2**	**55.8**	**86.0**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	6.5	4.9	11.4
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	21.6	8.8	13.3
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	21.2	3.4	24.7
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	70.4	6.2	28.7
TOTAL AVOIDANCE (ha)	**0.0**	**0.0**	**27.8**	**8.3**	**36.1**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**0.0**	**92.0**	**14.9**	**42.0**

Table 29-66: Direct impacts to *P. elatior* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	2.4	47.5	0.4	**50.3**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.19 *PERSOONIA HIRSUTA* (HAIRY GEEBUNG)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	The Hairy Geebung is a spreading shrub with small leaves of variable shape and yellow or orange tubular flowers on a short stem that grows into a leafy shoot. Long coarse hairs appear on flowers and short stiff ones on leaves. Grows from 0.3-1.5m tall. (DoE, 2014h; DoEE, 2018f)
ECOLOGY	Flowers in November to January, with flowers occasionally appearing as early as September. All *Persoonia* species rely upon insect pollination. It is likely that *Persoonia* pollination movement would occur within 130 m from each plant. This species is probably killed by fire yet will regenerate from seed. All *Persoonia* species are dependent on heat or mechanical disturbance for germination. It is often found in disturbed areas such as along track edges. (DoE, 2014h; DoEE, 2018f)
DISTRIBUTION AND HABITAT	Records of this species are scattered around Sydney from Singleton in the north, along the east coast to Bargo in the south, and the Blue Mountains in the west. It is known to occur in the Cumberland IBRA subregion. Inhabits dry sclerophyll open forest and woodland with shrubby understory, on sandy to stony soils derived from sandstone. (DoE, 2014h; OEH, 2017d)
POPULATIONS	As of 2007, the species was known 21 populations, mostly containing fewer than 10 individuals. One population near Appin contains 88 individuals. Total number of individuals is not known. (DoE, 2014h; DoEE, 2018f)
SOS SITES	The following SOS sites for the species have been identified: • Yengo (proposed) • Parr (proposed) • Maroota Ridge (proposed) • Fred Caterson Reserve (proposed) • Cromer (proposed)

	• West Cliff Mine (proposed) • Bargo (proposed)
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Persoonia hirsuta* (DoE, 2014h)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=19006

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS** Not applicable as the species is not a candidate species credit species. There is no habitat for *P. hirsuta* within the nominated areas. Mapping outside of the nominated areas was done as per species distribution model description below. **OUTSIDE THE NOMINATED AREAS** **Species distribution model (SDM).** Potential habitat outside the nominated areas was mapped using an SDM. The report for this process notes that this species has a small proportion of its records within the Cumberland Plain subregion, and therefore the SDM estimates that only a small proportion of available habitat for this species occurs within the Cumberland Plain. The mapping is considered to be highly precautionary. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION** Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset. **BIONET RECORD DOWNLOAD DATE** The initial assessment of *P. hirsuta* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the				

	species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *P. hirsuta* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	Populations of *P. hirsuta* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. All populations if *P. hirsuta* are considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-17 for a map of records and habitat across the Strategic Assessment Area. It is important to note that the records for this species are sensitive and have been denatured for representation on the map.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-68 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *P. hirsuta* in the Strategic Assessment Area. **Records** A total of six populations have been mapped within the Strategic Assessment Area. Of these: • Three are located in the south-west corner of the assessment area, in the Bargo/Buxton locality • One is located east of Campbelltown • Two are located to the north of GPEC **Potential habitat** The baseline mapping for this assessment has mapped 11,416.8 ha of potential habitat within the Strategic Assessment Area. This potential habitat is distributed as follows: • A large area of habitat is mapped within the Londonderry area to the north of GPEC • A large area of habitat is also mapped to occur in the Tahmoor/Bargo/Buxton locality in the south-west corner of the Strategic Assessment Area • Scattered habitat occurs in several disjunct locations It is noted that the Species Distribution Model (SDM) predicted that the majority of habitat for this species occurs outside of the Cumberland subregion. The SDM predicted the occurrence of significant areas of habitat outside of the western, southern, south-eastern, and north-eastern boundaries of the Strategic Assessment Area.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.19.1 NOMINATED AREAS

There is no potential habitat for the species mapped within the nominated areas. Avoidance of habitat was therefore not necessary.

29.19.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.19.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to loss of potential habitat. A summary of these impacts is provided in Table 29-69.

LOSS OF POTENTIAL HABITAT

There will be approximately 6.2 ha of impacts to potential habitat (0.1 per cent of mapped habitat across the Strategic Assessment Area). These impacts are primarily due to the development of the M7/Ropes Crossing Link Road outside the north-eastern corner of GPEC, and the development of a transport corridor to the east of WSA.

The areas being impacted upon do not support known records or populations of *P. hirsuta.*

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be very low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as possible. While there will be direct impacts to potential habitat, there is moderate confidence that the species will occur in the impact area (it is noted that the impacted habitat was modelled via the SDM process, which is considered to be precautionary and may over-predict habitat. There are no records in close proximity to the impacted areas of habitat)
- The consequence of impacts to the species (if they did occur) has been categorised as negligible. There will be a loss of 0.1 per cent of mapped potential habitat (endangered species), with moderate confidence that the species occurs in the impact area

29.19.4 FRAGMENTATION OF HABITAT

The placement of urban capable land and transport corridors within the Strategic Assessment Area will not lead to fragmentation of records or habitat of *P. hirsuta,* as it will not lead to the removal of habitat which links other areas of habitat or records together. All impacts to habitat of *P. hirsuta* are to already fragmented patches.

Therefore, there is no residual adverse risk of fragmentation as a result of loss of potential habitat under the Plan.

29.19.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *P. hirsuta.*

It is noted that a total of 395.6 ha of potential habitat for *P. hirsuta* is contained within three of the Plan's proposed reserves. These include:

- 77.3 ha of mapped habitat in the Georges River Koala Reserve
- 6 ha within the Confluence Reserve investigation area
- 312.3 ha of mapped habitat in the Gulguer Reserve investigation area

Further, an important population of *P. hirsuta* is located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the potential indirect impacts to the species that may occur as a result of development under the Plan. It also outlines if the generic management strategies in the Plan will be adequate for addressing indirect impacts, or if species-specific commitments are necessary.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.19.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DoE, 2014h) (and other key documents) for *P. hirsuta* identifies a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered:

- Inappropriate fire regimes
- Disturbance from recreational users
- Altered hydrology
- Weed invasion
- Infection with *Phytophthora cinnamomi*

Competition with dense native vegetation species, low population numbers, feral European honeybees making effective pollination unlikely have also been identified as key threats. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. hirsuta* are discussed below for each identified indirect impact.

It is noted that a total of 395.6 ha of potential habitat for *P. hirsuta* is contained within three of the Plan's proposed reserves, and an important population of the species is located within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES

P. hirsuta is threatened by altered fire regimes. The Plan has the potential to impact fire regimes as a result of increased human activity associated with development of urban capable land within the nominated areas and development of transport corridors outside of the nominated areas. As there is no mapped potential habitat within the nominated areas, the sites most at risk at the small areas of impacted potential habitat which are intercepted by the development of transport corridors.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. hirsuta* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk

The package of measures in the Plan is expected to adequately manage the risk to *P. hirsuta* from altered fire regimes as a result of development. This is because fire management authorities will be engaged to ensure they understand the requirements of *P. hirsuta* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

DISTURBANCE FROM RECREATIONAL USERS

Habitat disturbance from recreational users has been identified as a threat for *P. hirsuta*. The sites most at risk at the small areas of impacted potential habitat which are intercepted by the development of transport corridors.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including 395.6 ha of potential habitat for *P. hirsuta* in three of the Plan's proposed reserves, and an important population of *P. hirsuta* in the Georges River Koala Reserve)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *P. hirsuta* from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

ALTERED HYDROLOGY

Altered hydrology has been identified as a risk to *P. hirsuta*. As outlined above, sites most at risk are the small areas of impacted potential habitat which are intercepted by the development of transport corridors.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In particular, the implementation of mitigation measures for transport projects based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines. These include a range of provisions to mitigate and minimise changes to hydrology.

The package of measures in the Plan is expected to adequately manage the risk to *P. hirsuta* from changes to hydrology because transport projects will apply best practice approaches to avoiding and minimising any potential impacts to biodiversity values, including potential habitat for *P. hirsuta.*

WEED INVASION

P. hirsuta is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development within the northern half of the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *P. hirsuta*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *P. hirsuta* from the increased risk of weeds associated with development. This is because:

- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to biodiversity values, including potential habitat for *P. hirsuta*
- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development

INFECTION WITH PHYTOPHTHORA CINNAMOMI

P. hirsuta is threatened by exposure to *Phytophthora cinnamomi,* a soil-borne water mould which is fatal to many *Persoonia* species.

Development under the Plan has the potential to increase the spread of *Phytophthora cinnamomi* through increased site visitation rates and earthworks activities conducted during construction works. The areas which are most at risk are the small areas of impacted potential habitat which are intercepted by the development of transport corridors.

The Plan incorporates a range of general measures to manage the risks associated with *Phytophthora cinnamomi*. In summary, these include a commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:

- Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
- Entering into written agreements with delivery partners to implement priority disease control programs

The package of measures in the Plan is expected to adequately manage the risk to *P. hirsuta* from *Phytophthora cinnamomi* because it supports a landscape scale approach to the issue across the Cumberland subregion.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

No habitat for *P. hirsuta* has been mapped in any of the nominated areas, nor in or adjacent to any of the tunnel footprints. Therefore, *P. hirsuta* is not considered to be at risk from development of essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.19.7 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014h) (and other key documents) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *P. hirsuta* in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts such as:
  - Inappropriate fire regimes
  - Disturbance from recreational users
  - Altered hydrology
  - Weed invasion
  - Infection with *Phytophthora cinnamomi*

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to loss of 6.2 ha of mapped habitat within transport corridors. No fragmentation of species' habitat will occur.

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is very low. The total area of potential habitat which will be impacted is a small proportion of available habitat for the species with only moderate confidence of the species' presence in impacted areas.

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contains approximately 2,566.6 ha of potential habitat for *P. hirsuta.* For example, three of the proposed reserves in the Plan contain mapped habitat for the species (including 312.3 ha in the Gulguer Reserve investigation area. Note that the Georges River Koala Reserve contains a known important population of *P. hirsuta*).

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, disturbance from recreational users, altered hydrology, weed invasion and infection with *Phytophthora cinnamomi* have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.19.8 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.19.9 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-67 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15. The Plan is not inconsistent with any of the Threat Abatement Plans.

Table 29-67: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. hirsuta*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus *(Phytophthora cinnamomi*)	Threat Abatement Plan for Disease in Natural Ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data tables for occurrence and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-68: Occurrence of *P. hirsuta* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	6	0
(IMPORTANT POPULATIONS)	(6)	(0)
HABITAT MAPPING (Ha)	11,416.8	1,314.9

Table 29-69: Direct impacts to *P. hirsuta* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	0.0	0.0	6.2	**6.2**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.20 *PIMELEA CURVIFLORA* VAR. *CURVIFLORA*.

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	An erect, open shrub with elliptical leaves and dark red to yellow flowers. Grows to 40-50 cm high. (DoEE, 2018f)
ECOLOGY	May flower all year round but mostly October to January. Can survive for some time without foliage following fire or grazing, during which time it relies on energy reserves from its root system. The species is likely to be fire tolerant. Seedlings have been observed following fire events. (DEWHA, 2008i; DoEE, 2018f)
DISTRIBUTION AND HABITAT	Occurs in the coastal area of the Sydney and Illawarra regions of NSW. As of 1998, it was known from around 20 locations between northern Sydney and Maroota including Baulkham Hills, Blacktown, Hornsby, Parramatta, and Warringah Local Government Areas. In 2011, another population was found at in Shellharbour Local Government Area. Distribution overlaps with the following TECs: • Shale Sandstone Transition Forest • Blue Gum High Forest of the Sydney Basin Bioregion • Cumberland Plain Woodlands • Turpentine-Ironbark Forest in the Sydney Basin Bioregion Can be found on sandy soil, shaly soil, or shale/sandstone transition soils. Occurs on ridge tops and upper slopes in open forest and woodland. (DEWHA, 2008i; DoEE, 2018f)
POPULATIONS	Total population size is not known. As of 1998, two sites at Maroota had around 300 plants. However, the majority of populations contain fewer than 100 individuals. (DoEE, 2018f)
SOS SITES	The following SOS sites for the species have been identified: • Muogamarra Nature Reserve • Francis Greenway Correctional Complex

	• Albion Park
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Pimelea curviflora* var. *curviflora* (DEWHA, 2008i)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species
SPRAT LINK	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=4182

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	Yes
EXPERT REPORT (BCAR PROCESS)	There is no expert report available for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Potential habitat polygons were generated for this species using BioNet PCT associations, vegetation condition (intact, thinned), geology ('Hawkesbury Sandstone', 'Minchinbury Sandstone', 'Mount Hercules Sandstone Member', 'Razorback Sandstone Member'), soil (all Blacktown soil landscape within a 500 m buffer on Wianamatta (South Creek) Plus all Berkshire Park soil), elevation (below 300 m) and LiDAR/DEM data (Sandstone units selected only within a 100 m buffer on "Ridge and Crest" DEM layer). To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. These surveys either confirmed presence (known habitat) or absence (no longer considered potential habitat). The species was not recorded during surveys.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). Potential habitat polygons were generated for this species using BioNet PCT associations, vegetation condition (intact, thinned), geology ('Hawkesbury Sandstone', 'Minchinbury Sandstone', 'Mount Hercules Sandstone Member, 'Razorback Sandstone Member'), soil (all Blacktown soil landscape within a 500 m buffer on Wianamatta (South Creek) Plus all Berkshire Park soil) and elevation (below 300 m). No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				

	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *P. curviflora* var. *curviflora* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *P. curviflora* var. *curviflora* were downloaded in October 2020.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Populations were defined by clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	Populations of *P. curviflora* var. *curviflora* were considered important because they met one or more of the following criteria: a large population.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-19 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	Within the vicinity of the Cumberland subregion, the core area for the species is to the north-east of the subregion (outside the Strategic Assessment Area) within areas of extensive remnant vegetation. The Strategic Assessment Area supports many fewer records and includes four populations (from 18 BioNet records). Two populations are considered to be important (populations 456 and 622). The populations are located as follows: • Population 456 is located within the John Morony Correctional Complex, adjacent to Windsor Downs Nature Reserve • Population 622 is located north of GPEC in the locality of Agnes Banks • Populations 79 and 80 are located to the south of Douglas Park, between GMAC and Wilton. Despite extensive surveys at nearby Bingara Gorge in suitable habitat, the species was not recorded, suggesting that these two records may be misapplications for *P. curviflora* var. *sericea* which is recorded in that area The baseline mapping for this assessment has mapped 13,011.3 ha of known and potential habitat within the Strategic Assessment Area. Habitat for this species occurs as follows: • Scattered habitat occurs in the northern portion of the Strategic Assessment Area in the Kurrajong, Scheyville, and Londonderry localities. It is noted that the Londonderry locality supports a significant area of potential habitat • Thin and scattered areas of habitat occur along the western boundary of the Strategic Assessment Area, along the Nepean River to the north of Penrith, and southwards through Mulgoa to the locality of The Oaks • Scattered habitat occurs within and to the south of the GPEC nominated area, including the localities of Wianamatta Regional Park, North St Marys, Mount Druitt, Orchard Hills, Glenmore Park and Luddenham

	• Scattered habitat occurs between WSA and GMAC, in localities including Badgerys Creek, Kemps Creek, Middleton Grange, Catherine Field and Edmondson Park • Scattered habitat occurs to the west of Wilton and between Wilton and GMAC It is noted that no habitat is mapped as being present within WSA, Wilton or GMAC. A breakdown of occurrence for *P. curviflora* var. *curviflora* in the Strategic Assessment Area is provided in Table 29-71.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.20.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 66.3 ha of potential habitat within GPEC (not including excluded lands). Approximately 13.9 ha (21 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 13.5 ha was avoided for biodiversity purposes.
- 0.4 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 29-72.

It is important to note that the avoidance calculations in Table 29-72, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-72 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.20.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.20.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will not lead to direct impacts to known populations. However, it will lead to:

- A loss of potential habitat
- Fragmentation of potential habitat

LOSS OF POTENTIAL HABITAT

Approximately 55.3 ha of potential habitat for the species will be lost. This is 0.4 per cent of mapped potential habitat across the Strategic Assessment Area. A summary of these impacts is provided in Table 29-73.

Direct impacts to potential habitat occur:

- In Wianamatta Regional Park due to the Outer Sydney Orbital. However, there are no records of the species in that area despite the site being well visited in the past, and the fact that it was not identified in surveys undertaken as part of this project. The species is considered unlikely to occur in this location
- In scattered habitat within GPEC. There are no historical records of the species within the vicinity of these small habitat patches and, while it is possible the species may occur, it is considered to be unlikely

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be very low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as possible. While there will be direct impacts to potential habitat, there is moderate confidence that the species will occur in the impact areas. This is considered a precautionary rating
- The consequence of impacts to the species (if they did occur) has been categorised as negligible. There will be a loss of <1 per cent of mapped potential habitat (vulnerable species), with moderate confidence that the species occurs in the impact areas

29.20.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The Plan will lead to fragmentation of mapped habitat in the several parts of the Outer Sydney Orbital corridor within GPEC.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of fragmentation is considered to be very low. This is because:

- The likelihood of fragmentation has been categorised as unlikely. This is because:
  - The likelihood that development is presents a barrier to dispersal of the species is possible
  - The type of fragmentation is impact to mapped habitat only
- The consequence of fragmentation has been categorised as negligible. This is because the Plan will lead to fragmentation of mapped habitat in:
  - An area that the species is unlikely to occur (Wianamatta Regional Park)
  - In other small, isolated areas of mapped habitat that do not occur within the vicinity of historical records

29.20.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *P. curviflora* var. *curviflora*.

It is noted that a total of 1,185.9 ha of potential habitat for *P. curviflora* var. *curviflora* is contained within three of the Plan's proposed reserves. These include:

- 583 ha of mapped habitat in the Georges River Koala Reserve
- 9.2 ha within the Confluence Reserve investigation area
- 593.7 ha of mapped habitat in the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.20.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *P. curviflora* var. *curviflora* identifies a range of threats to the species (DEWHA, 2008i). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered:

- Weed invasion
- Habitat degradation
- Inappropriate fire regimes

Grazing by pest fauna such as the European rabbit, feral goats, and feral pigs have also been identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. curviflora* var. *curviflora* are discussed below for each identified indirect impact.

It is noted that a total of 1,185.9 ha of potential habitat for *P. curviflora* var. *curviflora* is contained within three of the Plan's proposed reserves. The establishment of conservation reserves for known habitat of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

WEED INVASION

P. curviflora var. *curviflora* is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban and transport have the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

P. curviflora var. *curviflora* is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include:

- Habitat within and to the north of GPEC
- Habitat adjacent to Wilton and GMAC

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity that are expected to adequately manage the risk to the species. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *P. curviflora* var. *curviflora*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program

  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

HABITAT DEGRADATION

Habitat degradation through unrestricted public access has been identified as a key threat to *P. curviflora* var. *curviflora* (DEWHA, 2008i). Development within GPEC, Wilton and GMAC may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat.

Populations of *P. curviflora* var. *curviflora* on public land are considered most at risk from this impact. Population 456 (to the north of GPEC) is close to (and may occur within) Windsor Downs Nature Reserve where access is managed. The other two populations in the Strategic Assessment Area are not on public land managed for conservation.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that a total of 1,185.9 ha of potential habitat for *P. curviflora* var. *curviflora* is contained within three of the Plan's proposed reserves
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

INAPPROPRIATE FIRE REGIMES

Altered fire regimes are an identified threat (OEH, 2019i). Increased human activity within the nominated areas increases the risk of fire to habitat areas supporting the species.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. curviflora* var. *curviflora* being:
  - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
  - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
  - A process to work with delivery partners to implement the Fire Management Strategy
  - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *P. curviflora* var. *curviflora*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

Mapped habitat does not occur within the tunnel footprints and impacts to the species will not occur in those locations.

29.20.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

Small areas of species habitat have been mapped within avoided lands in GPEC. Given the lack of records and the limited extent of habitat, impacts to habitat are considered unlikely due to essential infrastructure.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
  - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
  - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *P. curviflora* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.20.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008i) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *P. curviflora* var. *curviflora* in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts including:
  - Weed invasion
  - Habitat degradation from recreational activities, road and trail maintenance, and bush rock removal
  - Inappropriate fire regimes

HABITAT LOSS AND FRAGMENTATION

Given the very low risk to the species associated with habitat loss and fragmentation, implementation of the Plan will not adversely influence the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts on *P. curviflora* var. *curviflora* will be managed and mitigated through a number of commitments and actions in the Plan (see Chapter 15 for details). Indirect impacts will not adversely influence the long-term viability of the species.

CONCLUSION

The limited scale of direct and indirect impacts to the species will ensure that implementation of the Plan does not adversely influence the long-term viability of the species.

29.20.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.20.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-70 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *P. curviflora* var. *curviflora*, there are no relevant Threat Abatement Plans.

Table 29-70: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. curviflora* var. *curviflora*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-71: Occurrence of *P. curviflora* var. *curviflora* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	4	0
(IMPORTANT POPULATIONS)	(2)	(0)
HABITAT MAPPING (Ha)	13,011.3	1,911.5

Table 29-72: Avoidance of *P. curviflora* var. *curviflora* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	<0.1	0.0	523.8	523.8
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	<0.1	0.0	457.5	457.5
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**0.0**	**66.3**	**66.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	0.0	13.5	13.5
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.0	20.3	20.3
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	0.0	0.4	0.4
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.0	0.7	0.7
TOTAL AVOIDANCE (ha)	**0.0**	**0.0**	**0.0**	**13.9**	**13.9**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**0.0**	**0.0**	**21.0**	**21.0**

Table 29-73: Direct impacts to *P. curviflora* var. *curviflora* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	0.0	52.4	2.9	**55.3**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

29.21 *PTEROSTYLIS SAXICOLA* (SYDNEY PLAINS GREENHOOD ORCHID)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	A ground orchid with reddish brown and green flowers on a slender stem. Grows to 35 cm tall. (DoEE, 2018f)
ECOLOGY	Flowers from September to December and is probably dependent on climatic conditions. Following seed dispersal, the above ground parts of the plant die but the underground tuberoid remains until the following year. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	Records are restricted to western Sydney between Freemans Reach in the north and Picton in the south. It is known from seven primary locations in Western Sydney: • Georges River National Park, near Yeramba Lagoon • Ingleburn • Holsworthy • Peter Meadows Creek • St Marys Towers, near Douglas Park • Freemans Reach near Windsor • Scheyville near Windsor (DEWHA, 2008j; DoEE, 2018f) Occurs on the Cumberland Plain along an ecological gradient from: • Clay soils on gently hilly landscapes in PCT 849 • To clay to sandy soils in PCT 1395 on the edge of the Cumberland Plain • To thin accumulations of humus-rich sandy soil on sandstone rock shelves in PCTs 1081, 1083, 1181 and 1789 (Weston, 2018a)
POPULATIONS	Total population size is approximately 500 individuals. Individual population sizes are typically small. (DoEE, 2018f)

SOS SITES	The following SOS sites for the species have been identified: • Hawkesbury High School (Proposed) • Scheyville (Proposed) • Georges River (Proposed) • Campbelltown (Proposed)
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Pterostylis saxicola* (Sydney Plains Greenhood) (DEWHA, 2008j) Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (*Sus scrofa*) (DoEE, 2017b) Cumberland Plain Recovery Plan identifies actions at the state level (DECCW, 2011).
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64537

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	ECOSYSTEM CREDIT SPECIES	CANDIDATE SPECIES CREDIT SPECIES			
		WILTON	GMAC	WSA	GPEC
	No	Yes	Yes	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	Yes (Weston, 2018b, 2018a). Available at Supporting Document C				

HABITAT MAPPING

WITHIN THE NOMINATED AREAS

Expert report polygons. Potential habitat polygons were generated based on the occurrence of the following parameters:

- Vegetation type (suitable habitat included PCT 849, 1081, 1181 or 1395)
- Vegetation condition (intact)
- Soil type and topography (clay soils derived from Ashfield Shale on flat to gently hilly landscapes; clay to sandy soils derived from Hawkesbury Sandstone – Mittagong Formation – Ashfield Shale transition substrates on gently hilly landscapes; thin accumulations of humus-rich sandy soil on Hawkesbury Sandstone sheets and rock shelves on the either rims and steep sides of river valleys, sandstone plateaux, or dry sandstone gullies)

To refine these potential habitat polygons, targeted surveys for the species were then undertaken in a number of locations within the nominated areas. These surveys either confirmed presence (known habitat) or absence (no longer considered potential habitat). The species was not recorded during the targeted surveys.

It was not possible to access and survey all areas of potential habitat within the nominated areas. Any remaining potential habitat is considered precautionary and does not necessarily equate with actual habitat.

	OUTSIDE THE NOMINATED AREAS
	Knowledge based map (KBM). Mapping was prepared for this species using the following parameters: BioNet PCT associations, vegetation condition (intact), geology ('Hawkesbury Sandstone', 'Ashfield Shale', 'Mittagong Formation'), soil ('Lucas Heights', 'Woodlands') and elevation (<300 m).
POPULATION MAPPING	**RECORD SELECTION**
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *P. saxicola* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *P. saxicola* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations of were defined using the records dataset and available information about the nature of the species. Records within 500 m of one another considered a single population.
	IMPORTANT POPULATION CRITERIA
	Populations of *P. saxicola* were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. All populations of this species were considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-22 for a map of records and habitat across the Strategic Assessment Area. It is important to note that the records for this species are sensitive and have been denatured for representation on the map.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 29-75 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *P. saxicola* in the Strategic Assessment Area. **Records** A total of nine important populations have been identified within the Strategic Assessment Area: • Two populations occur in the north of the Strategic Assessment Area • One population (unsubstantiated) is located near Emu Plains, to the west of the GPEC nominated area • Four populations occur to the east of the northern part of GMAC • Two populations occur between Wilton and GMAC, one near Douglas Park and the other near Menangle

	It is noted that no species records are located within any of the nominated areas. **Potential habitat** The baseline mapping for this assessment has mapped 11,727.8 ha of potential habitat within the Strategic Assessment Area for this species. Habitat for this species is predominantly located towards the outer edges of the Strategic Assessment Area, with no mapped habitat located in the centre of the assessment area. Specifically, habitat is located as follows: • Scattered areas of habitat occur in the north of the Strategic Assessment Area, in the localities of Scheyville, Freemans Reach and Kurrajong • Thin areas of habitat occur between Mulgoa and Castlereagh, which are associated with the Nepean River • Areas of intermittently scattered and connected habitat occur in the localities of Mulgoa, Silverdale, Theresa Park, and Werombi • Areas of intermittently scattered and connected habitat occur along the south-eastern and eastern boundary of the Strategic Assessment Area, from Mowbray Park, through Wilton and Douglas Park, up to Menangle and through to St Helens Park, Kentlyn, and Macquarie Fields. It is noted that no potential habitat is mapped for this species within WSA.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.21.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 2,153.2 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 2,106 ha (97.8 per cent) has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,527.4 ha was avoided for biodiversity purposes
- 578.7 ha was avoided for other reasons

A breakdown of avoidance across each nominated area is provided in Table 29-76.

It is important to note that the avoidance calculations in Table 29-76, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-76 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.21.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

29.21.3 LOSS OF KNOWN POPULATIONS AND POTENTIAL HABITAT

Implementation of the Plan will lead to the loss of potential habitat. No known records will be impacted and habitat for the species will not be fragmented. A summary of these impacts is provided in Table 29-77.

LOSS OF POTENTIAL HABITAT

Approximately 47.1 ha of potential habitat for the species will be lost. This is 0.4 per cent of mapped potential habitat across the Strategic Assessment Area. The impacts occur predominantly within GMAC and Wilton.

The areas being impacted upon do not support known records or populations of *P. saxicola.*

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of impacts to mapped habitat are considered to be very low. This risk ranking is triggered for impacts to species' habitat, as follows:

- The likelihood of actual impacts occurring to the species within mapped habitat has been categorised as possible. While there will be direct impacts to potential habitat, there is moderate confidence that the species will occur in the impact area (it is noted that *P. saxicola* is sporadically distributed rather than continuously spread through its habitat (Weston, 2018b, 2018a), and therefore it is considered that there is moderate potential for the species to be present within mapped habitat)
- The consequence of impacts to the species (if they did occur) has been categorised as negligible. There will be a loss of <1 per cent of mapped potential habitat (endangered species), with moderate confidence that the species occurs in the impact area

29.21.4 FRAGMENTATION OF HABITAT

The placement of urban capable land and transport corridors within the Strategic Assessment Area will not lead to fragmentation of records or habitat of *P. saxicola,* as it will not lead to the removal of habitat which links other areas of habitat or records together. All impacts to habitat of *P. saxicola* are to already fragmented patches.

Therefore, there is no residual adverse risk of fragmentation as a result of loss of potential habitat under the Plan.

29.21.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for *P. saxicola.*

It is noted that a total of 1,695.1 ha of potential habitat for *P. saxicola* is contained within two of the Plan's proposed reserves. These include:

- 842.4 ha of mapped habitat in the Georges River Koala Reserve
- 852.7 ha of mapped habitat in the Gulguer Reserve investigation area

Further, an important population of *P. saxicola* is located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the potential indirect impacts to the species that may occur as a result of development under the Plan. It also outlines if the generic management strategies in the Plan will be adequate for addressing indirect impacts, or if species-specific commitments are necessary.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.21.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DEWHA, 2008j) (and other key documents) for *P. saxicola* identify a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats in key species documents) are considered relevant to implementation of the Plan:

- Weed invasion
- Inappropriate fire regimes
- Inappropriate habitat disturbance including unauthorised collection, trampling, recreational and maintenance activities and rubbish dumping

Grazing from domestic stock, feral pigs, and small population size and restricted distribution have also been identified as key threats. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *P. saxicola* are discussed below for each identified indirect impact.

It is noted that a total of 1,695.1 ha of potential habitat for *P. saxicola* is contained within two of the Plan's proposed reserves, and an important population of the species is located within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

WEED INVASION

P. saxicola is threatened with invasion and competition by weeds. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

P. saxicola is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occur adjacent to known populations or habitat. Key risk areas include vegetated areas in GPEC, Wilton and GMAC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *P. saxicola*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches

- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk to *P. spicata* from the increased risk of weeds associated with development. This is because:

- The proposed Georges River Koala Reserve (Commitment 10) intercepts mapped potential habitat and a known population of *P. saxicola.* Protection of this reserve and management for conservation purposes will contribute to long-term protection of known populations and habitat of *P. saxicola*
- There is a commitment (Commitment 15) which will coordinate, enable, and conduct effective weed control programs in strategic locations within the Strategic Assessment Area to manage priority weed species
- Proponents will be required to minimise the risk of weed spread, and to manage weeds, during the design, development, and operational stages of development
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)

INAPPROPRIATE FIRE REGIMES

Altered fire regimes are an identified threat (DEWHA, 2008j). Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the following mechanisms:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

It is noted *P. saxicola* is threatened by both very frequent and very infrequent fire. A minimum fire interval of 7 years and a maximum fire interval of 15 years is recommended for *P. saxicola* (DoEE, 2018f). Key risk areas include vegetated areas in GPEC, Wilton and GMAC.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *P. saxicola* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *P. saxicola*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to *P. saxicola* from altered fire regimes as a result of development. This is because:

- The proposed Georges River Koala Reserve (Commitment 10) intercepts mapped potential habitat and a known population of *P. saxicola.* Protection of this reserve and management for conservation purposes will contribute to long-term protection of known populations and habitat of *P. saxicola*
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting mapped potential habitat and/or known records for *P. saxicola* which is located adjacent to urban capable lands
- Fire management authorities will be engaged to ensure they understand the requirements of *P. saxicola* and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

INAPPROPRIATE HABITAT DISTURBANCE INCLUDING UNAUTHORISED COLLECTION, TRAMPLING, RECREATIONAL AND MAINTENANCE ACTIVITIES AND RUBBISH DUMPING

Inappropriate habitat disturbance has been identified as a threat to *P. saxicola*. Key risk areas include mapped potential habitat and known populations of the species, which occur in the vicinity of Wilton and GMAC. It is noted that mapped potential habitat for the species within GPEC is also at risk of habitat disturbance, although as there are no reliable known records within or directly adjacent to GPEC, the risk to the species in the locality of GPEC is not considered to be major.

Appendix E of the Plan includes a species-specific measure to consult with land managers of land containing known populations or habitat for *P. saxicola* to mitigate indirect impacts from habitat disturbance during construction and operation of the development, including controlling public access, managing maintenance activities such as mowing and weed control, and managing rubbish dumping. This measure applies to GMAC and Wilton and will be implemented via consultation with local council and other public agencies.

The Plan further incorporates a range of measures to mitigate the risks associated with inappropriate habitat disturbance for *P. saxicola*. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 1,695.1 ha of potential habitat for *P. saxicola* is contained within two of the Plan's proposed conservation reserves, and that an important population of the species occurs within the Georges River Koala Reserve
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to *P. saxicola* from inappropriate habitat disturbance as a result of development. This is because:

- A species-specific measure will require consultation with land managers to ensure protection of *P. saxicola* from inappropriate habitat disturbance
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction

- Conservation lands will be actively managed which will address disturbance in those areas (it is noted that 1,695.1 ha of potential habitat for *P. saxicola* is contained within two of the Plan's proposed conservation reserves, and that an important population of the species occurs within the Georges River Koala Reserve)
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

It is noted that there is no mapped potential habitat, nor known records of the species, within the footprint of the proposed tunnel developments within the transport corridors. Therefore, it is considered that development of tunnels under the Plan will not pose a threat to *P. saxicola*.

29.21.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There are no known records of *P. saxicola* within avoided lands in any of the nominated areas. However, there is 2,153.2 ha of potential habitat mapped for the species within avoided lands within Wilton and GMAC, and therefore it is considered to be possible that the species may occur within avoided lands in these nominated areas.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *P. saxicola* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.21.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008j) (and other key documents) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *P. saxicola* in relation to implementation of the Plan:

- Loss of habitat
- Indirect impacts including:
  - Weed invasion
  - Inappropriate fire regimes
  - Inappropriate habitat disturbance including unauthorised collection, trampling, recreational and maintenance activities and rubbish dumping

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to loss of 47.1 ha of mapped habitat within the nominated areas. No fragmentation of species' habitat will occur.

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is very low. The total area of potential habitat which will be impacted is a small proportion of available habitat for the species with only moderate confidence of the species' presence in impacted areas.

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contain approximately 6,149.1 ha of potential habitat for *P. saxicola*. It is likely that substantial areas of habitat for the species is contained within the SCA. For example, two of the proposed reserves in the Plan contain mapped habitat for the species (including 8,42.4 ha in the Georges River Koala Reserve. Note that this reserve area also contains a known important population of *P. saxicola*).

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with weed invasion, inappropriate fire regimes and inappropriate habitat disturbance including unauthorised collection, trampling, recreational and maintenance activities and rubbish dumping have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan, and through a species-specific commitment to manage habitat disturbance.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.21.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.21.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-74 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15. The Plan is not inconsistent with any of the Threat Abatement Plans.

Table 29-74: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. saxicola*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan
Predation, habitat degradation, competition and disease transmission by feral pigs	Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (*Sus scrofa*) (DoEE, 2017b)

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 29-75: Occurrence of *P. saxicola* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	9	1
(IMPORTANT POPULATIONS)	(9)	(1)
HABITAT MAPPING (Ha)	11,727.8	1,591.6

Table 29-76: Avoidance of *P. saxicola* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	953.2	1,774.4	0.0	14.3	2,741.9
HABITAT WITHIN EXCLUDED LANDS (ha)	169.9	405.5	0.0	13.4	588.7
HABITAT WITHOUT EXCLUDED LANDS (ha)	**783.3**	**1,368.9**	**0.0**	**0.9**	**2,153.2**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	534.9	992.5	0.0	0.0	1,527.4
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	68.3	72.5	0.0	0.0	70.9
AVOIDANCE FOR OTHER REASONS (ha)	237.3	341.4	0.0	0.0	578.7
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	30.3	24.9	0.0	0.0	26.9
TOTAL AVOIDANCE (ha)	**772.2**	**1,333.9**	**0.0**	**0.0**	**2,106.0**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**98.6**	**97.4**	**0.0**	**0.0**	**97.8**

Table 29-77: Direct impacts to *P. saxicola* within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	11.2	35.0	0.0	0.9	0.0	**47.1**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

SPECIES AT NO RISK OF DIRECT IMPACTS

29.22 *COMMERSONIA PROSTRATA* (DWARF KERRAWANG)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	A prostrate, mat-forming shrub with trailing branches up to 2 m long. Shows hairy, star-shaped flowers that change from white to pale pink with age. Flowers appear in clusters of 3-12. (DoEE, 2018f; OEH, 2020)
ECOLOGY	Flowers between September and November. Germinates in response to disturbance such as fire or flooding. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	Endemic to south-eastern Australia, distributed from central Gippsland in Victoria to the New South Wales coast. In NSW, it can be found near Tallong, Penrose, and Goulburn on the Southern Tablelands, and near Newcastle. It is known to occur in the Cumberland IBRA subregion In NSW, the species can be found on sandy or peaty soils in several habitats, such as: • Snow Gum Woodland at Rose Lagoon • Blue Leaved Stringybark Open Forest at Tallong • Brittle Gum Low Open Woodland at Penrose • Scribbly Gun Swamp Mahogany Broad-leaved Paperbark Ecotonal Forest at Tomago • The ecotone between Sedge Swamp and Swamp Forest on the Tomago Sandbeds (DoEE, 2018c; OEH, 2017c, 2020)
POPULATIONS	As of 2010, there were over 100,000 plants in 40 populations. A population in the North of the Providence Ponds Flora and Fauna Reserve in east Victoria contains almost all of the plants. The majority of the remaining populations contain less than 50. (DoEE, 2018f) In NSW populations range in size from one individual to approximately 2,000 (Rowes Lagoon). (OEH, 2020)
SOS SITES	The following SOS sites for the species have been identified: • Tomago area

	• Thirlmere Lakes National Park • Rowes Lagoon area
RELEVANT PLANS AND POLICIES	National Recovery Plan for the Dwarf Kerrawang (*Rulingia prostrata*) (Carter & Walsh, 2010) Threat Abatement Plan for Competition and Land Degradation by Rabbits (DoEE, 2016a)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=87152

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS** Not applicable as the species is not a candidate species credit species. Mapping was done as per the knowledge-based mapping method described below. **OUTSIDE THE NOMINATED AREAS** **Knowledge based map (KBM).** Potential habitat maps were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned, scattered trees), soil restrictions ('Berkshire Park', 'Freemans Reach', 'Hawkesbury', Monkey Creek, 'Richmond', 'South Creek', 'Theresa Park', 'Upper Castlereagh', 'Bakers Lagoon', 'Ettalong') and geology ('Hawkesbury Sandstone', 'Minchinbury Sandstone').				
POPULATION MAPPING	**RECORD SELECTION** Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset. **BIONET RECORD DOWNLOAD DATE** The initial assessment of *C. prostrata* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *C. prostrata* were downloaded in September 2019.				

	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Populations were considered to constitute clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	All populations were considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-4 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	A single important population of this species (from 18 BioNet records) has been mapped within Thirlmere Lakes National Park on the south-western edge of the Strategic Assessment Area. The baseline mapping for this assessment has mapped approximately 61.9 ha of potential habitat within the Strategic Assessment Area. Mapped habitat shows very small and scattered occurrences of habitat on the edges of the Strategic Assessment Area, near Castlereagh, to the south of Wilton, to the south of Bargo and extremely small (<100 m^2) potential habitat patches occurring between Thirlmere and Mulgoa. No habitat is mapped within any of the nominated areas or transport corridors. See Table 29-79 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *C. prostrata* in the Strategic Assessment Area.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

No species habitat or records occur within the nominated areas or transport corridors. Avoidance of habitat was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

Implementation of the Plan will not lead to direct impacts or fragmentation of the species. As a result, the Plan does not provide offsets for the species.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.22.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan for *C. prostrata* identifies a range of threats to the species (Carter & Walsh, 2010). As outlined in Chapter 15 (Section 15.5 and Attachment A), consideration was given to the potential relevance of these threats as indirect impacts that may result from implementation of the Plan.

Given the limited extent of species habitat and records in the Strategic Assessment Area, and the distance that they occur from the nominated areas, it was considered unlikely that implementation of the Plan would exacerbate any of the identified threats and would therefore not result in any indirect impacts.

Climate change is a relevant threat to the species. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

It is worth noting that the Plan includes a range of landscape scale measures that will protect biodiversity (e.g. protection of large areas of land, Fire Management Strategy, Weed Control Strategy, and Pest Animal Control Implementation Strategy). These measures will benefit all biodiversity in the Cumberland subregion and may potentially relate to this species.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

Given the species does not occur within the nominated areas or transport corridors, there is no risk of additional impacts from essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

As outlined above, implementation of the Plan will not lead to any direct or indirect impacts to the species. This will ensure that the implementation of the Plan does not adversely influence their long-term viability.

29.22.2 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan (Carter & Walsh, 2010) is to minimise the probability of extinction of the Dwarf Kerrawang in the wild and to increase the probability of important populations becoming self-sustaining in the long-term. Specific objectives include:

- Acquire accurate information as baseline data for ongoing monitoring
- Identify habitat that is critical, common, or potential.
- Ensure that all populations and their habitat are protected and managed appropriately
- Manage threats to populations
- Identify key biological functions
- Determine the growth rates and viability of populations
- Establish populations in cultivation
- Build community support for conservation

Implementation of the Plan will not impact the species and will not prevent the achievement of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT THE IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to support the overall recovery of *C. prostrata*. The Plan will not prevent implementation of any of the actions.

29.22.3 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-78 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *C. prostrata*, there are no relevant Threat Abatement Plans.

Table 29-78: Relevant key Threatening Processes and associated Threat Abatement Plans for *C. prostrata*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data table for occurrence.

Table 29-79: Occurrence of *C. prostrata* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	61.9	42.4

29.23 *DEYEUXIA APPRESSA*

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	An erect perennial grass. Leaves are deeply grooved, hairy on top and rough underneath. Displays compound inflorescence containing spikelets. Grows to approximately 0.9 m tall. (OEH, 2018e)
ECOLOGY	Flowers in spring to summer and grows in moist conditions. Given that the species hasn't been observed in over 60 years, very little is known of the species' ecology. (DEWHA, 2008c; OEH, 2018e)
DISTRIBUTION AND HABITAT	Records are highly restricted to the Sydney area (south of Bankstown, Killara). Records of this species have not been collected since pre-1942. This species may now be extinct as a result of habitat loss due to development. Grows in moist conditions and inhabits the following TECs: • Shale Sandstone Transition Forest • Cumberland Plain Woodlands • Turpentine-Ironbark Forest in the Sydney Basin Bioregion (DEWHA, 2008c; OEH, 2018e)
POPULATIONS	First collected in 1930 at Herne Bay, Saltpan Creek off the Georges River south of Bankstown, then in 1941 at Killara, near Hornsby. This species has not been observed since and may be extinct in the wild. (DEWHA, 2008c)
SOS SITES	*D. appressa* has been allocated to the Data Deficient management stream of the Saving our Species program, as there is no known extant population in NSW.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Deyeuxia appressa* (DEWHA, 2008c)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.

SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7438

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">No</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report for this species.</td></tr>
<tr><td rowspan="4">HABITAT MAPPING</td><td colspan="5">WITHIN THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Not applicable as the species is not a candidate species credit species. Mapping was done as per knowledge-based mapping method described below.</td></tr>
<tr><td colspan="5">OUTSIDE THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Knowledge based map (KBM). Mapping was prepared for this species utilising the following parameters: BioNet PCT associations, vegetation condition (intact, thinned), and geographic restrictions (habitat restricted to 10 km around species records).</td></tr>
<tr><td rowspan="6">POPULATION MAPPING</td><td colspan="5">RECORD SELECTION</td></tr>
<tr><td colspan="5">All available BioNet records were used to identify populations, with no date restrictions.</td></tr>
<tr><td colspan="5">BIONET RECORD DOWNLOAD DATE</td></tr>
<tr><td colspan="5">The initial assessment of D. appressa was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020.
Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset.
The BioNet records used for the assessment of D. appressa were downloaded in September 2019.</td></tr>
<tr><td colspan="5">POPULATION DEFINITION</td></tr>
<tr><td colspan="5">There are not thought to be any extant populations of this species (as there are no recent records) and it is considered possible that the species is now extinct.</td></tr>
<tr><td colspan="5">IMPORTANT POPULATION CRITERIA</td></tr>
<tr><td colspan="5">All populations were considered to be important as the species is endangered.</td></tr>
</table>

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in

conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-6 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	*D. appressa* has no records or important populations within the Strategic Assessment Area. Two important populations (from 3 BioNet records) have been mapped in the north-east of the Cumberland subregion. It is noted that this species has not been recorded since 1942 and that it may be extinct in the wild. The baseline mapping for this assessment has mapped 19.3 ha of habitat for this species within the Strategic Assessment Area. Habitat occurs as very small and disjointed patches in the north-east of the Strategic Assessment Area, in the district of Holsworthy, Hammondville, Moorebank and Cabramatta. No habitat has been mapped within, or in close proximity to, any of the nominated areas or transport corridors. See Table 29-81 at the end of this species assessment for a breakdown of the occurrence of records and habitat for *D. appressa* in the Strategic Assessment Area.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

No species habitat or records occur within the nominated areas or transport corridors. Avoidance of habitat was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

Implementation of the Plan will not lead to direct impacts or fragmentation of the species. As a result, the Plan does not provide offsets for the species.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.23.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *D. appressa* identifies a range of threats to the species if it is still extant. As outlined in Chapter 15 (Section 15.5 and Attachment A), consideration was given to the potential relevance of these threats as indirect impacts that may result from implementation of the Plan.

Given the lack of records and the limited extent of species habitat in the Strategic Assessment Area, and the distance that they occur from the nominated areas, it was considered unlikely that implementation of the Plan would exacerbate any of the identified threats and would therefore not result in any indirect impacts.

It is worth noting that the Plan includes a range of landscape scale measures that will protect biodiversity (e.g. protection of large areas of land, Fire Management Strategy, Weed Control Strategy, and Pest Animal Control Implementation Strategy). These measures will benefit all biodiversity in the Cumberland subregion and may potentially relate to this species if it is still extant.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

Given the species does not occur within the nominated areas or transport corridors, there is no risk of additional impacts from essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

As outlined above, the species is now considered likely to be extinct. In addition, implementation of the Plan will not lead to any direct or indirect impacts to mapped habitat for the species. This will ensure that the implementation of the Plan does not adversely influence its long-term viability if it is still extant.

29.23.2 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.23.3 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-80 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *D. appressa*, there are no relevant Threat Abatement Plans.

Table 29-80: Relevant key Threatening Processes and associated Threat Abatement Plans for *D. appressa*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data table for occurrence.

Table 29-81: Occurrence of *D. appressa* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	0	0
(IMPORTANT POPULATIONS)	(0)	(0)
HABITAT MAPPING (Ha)	19.3	0.0

29.24 *GENOPLESIUM BAUERI* (YELLOW GNAT-ORCHID)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	A terrestrial orchid growing to 6-15 cm high. Inflorescence is 1-3 cm long with 1-6 flowers that are 15 mm across. Flowers are green and red or reddish. (DoE, 2014j)
ECOLOGY	Flowers between December and April. Plants are visible above ground for approximately two months. Often seen after fire. (DoE, 2014j)
DISTRIBUTION AND HABITAT	Endemic to New South Wales. Occurs within coastal areas from Ulladulla on the south coast to Port Stephens on the mid-north coast, although it has been recorded from as far west as Woodford in the Blue Mountains and Penrose State Forest in the southern highlands. Area of occupancy is 168 km^2. It grows in heathland to shrubby woodland on sands or sandy loams, or in shrubby forest to heathy forest on well-drained sandy and gravelly soils. (DoE, 2014j)
POPULATIONS	As of 2010, total number of mature individuals was thought to be less than 250 (DoE, 2014j).
SOS SITES	The following SOS sites for the species have been identified: • Ku-ring-gai Chase National Park • Ku-ring-gai Wildflower Garden • Bomaderry Creek • Callala
RELEVANT PLANS AND POLICIES	Conservation Advice for *Genoplesium baueri* (brittle midge orchid, yellow gnat orchid) (DoE, 2014j)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7528

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">No</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report available for this species.</td></tr>
<tr><td rowspan="4">HABITAT MAPPING</td><td colspan="5">WITHIN THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Not applicable as the species is not a candidate species credit species. Mapping was done as per knowledge-based mapping method described below.</td></tr>
<tr><td colspan="5">OUTSIDE THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Knowledge based map (KBM). Potential habitat polygons were generated for this species using BioNet PCT associations, vegetation condition (intact), and elevation (below 500 m).
No targeted surveys as part of this project were undertaken outside the nominated areas.</td></tr>
<tr><td rowspan="6">POPULATION MAPPING</td><td colspan="5">RECORD SELECTION</td></tr>
<tr><td colspan="5">Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.</td></tr>
<tr><td colspan="5">BIONET RECORD DOWNLOAD DATE</td></tr>
<tr><td colspan="5">The initial assessment of G. baueri was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020.
Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset.
The BioNet records used for the assessment of G. baueri were downloaded in September 2019.</td></tr>
<tr><td colspan="5">POPULATION DEFINITION</td></tr>
<tr><td colspan="5">Biological populations were defined using the records dataset and available information about the nature of the species.
Records within 500 m of each other have been considered to be a single population.</td></tr>
<tr><td colspan="5">IMPORTANT POPULATION CRITERIA</td></tr>
<tr><td colspan="5">All populations of G. baueri have been considered as important as the species is endangered.</td></tr>
</table>

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-8 for a map of records and habitat across the Strategic Assessment Area. It is important to note that the records for this species are sensitive and have been denatured for representation on the map.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	There is a single population (with a single record from June 2017) within the Strategic Assessment Area, which is found on the eastern side of Appin village within GMAC (outside urban capable land). The population is considered important. The baseline mapping for this assessment has mapped approximately 768.3 ha of known and potential habitat within the Strategic Assessment Area. Habitat for this species is located in the south of the Strategic Assessment Area, in the following areas: • A patch of habitat occurs to the south of Wilton, south of the intersection of Macarthur Drive and Picton Road • Long and thin stretches of habitat occur along the south-eastern boundary of the Strategic Assessment Area, spanning from Appin in the south through to Holsworthy in the north. It is likely that suitable habitat for this species continues to the east of this area, beyond the Strategic Assessment Area boundary and into adjacent remnant vegetation Overall, very little suitable habitat for this species occurs within the Strategic Assessment Area. A breakdown of occurrence for *G. baueri* in the Strategic Assessment Area is provided in Table 29-83.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.24.1 NOMINATED AREAS

There is no mapped habitat for *G. baueri* within any of the nominated areas, and therefore avoidance of habitat was not necessary.

It is noted that there is a single record of *G. baueri* within GMAC, which occurs in land avoided for biodiversity purposes. No other records of the species occur within the Strategic Assessment Area.

29.24.2 TRANSPORT

No habitat or records for the subspecies occur within the transport corridors. Avoidance of habitat was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

Implementation of the Plan will not lead to direct impacts or fragmentation of the species. As a result, the Plan does not provide offsets for the species.

It is noted that a total of 384.8 ha of potential habitat for *G. baueri* is located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.24.3 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *G. baueri* identifies habitat disturbance as a key threat to the species (DoE, 2014j). This threat is considered relevant to implementation of the Plan and is discussed below.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for [add the species name] are discussed below for the identified indirect impact.

It is noted that a total of 384.8 ha of potential habitat for *G. baueri* is contained within the Georges River Koala Reserve. The establishment of conservation reserves containing habitat for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

HABITAT DISTURBANCE

Habitat disturbance through unrestricted public access and rubbish dumping have been identified as a key threat to the species (DoE, 2014j). Development within Wilton and GMAC may lead to an increase in human activity within the species' known and potential habitat areas, and this may exacerbate the threat. This is most relevant to the known population that occurs on avoided lands within GMAC.

Appendix E of the Plan includes a species-specific measure to manage the risk of human disturbance to the population within GMAC (population 21). This measure will be implemented through consultation with local councils and other public agencies.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. Note that 384.8 ha of potential habitat for *G. baueri* is located within the Georges River Koala Reserve
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure

compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping

- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the species from inappropriate habitat disturbance as a result of development. This is because:

- There is a species-specific measure to manage the threat to the known population
- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

There is no mapped habitat within transport corridors and the species is not at risk of impacts in these locations.

29.24.4 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There is a known population of the species which occurs on avoided lands within GMAC.

Given the limited distribution of the species within avoided lands it is considered likely that avoidance of direct impacts will be possible.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors

- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect *G. baueri* from impacts from essential infrastructure. These include:

- Commitment 2.2, which specifically prioritises avoidance of impacts to *G. baueri*
- A measure in the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, which requires that avoidance of impacts to *G. baueri* be prioritised

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *G. baueri* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.24.5 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014j) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *G. baueri* in relation to implementation of the Plan:

- Habitat loss
- Habitat disturbance

HABITAT LOSS

There will be no habitat loss as a result of implementation of the Plan.

HABITAT DISTURBANCE

The Plan includes a range of measures (including a species-specific measure) to ensure that habitat disturbance will not affect the species.

CONCLUSION

There are no direct impacts to the species and suitable management measures in the Plan to address potential indirect impacts. This will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.24.6 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.24.7 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-82 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *G. baueri*, there are no relevant Threat Abatement Plans.

Table 29-82: Relevant key Threatening Processes and associated Threat Abatement Plans for *G. baueri*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data tables for occurrence and avoidance. Cross references to the tables are provided throughout the text above.

Table 29-83: Occurrence of *G. baueri* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	0
(IMPORTANT POPULATIONS)	(1)	(0)
HABITAT MAPPING (Ha)	768.3	85.3

29.25 *HIBBERTIA PUBERULA* SUBSP. *GLABRESCENS*

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the subspecies. It provides an overview of the subspecies' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key subspecies' documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	A prostrate shrub with spreading, wiry branches which can be up to 40 cm long. Flowers are yellow with notched petals. (DoEE, 2018f)
ECOLOGY	Flowers from October to December. Seeds occur from October to January. Vegetative reproduction is theoretically possible as the subspecies is a prostrate shrub, however, occurrences of vegetative reproduction have not been observed for this species. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	Only known from Bankstown Airport, south-west of Sydney. Occurs over an area covering two hectares. It is noted that since 1986, comprehensive surveys have been carried out in remnant vegetation throughout the suburb of Bankstown, and no further sites for this species have been located. Occurs in highly modified Georges River Tertiary Alluvium Floodplain Communities with sandy tertiary alluvium with high silt content. (DoEE, 2018f) Recent attempts were made to translocate the subspecies to Voyager Point Reserve. This occurs outside of the Strategic Assessment Area, and the current status of that translocated population is not known.
POPULATIONS	As of 2009, there were estimated to be fewer than 50 individuals from one population in Area 5, Bankstown Airport. As the subspecies was first observed in 2006, historical population data is limited, although it is suspected the subspecies has undergone historical reduction in numbers based on aerial photography records showing ongoing destruction of suitable habitat. (DoEE, 2018f) Assessment of all BioNet records of the species indicates that over 90 per cent of known records occur within the Cumberland subregion. Therefore, for the purposes of this assessment, *H. puberula* subsp. *glabrescens* is considered to be an endemic species to the region.

SOS SITES	The following SOS sites for the subspecies have been identified: • Bankstown Airport • Voyager Point Reserve • Bill Anderson Reserve (Proposed) • Riverside Park Reserve (Proposed) • East Hills Footbridge Reserve (Proposed) • East Hills Reserve (Proposed
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Hibbertia* sp. Bankstown (R.T. Miller & C.P. Gibson s.n. 18/10/06) (a shrub) (DEWHA, 2008l)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this subspecies.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81969

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the subspecies is a candidate species under the BCAR process*
- *If an expert report was prepared for the subspecies under the BCAR process*
- *An overview of the habitat mapping for the subspecies within and outside the nominated areas*
- *An overview of the population mapping for the subspecies*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	No	No	No	No
EXPERT REPORT (BCAR PROCESS)	While *Hibbertia puberula* subsp. *glabrescens* is not a candidate species credit species, two expert reports were prepared for the *Hibbertia puberula* species group. These reports included some discussion about subsp. *glabrescens*. The reports were prepared because *Hibbertia puberula* subsp. *puberula* (which is not listed under the EPBC Act) is a candidate species credit species for the BCAR process. The two expert reports address the *Hibbertia puberula* species group in: • GPEC and WSA (Miller, 2018a) • Wilton and GMAC (Miller, 2018b)				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Not applicable as the subspecies is not a candidate species credit species. Mapping was done as per the knowledge-based mapping method described below.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). Mapping for this subspecies was undertaken using the following parameters: • BioNet PCT associations • Geographic restrictions. Given the very limited distribution of the subspecies, potential habitat was restricted to 1 km surrounding known records				

POPULATION MAPPING	**RECORD SELECTION**
	All available BioNet records were used to identify populations, with no date restrictions.
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *Hibbertia puberula* subsp. *glabrescens* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *Hibbertia puberula* subsp. *glabrescens* were downloaded in September 2019.
	POPULATION DEFINITION
	The subspecies is known to occur naturally in one location, as a single population. The translocation site at Voyager Point Reserve has been planted with a number of individuals propagated from the Bankstown location.
	IMPORTANT POPULATION CRITERIA
	The population of *H. puberula* subsp. *glabrescens* was considered to be important due to the threat status of the subspecies.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the subspecies in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment.

This section also provides a discussion of how the occurrence information used in the assessment compares to information in the expert reports for the species.

MAP	See Map 29-10 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	*H. puberula* subsp. *glabrescens* has no records within the Strategic Assessment Area. The subspecies is only known from Bankstown Airport (which occurs just outside of the eastern edge of the Strategic Assessment Area). It has not been recorded at any other sites, despite targeted surveys throughout the Bankstown area. A total of 43.7 ha of potential habitat has been mapped on the edge of the Strategic Assessment Area, along the Georges River to the east of Moorebank. Mapped habitat is confined to areas in proximity to the Bankstown Airport. Overall, the area of potential habitat for this subspecies within the Strategic Assessment Area is very small. No habitat has been mapped within, or in close proximity to any of the nominated areas or transport corridors.
COMPARISON WITH EXPERT REPORTS	**Expert report for WSA and GPEC** (Miller, 2018a) The expert report for WSA and GPEC concludes that for *H. puberula* subsp. *glabrescens*: *"The likelihood of occurrence within or adjacent to the GPEC is considered to be low to moderate, and the likelihood of occurrence within or adjacent to the WSA is assessed as low."* The subspecies was not included in the BCAR as a candidate species credit species in these two nominated areas because: • Of a lack of suitable habitat in urban capable lands • Surveys for *H. puberula* subsp. *fumana* and *H. puberula* subsp. *puberula* did not identify any records for subsp. *glabrescens*

	Mapping for the subspecies within WSA and GPEC was therefore not prepared which is consistent with the approach taken in the expert report. **Expert report for Wilton and GMAC** (Miller, 2018b) The expert report for Wilton and GMAC concludes that the species is not likely to be present in Wilton. This is consistent with the BCAR which does not identify it as a candidate species credit species in that location, and the mapping for the project. However, it is noted that the expert report for Wilton and GMAC identifies an area of potential habitat for the subspecies at Menangle Park within GMAC. The expert report says: *"Likely habitat for Hibbertia puberula* subsp. *glabrescens occurs at Menangle Park. An area of approximately 92ha could contain likely habitat niches within the growth area footprint, and a further 31 ha of land containing likely habitat niches adjacent to the footprint"* At the time the expert report was prepared, the area in question near Menangle Park was part of the proposed urban capable land. This area has since been removed from urban capable land and is mapped as excluded land. The area is subject to a separate planning proposal, and it is understood that it is undergoing a separate biodiversity approvals process. Ecological reports relating to that area have not identified the subspecies as being present. No areas identified by the expert as potential habitat for *H. puberula* subsp. *glabrescens* occur within urban capable lands and the subspecies is not a candidate credit species within GMAC for this assessment. Given the species is not a candidate credit species within GMAC, the habitat mapping was undertaken using the KBM approach described above for areas outside the nominated areas. This process appropriately mapped habitat for the subspecies only within the vicinity of Bankstown Airport.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the subspecies through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

No habitat or records for the subspecies occur within the nominated areas or transport corridors. Avoidance of habitat was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the subspecies occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

Implementation of the Plan will not lead to direct impacts or fragmentation of the subspecies. As a result, the Plan does not provide offsets for the subspecies.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.25.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for the *H. puberula* subsp. *glabrescens* identifies a range of threats to the subspecies (DEWHA, 2008l). However, given the lack of records, the limited extent of habitat in the Strategic Assessment Area, and the distance that they occur from the nominated areas, it was considered unlikely that implementation of the Plan would exacerbate any of the identified threats and would therefore not result in any indirect impacts.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

Given the subspecies does not occur within the nominated areas or transport corridors, there is no risk of additional impacts from essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the subspecies. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

As outlined above, implementation of the Plan will not lead to any direct or indirect impacts to mapped habitat for the species. This will ensure that the implementation of the Plan does not adversely influence its long-term viability if it is still extant.

29.25.2 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.25.3 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-84 where they relate to:

- The potential direct impacts of the Plan, or

- The relevant indirect impacts

For *H. puberula* subsp. *glabrescens*, there are no relevant Threat Abatement Plans.

Table 29-84: Relevant key Threatening Processes and associated Threat Abatement Plans for *H. puberula* subsp. *glabrescens*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data table for occurrence.

Table 29-85: Occurrence of *H. puberula* subsp. *glabrescens* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	0	0
(IMPORTANT POPULATIONS)	(0)	(0)
HABITAT MAPPING (Ha)	43.7	0.0

29.26 *LEUCOPOGON EXOLASIUS* (WORONORA BEARD-HEATH)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	An erect shrub with pointed leaves and white, tubular flowers. Grows to 1m tall. (DoEE, 2018f)
ECOLOGY	Flowers in August and fruit matures in October. Seasonal changes trigger seed germination and fire may improve uptake. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	The species has a fragmented distribution over seven known locations. It is endemic to the Sydney region and central coast of NSW. It is known to occur in the Cumberland IBRA subregion. The species can be found: • Along the Georges River and Stokes Creek • Holsworthy Military Reserve • In Royal National Park and Heathcote National Park • Along the Grose River and Woronora River in the Blue Mountains The distribution overlaps with the Shale Sandstone Transition Forest TEC. It is found on rocky hillsides along creek banks and inhabits woodland on sandstone and sandy alluvium in areas with low nutrient soils. (DoEE, 2018f; OEH, 2017h)
POPULATIONS	There is limited population information for this species. BioNet Atlas of NSW Wildlife shows some occurrences in the Cumberland Plain south of Liverpool and east of Campbelltown. (OEH, 2019b)
SOS SITES	The following SOS sites for the species have been identified: • Dharawal/Heathcote • Upper Nepean State Conservation Area
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Leucopogon exolasius* (DEWHA, 2008e)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.

SPRAT LINK	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=14251

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">No</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report for this species.</td></tr>
<tr><td rowspan="4">HABITAT MAPPING</td><td colspan="5">WITHIN THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Not applicable as the species is not a candidate species credit species. Mapping was done as per knowledge-based mapping method described below.</td></tr>
<tr><td colspan="5">OUTSIDE THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Knowledge based map (KBM). Potential habitat mapping was completed for this species using the following parameters: BioNet PCT associations, vegetation condition (intact, thinned), waterways (restricted to within a 200 m buffer distance of the Cataract River and the Georges River), soil type ('Berkshire Park', 'Freemans Reach', 'Hawkesbury', 'Monkey Creek', 'Richmond', 'South Creek', 'Theresa Park', 'Upper Castlereagh'), geology ('Alluvial channel deposits- in-channel bar', 'Alluvial floodplain deposits', 'Alluvial terrace deposits', 'Alluvium', 'Hawkesbury Sandstone', 'Minchinbury Sandstone'), elevation (below 400 m) and rainfall (between 1,000 mm – 4,000 mm).</td></tr>
<tr><td rowspan="5">POPULATION MAPPING</td><td colspan="5">RECORD SELECTION</td></tr>
<tr><td colspan="5">Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.</td></tr>
<tr><td colspan="5">BIONET RECORD DOWNLOAD DATE</td></tr>
<tr><td colspan="5">The initial assessment of L. exolasius was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020.
Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset.
The BioNet records used for the assessment of L. exolasius were downloaded in September 2019.</td></tr>
<tr><td colspan="5">POPULATION DEFINITION</td></tr>
<tr><td colspan="5">Biological populations were defined using the records dataset and available information about the nature of the species.</td></tr>
</table>

	Clustered records connected by relatively intact and continuous vegetation and/or riparian corridors, or if separated, not by permanent barriers likely to obstruct pollinators.
	IMPORTANT POPULATION CRITERIA
	There are no important populations of *L. exolasius* identified in the Strategic Assessment Area.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-11 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	A total of four populations occurs in the Strategic Assessment Area. All are in the south or east, none of which are considered important. The baseline mapping for this assessment has mapped 267.2 ha of potential habitat within the Strategic Assessment Area (see Table 29-87). The potential habitat predominantly occurs along the Georges River, in the south-eastern edge of the Strategic Assessment Area. Habitat is located as follows: • A small area occurs along the Cataract River, at the intersection of the river with Wilton Road • Small, thin areas of habitat occur along the Georges River to the east of the Appin township • Small, thin areas of habitat occur along the Georges River, to the south-east of Ruse and Airds • A small, isolated patch of habitat occurs at Voyager Point, adjacent to the Georges River

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

29.26.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 23.7 ha of potential habitat within the nominated areas (not including excluded lands). All of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 13.7 ha was avoided for biodiversity purposes
- 10 ha was avoided for other reasons

A breakdown of avoidance across each nominated area is provided in Table 29-88.

It is important to note that the avoidance calculations in Table 29-88, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 29-88 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

29.26.2 TRANSPORT

There is no mapped habitat within the transport corridors.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

Implementation of the Plan will not lead to direct impacts or fragmentation of the species. As a result, the Plan does not provide offsets for the species.

It is noted that a total of 119.2 ha of potential habitat for *L. exolasius* is contained within the Georges River Koala Reserve.

Further, an important population of *L. exolasius* is located within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.26.3 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *L. exolasius* identifies a range of threats to the species (DEWHA, 2008e). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion

Stochastic events leading to localised extinctions, small range and population size, unknown distribution and abundance of individual populations have also been identified as key threats. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these threats across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for *L. exolasius* are discussed below for each identified indirect impact.

It is noted that a total of 119.2 ha of potential habitat for *L. exolasius* is contained within one of the Plan's proposed reserves, and an important population of the species is located within the Georges River Koala Reserve. The establishment of conservation reserves for known habitat and populations of this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes are identified as a potential threat to the species (DEWHA, 2008e). This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Increased human activity within the nominated areas has the potential to alter fire regimes, through potentially increasing fire frequencies in some areas, and decreasing fire frequencies in others, through the mechanisms outlined above.

Key risk areas are those that are easily accessible to the public and in close proximity to urban development and roads. Population 76 occurs close to the southern part of GMAC.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity that are expected to adequately manage the risk to the species from altered fire regimes as a result of development. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for *Leucopogon exolasius* being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for *L. exolasius*. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

WEED INVASION

Weed invasion is identified as a potential threat to the species. Weeds are already present within the Strategic Assessment Area and are unlikely to pose a novel threat. However, urban, transport and agricultural development has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

Key risk areas are those that are easily accessible to the public and in close proximity to urban development and roads. Population 76 occurs close to the southern part of GMAC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity that are expected to adequately manage the risk to the species. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for *L. exolasius*:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program

  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

The species does not occur within the vicinity of the tunnels and will not be at risk of further impacts in those locations.

29.26.4 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

A small area of species habitat has been mapped within avoided lands in GMAC in the south of the nominated area. Given its location, impacts to habitat are considered unlikely due to essential infrastructure.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
  - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
  - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing

- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to *L. exolasius* from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.26.5 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2008e) identifies the following key issues that are likely to have the greatest influence on the long-term viability of *L. exolasius* in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts
    - Inappropriate fire regimes
    - Weed invasion

HABITAT LOSS

There will be no habitat loss as a result of implementation of the Plan.

INDIRECT IMPACTS

The potential indirect impacts associated with changed inappropriate fire regimes and weed invasion will be managed and mitigated through a number of commitments and actions in the Plan (see Chapter 15 for details).

CONCLUSION

The lack of direct impacts, limited scale of potential indirect impacts to the species' habitat and the management measures in the Plan to address indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

29.26.6 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.26.7 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-86 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For *L. exolasius*, there are no relevant Threat Abatement Plans.

Table 29-86: Relevant key Threatening Processes and associated Threat Abatement Plans for *L. exolasius*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data tables for occurrence and avoidance. Cross references to the tables are provided throughout the text above.

Table 29-87: Occurrence of *L. exolasius* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	4	0
(IMPORTANT POPULATIONS)	(0)	(0)
HABITAT MAPPING (Ha)	267.2	0.0

Table 29-88: Avoidance of *L. exolasius* habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	24.0	0.0	0.0	24.0
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	0.3	0.0	0.0	0.3
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**23.7**	**0.0**	**0.0**	**23.7**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	13.7	0.0	0.0	13.7
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	57.9	0.0	0.0	57.9
AVOIDANCE FOR OTHER REASONS (ha)	0.0	10.0	0.0	0.0	10.0
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	42.1	0.0	0.0	42.1
TOTAL AVOIDANCE (ha)	**0.0**	**23.7**	**0.0**	**0.0**	**23.7**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**100.0**	**0.0**	**0.0**	**100.0**

29.27 *PERSOONIA GLAUCESCENS* (MITTAGONG GEEBUNG)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	An erect shrub with greyish-green erect leaves, yellow flowers and fruit that resemble small plums. It grows up to 3 m tall. (OEH, 2019h)
ECOLOGY	Flowers from late summer to autumn. Fire-sensitive species, adults are killed by fire and recruitment is only by seed. Often seen following disturbance. (DEWHA, 2008h; OEH, 2019h)
DISTRIBUTION AND HABITAT	Restricted distribution in NSW from Picton to Kangaroo Valley. The species has been collected in Buxton, Hill Top, Nattai Creek, Welby, and Kangaloon. It is known to occur in the Cumberland IBRA subregion. Distribution overlaps the following TECs: • Shale Sandstone Transition Forest • White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland • Turpentine-Ironbark Forest in the Sydney Basin Bioregion • Temperate Highland Peat Swamps on Sandstone Inhabits woodland to dry sclerophyll forest on clayey and gravely laterite, and well-drained soils. Prefers ridge-tops, plateau and upper slopes. (DEWHA, 2008h; OEH, 2017e, 2019h)
POPULATIONS	Population information is limited. The BioNet Atlas of NSW Wildlife shows several occurrences around Bargo and Buxton in the south of the Strategic Assessment Area. (OEH, 2019b)
SOS SITES	The following SOS sites for the species have been identified: • Bargo State Conservation Area • Mt Alexandra, Welby, and Jellore • Upper Nepean State Conservation Area
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Persoonia glaucescens* (Mittagong Geebung) (DEWHA, 2008h)

SPECIES-SPECIFIC GUIDELINES	*Persoonia glaucescens* Environmental Impact Guidelines (NPWS, 2000b)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=12770

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Not applicable as the species is not a candidate species credit species. Mapping was done as per knowledge-based mapping method described below.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). Mapping was prepared for this species using the following parameters: BioNet PCT associations, vegetation condition (intact, thinned) and elevation (250m-650m).				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *P. glaucescens* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *P. glaucescens* were downloaded in September 2019.				
	POPULATION DEFINITION				
	Biological populations were defined using the records dataset and available information about the nature of the species. Individuals within 500 m of each other are likely to be interbreeding and are therefore considered to be the same population.				

	IMPORTANT POPULATION CRITERIA
	Populations of *P. glaucescens* were considered important because they met one or more of the following criteria: • A population that is important for maintaining the Extent off Occurrence of a species • A population within a conservation reserve • A population that is a site-managed species or iconic species targeted for conservation under the NSW Saving our Species program

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 29-16 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	Within the Strategic Assessment Area, the species occurs in the south-western corner. A total of 10 important populations have been mapped, of which two populations are either wholly or partly located within existing conservation reserves. Important populations occur in the area between Buxton, Couridjah, Charlies Point Road, and the northern boundary of Buxton. Two non-important populations have also been mapped within the Strategic Assessment Area. Non-important populations occur to the south of the Bargo township, in the area between Remembrance Drive and the western boundary of the Strategic Assessment Area. The baseline mapping for this assessment has mapped approximately 2,378.2 ha of potential habitat within the Strategic Assessment Area (see Table 29-90). This occurs as scattered habitat in the south-western portion of the Strategic Assessment Area. No habitat is mapped in any of the nominated areas or transport corridors for this species.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

No species habitat or records occur within the nominated areas or transport corridors. Avoidance of habitat was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 29.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

Implementation of the Plan will not lead to direct impacts or fragmentation of the species. As a result, the Plan does not provide offsets for the species.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

29.27.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for *P. glaucescens* identifies a range of threats to the species (DEWHA, 2008h). However, given the distance of mapped habitat and records from the nominated areas and transport corridors implementation of the Plan is considered unlikely to exacerbate these threats for the species.

It is worth noting that the Plan includes a range of landscape scale measures that will protect biodiversity (e.g. protection of large areas of land, Fire Management Strategy, Weed Control Strategy, and Pest Animal Control Implementation Strategy). These measures will benefit all biodiversity in the Cumberland subregion and may potentially relate to this species.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

Given the species does not occur within the nominated areas or transport corridors, there is no risk of additional impacts from essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

29.27.2 IMPLICATIONS FOR LONG-TERM VIABILITY

As outlined above, implementation of the Plan will not lead to any direct or indirect impacts to the species. This will ensure that the implementation of the Plan does not adversely influence their long-term viability.

29.27.3 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

29.27.4 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 29-89 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15. The Plan is not inconsistent with any Threat Abatement Plans.

Table 29-89: Relevant key Threatening Processes and associated Threat Abatement Plans for *P. glaucescens*

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus *(Phytophthora cinnamomi*)	Threat Abatement Plan for Disease in Natural Ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant Threat Abatement Plan
Novel biota and their impact on biodiversity	There is no relevant Threat Abatement Plan

DATA TABLES

This section sets out the data tables for occurrence.

Table 29-90: Occurrence of *P. glaucescens* in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	12	2
(IMPORTANT POPULATIONS)	(10)	(2)
HABITAT MAPPING (Ha)	2,378.2	266.8

30 Threatened fauna impact assessment

30.1 INTRODUCTION

There are 20 Category 1 threatened fauna species that are assessed in this Chapter. These species were identified as needing detailed assessment (see Part 3 for the approach, and Chapter 28 for the results) as they are reliant on the Cumberland subregion and have some potential to be impacted (directly, indirectly, or cumulatively).

The Chapter is structured around the level of risk of residual adverse direct impacts (prior to the application of offsets) occurring to each species (see Table 30-1). Species most at risk from direct impacts from development under the Plan are discussed first, with species at lower levels of risk discussed subsequently.

The overall assessment approach for threatened fauna is presented below in Section 30.2, and the methodology for the risk assessment is set out in Section 30.3.

The analysis in this Chapter concludes that the avoidance, mitigation and offset measures in the Plan will ensure that the long-term viability of all 20 threatened fauna species will not be adversely influenced.

Given the amount of information and complexity of the assessment for Koala, it is assessed and presented differently to the other species (see Section 30.5).

Given their similarities, the five threatened migratory shorebirds are assessed together in the one section (see Section 30.20)

Table 30-1: Species assessed in the threatened flora chapter categorised according to the risk of residual adverse direct impacts

Level of risk of residual adverse direct impacts to species	Number of species	Species names
High risk	1	• *Phascolarctos cinereus* (Koala)
Medium risk	1	• *Lathamus discolor* (Swift Parrot)
Low risk	5	• *Anthochaera phrygia* (Regent Honeyeater) • *Botaurus poiciloptilus* (Australasian Bittern) • *Chalinolobus dwyeri* (Large-eared Pied Bat) • *Dasyurus maculatus maculatus* (Spot-tailed Quoll) • *Pteropus poliocephalus* (Grey-headed Flying Fox)
Very low risk	4	• *Litoria aurea* (Green and Golden Bell Frog) • *Petauroides volans* (Greater Glider) • *Pommerhelix duralensis* (Dural Land Snail) • *Rostratula australis* (Australian Painted Snipe)

No risk	9	• *Heleioporus australiacus* (Giant Burrowing Frog)
		• *Hirundapus caudacutus* (White-throated Needletail)
		• *Hoplocephalus bungaroides* (Broad-headed Snake)
		• *Macquaria australasica* (Macquarie Perch)
		• **Threatened migratory shorebirds:**
		  ○ *Calidris canutus* (Red Knot)
		  ○ *Calidris ferruginea* (Curlew Sandpiper)
		  ○ *Charadrius leschenaultia* (Greater Sand Plover)
		  ○ *Limosa lapponica baueri* (Bar-tailed Godwit)
		  ○ *Numenius madagascariensis* (Eastern Curlew)

30.2 THREATENED FAUNA ASSESSMENT APPROACH

The assessments for threatened fauna follow a standard format. However, the content is tailored for the specific context of each species.

There are nine sections to the assessments. They are described below and include:

- Species background
- Approach to baseline data
- Occurrence in the Strategic Assessment Area
- Avoidance of impacts
- Direct impacts and offsets
- Potential indirect impacts and mitigation
- Potential additional impacts from essential infrastructure and tunnels
- Likely effects of implementation of the Plan on the long-term viability of the species
- Data tables

To assist the reader, standard explanatory text about the purpose and content of each section is provided throughout the assessments in *blue italics text*. The text is repeated for each species. It enables the reader to quickly understand the content of each section and where in the broader report more detailed information is available about a particular issue.

30.2.1 SPECIES BACKGROUND

Sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

30.2.2 APPROACH TO BASELINE DATA

Provides a summary of the baseline information used in the assessment. It sets out:

- If the species is a candidate species under the BCAR process. A candidate species is a species that has been determined through the BCAR assessment as needing to be assessed because suitable habitat occurs in the nominated areas. A candidate species can be either an ecosystem credit species (ECS) (one that can be reasonably predicted to occur within a nominated area based on the habitat that occurs there - surveys are not required to determine the presence of these species); or a species credit species (SCS) (one that cannot be reasonably predicted to occur within a nominated areas based on habitat – species in these areas may either be assumed present, or their presence needs to be determined through surveys or a report prepared by an expert on that species). Understanding whether a species has been categorised as a candidate species is useful to know for the EPBC Act assessments as it is based on the application of a systematic method under the BCAR process and provides an initial indication of how development in the nominated areas might interact with the species. This helps to shape the assessment narrative
- If an expert report was prepared for the species under the BCAR process. Expert reports were prepared as part of the BCAR process for a subset of species that: could not be sufficiently surveyed for within the nominated areas due to either access restrictions, seasonality or their cryptic nature; or had highly specific habitat requirements and restrictions for which expert advice was required. It is relevant to note that the expert reports were prepared as a requirement of the BCAR process and were not specifically prepared to support the EPBC assessments. As a result, the expert reports are not relied on heavily in these assessments and instead, information (particularly relating to species ecology and distribution) has been identified and drawn on as relevant
- An overview of the habitat mapping for the species within and outside the nominated areas. Habitat maps were generated using either species distribution models (SDMs), knowledge-based maps (KBMs) reflecting broad habitat associations (for instance, with mapped PCTs) and expert polygons defined through the expert reports under the BCAR process
- An overview of the population mapping for the species. This includes:
    - Any filters applied to the use of species (BioNet) records
    - Assumptions made in identifying biological populations from the species records. It is relevant to note that the method used to define populations for this assessment was tailored to the available data and purpose of the baseline mapping. While the definition used is based on the theoretical definition of a biological population

used elsewhere in the literature, it is confounding to try to match or relabel these populations to corresponding populations in other publications, such as recovery plans or species profiles, which will be based on a different dataset, often with a different purpose, set of criteria and level of resolution. The population mapping presented in this report therefore needs to be considered as standalone and fit for purpose.

- Any criteria met in determining the importance of populations

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

30.2.3 OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

Describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file (layered PDF). The map provides critical context for the assessment and should be viewed in conjunction with the text presented in the assessments. This section also provides a qualitative description of where records and habitat occur.

For threatened migratory shorebirds, habitat mapping was undertaken using a different approach. This is described in detail in Chapter 32 and is based on identifying the importance of habitat sites for shorebirds across the Cumberland subregion in accordance with the relevant significant impact guidelines.

30.2.4 AVOIDANCE OF IMPACTS

Provides an overview of the area of potential habitat that was avoided for each species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan.

The definition of what constitutes avoidance has been adopted from the BCAR process. Under the BAM, avoidance refers to land that is suitable for development and included in the area proposed for development or biodiversity certification, but has been avoided and not certified because of its biodiversity value. This is referred to as avoidance for 'biodiversity purposes' in this assessment.

Land not impacted because it is not suitable for development or biodiversity certification, or land that has been excluded from the area proposed for development is not considered to have been avoided under the BAM. This land is referred to as avoidance for 'other purposes' and includes:

- Land that is mapped as a riparian corridor associated with a Strahler order 3 stream or above (or Strahler order 2 streams with mapped vegetation, adjacent to avoided lands or that contribute to landscape connectivity). Riparian buffers applied are consistent with the *Water Management Act 2000*:
  - Strahler stream order 2 - buffer 20 m either side
  - Strahler stream order 3 - buffer 30 m either side
  - Strahler stream order 4 and above - buffer 40 m either side
- State protected land within avoided lands (>18 degrees slope, considered too steep for urban development)

Flood-prone land is not included in the list of land avoided for other purposes because significant development does occur within flood-prone land in the Plan Area. The use of fill and other flood-mitigation works means that flood-prone land does not necessarily constrain urban development.

Some land within the nominated areas was not considered for inclusion in the area proposed for development and has therefore been identified as 'excluded' land. These lands include:

- Existing protected land, including reserves and established offset sites
- Council owned land which is zoned for environmental conservation, environmental management or recreation
- Commonwealth land, such as Defence Establishment Orchard Hills
- Lands within the nominated areas already assessed as part of another development approval (Bingara Gorge), or lands progressing through an alternate assessment (Mount Gilead, Menangle Park, Sydney Metro Stage 1)
- Lands already developed (existing urban areas, urban land zones and roads)

A further, detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.2.5 DIRECT IMPACTS AND OFFSETS

Provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat.

Direct impacts were determined based on an intersect of the urban capable lands and transport corridors with the baseline mapping generated for each threatened fauna species. It has been assumed that total permanent clearing will occur within the urban capable lands and transport corridors for the purposes of the assessment. However, it is important to note that in reality:

- Further avoidance will be undertaken within the transport corridors (see Chapter 7)
- Direct impacts will occur progressively over the life of the Plan, which reduces the severity of impacts

The extent or scale of loss is presented in terms of:

- Number and size of populations/important populations
- Hectares of potential habitat

The analysis also considers the likelihood of direct impacts leading to fragmentation of populations and areas of potential habitat.

To provide a sense of the magnitude and importance of direct impacts, the risk of residual adverse impacts to each species occurring as a result of any direct impacts was characterised as per the methodology set out in Section 30.3 below.

The Plan provides offsets for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.2.6 POTENTIAL INDIRECT IMPACTS AND MITIGATION

Identifies the potential indirect impacts to each species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to a species if:

- The indirect impact is identified as a threat in a relevant profile, conservation advice or recovery plan, *and*
- The threat is present in the Cumberland subregion, *and/or*
- The Plan has the potential to introduce or exacerbate the threat in a way that may affect the known occurrence of a species or associated habitat

Relevant indirect impacts were identified by drawing on distribution, ecological and life history information in SPRAT and other species profiles, conservation advices and recovery plans, and species records and habitat maps prepared for this Assessment Report.

The indirect impacts section then goes on to determine if the generic management strategies in the Plan will be adequate for addressing indirect impacts, or if species-specific commitments are necessary. Species-specific commitments were generally considered necessary where a species was found to have a particular vulnerability or susceptibility to a potential indirect impact in a discrete location.

Please refer to Chapter 15 for a detailed discussion and analysis of the type and nature of indirect impacts associated with the classes of action and the relevant mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.2.7 POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

Considers the potential additional impacts to species due to essential infrastructure projects that are needed to support development within the nominated areas. These might include projects such as water and electricity utilities, communications facilities, stormwater management systems, and waste or resource management systems. The assessment covers projects that may need to be located outside urban capable lands and on areas that are identified as avoided lands within the nominated areas.

This section also assesses the likelihood of potential additional impacts to species due to the tunnel sections of the transport corridors. The impacts of tunnels were assessed separately to the rest of the transport corridors as only small areas of the footprints will be disturbed and it is not possible to determine at this stage the nature and extent of those impacts.

Please refer to the following chapters for details about these development types:

- Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels
- Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)

30.2.8 LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

Considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

30.2.9 DATA TABLES

Sets out the data tables for occurrence, avoidance and direct impacts for each species.

30.3 RISK ASSESSMENT APPROACH FOR THREATENED FAUNA

This section sets out:

- The purpose of the risk assessment approach
- The risk assessment framework
- A description of the risk ratings
- The likelihood and consequence definitions for direct impacts to populations and/or potential habitat
- The likelihood and consequence definitions for direct impacts leading to fragmentation

30.3.1 PURPOSE

The purpose of the risk assessment for threatened fauna was to determine the level of risk of residual adverse impacts occurring to a species as a result of direct impacts. Indirect impacts were assessed differently (see Chapter 15) and were not subject to the same risk assessment process.

The term "residual adverse impacts" was used as it forms part of the EPBC Act Environmental Offsets Policy (DSEWPC, 2012c). Offsets are typically required under the EPBC Act when residual adverse impacts remain after avoidance and mitigation measures have been applied. In this case, the Plan provides offsets for species which are considered to be at high or medium risk of residual adverse impacts. Offsets are not provided for species which are considered to be at low or very low risk. As outlined above, the rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

A risk based approach to considering residual adverse impacts is appropriate for the strategic assessment. The ToR (Clause 4.2) identify the need for the impact assessment to consider the "level of likely risk to each protected matter". The spatial and temporal scale of the Plan means that there is an inherent level of uncertainty in the baseline data (both for habitat and records). In particular, the potential habitat mapping for the majority of species is highly precautionary and does not necessarily indicate with great certainty if a species will occur in an impact area. It is critical therefore to understand the level of risk to each species rather than take a simplistic view of direct impacts as presented in the impact numbers.

30.3.2 RISK ASSESSMENT FRAMEWORK

Risk is generally considered to be the combination of the likelihood and consequence of an event occurring. The methodology used in the assessment is based on an adapted version of the Australian Standard on Risk Management (Standards Australia, 2018).

The assessment for threatened fauna first considered if a species is restricted in its use of habitat (e.g. Green and Golden Bell Frog) or if it is mobile and wide ranging (e.g. Swift Parrot). This distinction was made as the criteria for risk differs depending on the nature of the species. A known location for a species which is restricted in terms or habitat or movement is generally going to be assessed as more important and vulnerable. A restricted species has limited ability or opportunity to disperse or seek refuge and the potential impacts to that location will necessarily be more concerning. In contrast, a record for a highly mobile species indicates the likely suitability and value of that area as habitat, and issues relating to barriers to movement and proportion of habitat impacted are more relevant to understanding the level of concern from potential impacts.

RESTRICTED SPECIES

The determination of the risk of residual adverse impacts for restricted species (see Section 30.3.4 for more information) was based on:

- The risk ratings in Table 30-2
- Understanding the risk of residual adverse impacts due to direct impacts to populations and/or potential habitat based on:
    - The likelihood definitions in Table 30-3
    - The consequence definitions in Table 30-4, Table 30-5, Table 30-6 and Table 30-7
- Understanding the risk of residual adverse impacts due to fragmentation based on:
    - The likelihood definitions in Table 30-8
    - The consequence definitions in Table 30-11

The final level of risk for a species was determined on a precautionary basis. The highest level of risk based on the consideration of impacts to populations, potential habitat, or due to fragmentation was taken.

WIDE RANGING SPECIES

The determination of the risk of residual adverse impacts for wide ranging species (see Section 30.3.5 for more information) was based on:

- The risk ratings table shown in Table 30-2
- The likelihood definitions in Table 30-12
- The consequence definitions in Table 30-13

30.3.3 RISK RATINGS

Four levels of risk were defined through the process (see Table 30-2). They were:

- Very low risk = very low risk that residual adverse impacts to a species will occur. Offsets for residual impacts were not considered necessary
- Low risk = low risk that residual adverse impacts to a species will occur. Offsets for residual impacts were not considered necessary
- Medium risk = medium risk that residual adverse impacts to a species will occur. Offsets were considered necessary
- High risk = high risk that residual adverse impacts to a species will occur. Offsets were considered necessary

Where there were no direct impacts to a species, there was considered to be no risk of residual adverse impacts.

Table 30-2: Risk ratings table

	CONSEQUENCE				
LIKELIHOOD	**Negligible**	**Minor**	**Moderate**	**Major**	**Extreme**
Almost certain	Low	Medium	Medium	High	High
Likely	Low	Low	Medium	Medium	High
Possible	Very low	Low	Low	Medium	Medium
Unlikely	Very low	Very low	Low	Low	Medium

30.3.4 RISK APPROACH FOR RESTRICTED SPECIES

LIKELIHOOD AND CONSEQUENCE DEFINITIONS FOR DIRECT IMPACTS TO POPULATIONS AND/OR POTENTIAL HABITAT

Likelihood

Table 30-3 sets out the definitions for the likelihood that a threatened fauna species will be directly impacted due to impacts to populations and/or potential habitat. These definitions:

- Draw on the baseline data for the species in terms of records and potential habitat mapping
- Consider the level of confidence in the records and potential habitat mapping. Strict definitions of "high", "moderate" and "low" confidence are not provided as they are species specific in relation to the baseline data. Judgements about the level of confidence in the data were instead determined based on the expert judgement of the assessment team who created the baseline data

Table 30-3: Likelihood definitions for direct impacts to populations and/or potential habitat

Likelihood	Definition
Almost certain	• Direct impacts to a known population with high confidence in the accuracy of the records
Likely	• Direct impacts to a known population with some uncertainty in the accuracy of the records OR • Direct impacts to potential habitat with high confidence that the species occurs in the impact area
Possible	• No direct impacts to a known population • Direct impacts to potential habitat with moderate confidence that the species occurs in the impact area
Unlikely	• No direct impacts to a known population • Direct impacts to potential habitat with low confidence that the species occurs in the impact area

Consequences

Consequence was determined by separately considering impacts to potential habitat as well as any impacts to known populations. The highest ranking of consequence was then taken for a species.

The criteria for determining consequence were based on a range of factors including:

- Conservation status. Impact thresholds for consequence were smaller for critically endangered species than for endangered species, and smaller for endangered species than for vulnerable species
- If the species is considered to be an SAII entity under the BCAR process or is endemic (>90 per cent of records in the subregion) to the Cumberland subregion. Species that met either of these criteria were treated under the consequence thresholds for critically endangered species even if they had a lower conservation status

- The application of both population impact thresholds and potential habitat impact thresholds. It should be noted that like all threshold approaches the numbers are arbitrary to a degree. However, the thresholds are considered to be appropriate because they:
    - Reflect the nature of the baseline data. In particular the potential habitat mapping which has been generated across the Strategic Assessment Area is precautionary in many cases and over-maps habitat
    - Are structured around conservation status
    - Reflect the expert view of the assessment team about the level of risk to species

The consequence definitions for direct impacts due to impacts to populations and/or potential habitat are set out in:

- Table 30-4, Table 30-5 and Table 30-6 for potential habitat
- Table 30-7for populations

Table 30-4: Consequence definitions for direct impacts to potential habitat for vulnerable species

Potential habitat thresholds	Confidence that species occurs in impact area		
	High	Moderate	Low
Loss of >15% of mapped potential habitat	Extreme	Extreme	Minor
Loss of 10-15% of mapped potential habitat	Extreme	Major	Minor
Loss of 6-10% of mapped potential habitat	Major	Moderate	Negligible
Loss of 2-6% of mapped potential habitat	Moderate	Minor	Negligible
Loss of <2% of mapped potential habitat	Minor	Negligible	Negligible

Table 30-5: Consequence definitions for direct impacts to potential habitat for endangered species

Potential habitat thresholds	Confidence that species occurs in impact area		
	High	Moderate	Low
Loss of >10% of mapped potential habitat	Extreme	Extreme	Minor
Loss of 7-10% of mapped potential habitat	Extreme	Major	Minor
Loss of 3-7% of mapped potential habitat	Major	Moderate	Negligible
Loss of 1-3% of mapped potential habitat	Moderate	Minor	Negligible
Loss of <1% of mapped potential habitat	Minor	Negligible	Negligible

Table 30-6: Consequence definitions for direct impacts to potential habitat for critically endangered, SAII* and/or endemic species**

Potential habitat thresholds	Confidence that species occurs in impact area		
	High	Moderate	Low
Loss of >5% of mapped potential habitat	Extreme	Extreme	Minor
Loss of 2-5% of mapped potential habitat	Extreme	Major	Minor
Loss of 1-2% of mapped potential habitat	Major	Moderate	Negligible
Loss of 0.5-1% of mapped potential habitat	Moderate	Minor	Negligible
Loss of <0.5% of mapped potential habitat	Minor	Negligible	Negligible

* SAII = species that are potentially subject to Serious and Irreversible Impacts as identified through the BCAR process

** Endemic = species that are considered endemic to Cumberland subregion because more than 90% of records of the species occur within the subregion

Table 30-7: Consequence definitions for direct impacts to populations

Consequence	TYPE OF IMPACT	MEASURE BY CONSERVATION STATUS		
		Vulnerable	Endangered	Critically endangered or SAII* or endemic**
Extreme	• Impacts to known population, OR	• Loss of 2 or more important populations	• Loss of 2 or more populations	• Loss of 1 or more populations
	• Impacts to population at edge of occurrence	• Loss of 1 important population at edge of occurrence	• Loss of 1 population at edge of occurrence	• Loss of records within a population at the edge of occurrence
Major	• Impacts to known population, OR	• Loss of 1 important population	• Loss of 1 population	• Loss of records within a population
	• Impacts to population at edge of occurrence	• Loss of records within an important population at the edge of occurrence	• Loss of records within a population at the edge of occurrence	• N/A
Moderate	• Impacts to known population, OR	• Loss of records within an important population, or the loss of a non-important population	• Loss of records within a population	• N/A
	• Impacts to population at edge of occurrence	• N/A	• N/A	• N/A
Minor	• Impacts to known population, OR	• Loss of records within a non-important population	• N/A	• N/A
	• Impacts to population at edge of occurrence	• N/A	• N/A	• N/A
Negligible	• Impacts to known population, OR	• N/A	• N/A	• N/A
	• Impacts to population at edge of occurrence	• N/A	• N/A	• N/A

* SAII = species that are potentially subject to Serious and Irreversible Impacts as identified through the BCAR process

** Endemic = species that are considered endemic to Cumberland subregion because more than 90% of records of the species occur within the subregion

LIKELIHOOD AND CONSEQUENCE DEFINITIONS FOR FRAGMENTATION IMPACTS

Likelihood

Table 30-8 sets out a matrix for determining the likelihood that a threatened fauna species will be impacted by fragmentation. The two axes of the matrix are:

- Barrier likelihood which represents a judgement about how likely a particular development will disrupt connectivity for a species. Table 30-9 provides examples of different barrier likelihoods
- Fragmentation type which sets out how a species may be impacted. Table 30-10 provides criteria for fragmentation types

Table 30-8: Likelihood definitions for fragmentation

	FRAGMENTATION TYPE (see Table 30-10)			
BARRIER LIKELIHOOD (see Table 30-9)	**Certain impact within population**	**Likely impact within population OR certain impact between populations**	**Possible impact between populations OR likely impact to habitat connected to a population**	**Impact to mapped habitat only**
Certain barrier	Almost certain	Almost certain	Likely	Possible
Likely barrier	Almost certain	Likely	Possible	Possible
Possible barrier	Likely	Likely	Possible	Unlikely
Unlikely barrier	Possible	Possible	Unlikely	Unlikely

Table 30-9: Examples of barrier likelihood

Barrier likelihood	**Examples**
Certain barrier	• If species thought to be unable to cross barriers >100 m, a 1 km barrier is inconsistent with dispersal requirements • If species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with little to no vegetation (such as high density urban and/or commercial areas) is inconsistent with dispersal requirements • If species is highly susceptible to being impacted by major roads with high traffic density (either through high roadkill rates, through aversion to noise and light, or through aversion to crossing open spaces) a major road is inconsistent with dispersal requirements
Likely barrier	• If species thought to be unable to cross barriers >100 m, a 300 m barrier is likely to be inconsistent with dispersal requirements • If species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with sparse vegetation (such as low to moderate density urban areas with gardens) are likely to be inconsistent with dispersal requirements • If species is thought to be susceptible to being impacted by major roads with high traffic density (either through moderate roadkill rates, through moderate aversion to noise and light, or through moderate aversion to crossing open spaces) a major road is likely to be inconsistent with dispersal requirements
Possible barrier	• If species thought to be unable to cross barriers >100 m, a 150 m barrier may be inconsistent with dispersal requirements • If species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with sparse vegetation (such as rural residential areas and agricultural areas) may be inconsistent with dispersal requirements

Barrier likelihood	Examples
	• If species is thought to have potential to be impacted by major roads with high traffic density (either through possible roadkill occurrences, possible aversion to noise and light, or through possible aversion to crossing open spaces), a major road may be inconsistent with dispersal requirements
Unlikely barrier	• If species thought to be unable to cross barriers >100 m, barrier of <100 m is unlikely to be inconsistent with dispersal requirements • If species requires continuous or semi-continuous vegetated areas for dispersal (e.g. to provide shelter for fauna or to support pollinator populations), areas with moderate vegetation density (such as parks, nature reserves and vegetated areas) are unlikely to be inconsistent with dispersal requirements • If species is not known to be impacted by major roads with high traffic density (the species is not known to be susceptible to roadkill, noise or light aversion, or aversion to open spaces), then a major road is unlikely to be inconsistent with dispersal requirements

Table 30-10: Criteria for fragmentation types

Fragmentation type	Criteria
Certain impact within population	• Barrier is placed between records of a single population, with high confidence in the accuracy of the records
Likely impact within population **OR** **certain impact between populations**	• Barrier is placed between records of a single population, with some uncertainty in the accuracy of the records, OR • Barrier is placed in mapped potential habitat between records of two or more different populations, with high confidence in the accuracy of the records
Possible impact between populations OR likely impact to habitat connected to a population	• Barrier is placed in mapped potential habitat between records of two or more different populations, with some uncertainty in the accuracy of the records, OR • Barrier is placed in mapped potential habitat, where the mapped habitat is in the vicinity of, or connected to, only one known population of the species
Impact to mapped habitat only	• Barrier is placed in mapped potential habitat, where the mapped habitat is not connected to any known populations of the species

Consequences

Consequence was determined by considering fragmentation type and applying different criteria depending on the conservation status of the species.

Table 30-11: Consequence definitions for fragmentation

Consequence	Fragmentation type	Criteria for vulnerable	Criteria for endangered	Criteria for critically endangered or SAII* or endemic**
Extreme	Internal fragmentation	• Internal fragmentation of two or more important populations, OR • Internal fragmentation of an important population at edge of occurrence	• Internal fragmentation of two or more populations, OR • Internal fragmentation of a population at edge of occurrence	• Internal fragmentation of one population
	Fragmentation between populations	• Fragmentation between populations, which impacts an important population at the edge of occurrence	• Fragmentation between populations, which impacts a population at the edge of occurrence	• Fragmentation between populations, which impacts a population at the edge of occurrence, OR • Fragmentation between populations, which impacts two or more populations which are not at the edge of occurrence
	Fragmentation between a population and potential habitat	• N/A	• N/A	• N/A
	Fragmentation of potential habitat	• N/A	• N/A	• N/A
Major	Internal fragmentation	• Internal fragmentation of one important population	• Internal fragmentation of one population	• N/A
	Fragmentation between populations	• Fragmentation between populations, which impacts two or more important populations which are not at the edge of occurrence	• Fragmentation between populations, which impacts two or more populations which are not at the edge of occurrence	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one important population, where the population is separated from a large area of connected mapped potential habitat	• Fragmentation of one population, where the population is separated from a large area of connected mapped potential habitat, OR	• Fragmentation of one population, where the population is separated from a large area of connected mapped potential habitat, OR

Consequence	Fragmentation type	Criteria for vulnerable	Criteria for endangered	Criteria for critically endangered or SAII* or endemic**
			• Fragmentation of two or more populations, where each population is connected to either a moderate or small area of connected mapped potential habitat	• Fragmentation of two or more populations, where each population is connected to either a moderate or small area of connected mapped potential habitat
	Fragmentation of potential habitat	• N/A	• N/A	• Fragmentation of a large area of potential habitat with no associated records
Moderate	Internal fragmentation	• Internal fragmentation of two or more non-important populations	• N/A	• N/A
	Fragmentation between populations	• Fragmentation between populations, which impacts one important population and one or more non-important populations not at the edge of occurrence	• N/A	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one important population, where the population is separated from a moderate area of connected mapped potential habitat	• Fragmentation of one population, where the population is separated from a moderate area of connected mapped potential habitat	• Fragmentation of one population, where the population is separated from a moderate area of connected mapped potential habitat
	Fragmentation of potential habitat	• Fragmentation of a large area of potential habitat with no associated records	• Fragmentation of a large area of potential habitat with no associated records	• Fragmentation of a moderate area of potential habitat with no associated records
Minor	Internal fragmentation	• Internal fragmentation of one non-important populations	• N/A	• N/A
	Fragmentation between populations	• Fragmentation between populations, which impacts two or more non-important populations not at the edge of occurrence	• N/A	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one important population, where the population is separated from a small area of	• Fragmentation of one or more populations, where the population is	• Fragmentation of one population, where the population is separated

Consequence	Fragmentation type	Criteria for vulnerable	Criteria for endangered	Criteria for critically endangered or SAII* or endemic**
		connected mapped potential habitat, OR • Fragmentation of one or more non-important population, where the population is separated from a large area of connected mapped potential habitat	separated from a small area of connected mapped potential habitat	from a small area of connected mapped potential habitat
	Fragmentation of potential habitat	• Fragmentation of a moderate area of potential habitat with no associated records	• Fragmentation of a moderate area of potential habitat with no associated records	• Fragmentation of a small area of potential habitat with no associated records
Negligible	Internal fragmentation	• N/A	• N/A	• N/A
	Fragmentation between populations	• N/A	• N/A	• N/A
	Fragmentation between a population and potential habitat	• Fragmentation of one or more non-important populations, where the population is separated from a moderate or small area of connected mapped potential habitat	• N/A	• N/A
	Fragmentation of potential habitat	• Fragmentation of a small area of potential habitat with no associated records, OR • Fragmentation of mapped habitat, where impacted habitat occurs outside of the known range of the species	• Fragmentation of a small area of potential habitat with no associated records, OR • Fragmentation of mapped habitat, where impacted habitat occurs outside of the known range of the species	• Fragmentation of mapped habitat, where impacted habitat occurs outside of the known range of the species

* SAII = species that are potentially subject to Serious and Irreversible Impacts as identified through the BCAR process

** Endemic = species that are considered endemic to Cumberland subregion because more than 90% of records of the species occur within the subregion

30.3.5 RISK APPROACH FOR WIDE-RANGING SPECIES

An amended risk assessment approach was applied for wide-ranging species. This reflected the difference in how wide-ranging species use habitat.

LIKELIHOOD

Table 30-12 sets out the definitions for the likelihood that a wide-ranging fauna species will be subjected to substantial impacts. "Substantial" in this case is defined as impacts that could materially affect the species' use of the Strategic Assessment Area.

These definitions:

- Draw on the baseline data for the species in terms of records and potential habitat mapping
- Consider the scale of impacts to records and potential habitat mapping. Strict definitions of "major", "moderate" and "minor" impacts are not provided as they are species specific in relation to the baseline data. Judgements about how to categorise the scale of impacts were instead determined based on the expert judgement of the assessment team who created the baseline data

Table 30-12: Likelihood definitions for direct impacts for wide ranging species

Likelihood	Definition
Almost certain	• Impacts to breeding or roosting habitat
Likely	• No impacts to breeding or roosting habitat • Major impacts to foraging habitat
Possible	• No impacts to breeding or roosting habitat • Moderate impacts to foraging habitat
Unlikely	• No impacts to breeding or roosting habitat • Minor impacts to foraging habitat

CONSEQUENCES

Consequence was determined by separately considering impacts to potential habitat as well as any impacts to known populations. The highest ranking of consequence was then taken for a species.

Consistent with the approach for restricted species, the criteria for determining consequence were based on a range of factors including:

- Conservation status. Impact thresholds for consequence were smaller for critically endangered species than for endangered species, and smaller for endangered species than for vulnerable species
- If the species is considered to be an SAII entity under the BCAR process or is endemic (>90 per cent of records in the subregion) to the Cumberland subregion. Species that met either of these criteria were treated under the consequence thresholds for critically endangered species even if they had a lower conservation status
- The application of potential habitat impact thresholds. It should be noted that like all threshold approaches the numbers are arbitrary to a degree. However, the thresholds are considered to be appropriate because they:
    - Reflect the nature of the baseline data. In particular the potential habitat mapping which has been generated across the Strategic Assessment Area is precautionary in many cases and over-maps habitat
    - Are structured around conservation status
    - Reflect the expert view of the assessment team about the level of risk to species

Table 30-13: Consequence definitions for impacts to wide ranging species

Consequence	TYPE OF IMPACT	MEASURE BY CONSERVATION STATUS		
		Vulnerable	**Endangered**	**Critically endangered or SAII* or endemic****
Extreme	• Impacts to core breeding or roosting area, OR	• Loss of a core breeding or roosting area	• Moderate impacts to a core breeding or roosting area	• Any impacts to a core breeding or roosting area
	• Impacts to mapped potential habitat	• Loss of >15% of mapped potential habitat	• Loss of >10% of mapped potential habitat	• Loss of >5% of mapped potential habitat
Major	• Impacts to core breeding or roosting area, OR	• Major impacts to a core breeding or roosting area	• Minor impacts to a core breeding or roosting area	• N/A
	• Impacts to mapped potential habitat	• Loss of 10-15% of mapped potential habitat	• Loss of 7-10% of mapped potential habitat	• Loss of 2-5% of mapped potential habitat
Moderate	• Impacts to core breeding or roosting area, OR	• Moderate impacts to a core breeding or roosting area	• N/A	• N/A
	• Impacts to mapped potential habitat	• Loss of 6-10% of mapped potential habitat	• Loss of 3-7% of mapped potential habitat	• Loss of 1-2% of mapped potential habitat
Minor	• Impacts to core breeding or roosting area, OR	• Minor impacts to a core breeding or roosting area	• N/A	• N/A
	• Impacts to mapped potential habitat	• Loss of 2-6% of mapped potential habitat	• Loss of 1-3% of mapped potential habitat	• Loss of 0.5-1% of mapped potential habitat
Negligible	• Impacts to core breeding or roosting area, OR	• No impacts to a core breeding or roosting area	• N/A	• N/A
	• Impacts to mapped potential habitat	• Loss of <2% of mapped potential habitat	• Loss of <1% of mapped potential habitat	• Loss of <0.5% of mapped potential habitat

* SAII = species that are potentially subject to Serious and Irreversible Impacts as identified through the BCAR process

** Endemic = species that are considered endemic to Cumberland subregion because more than 90% of records of the species occur within the subregion

30.4 MEETING AUSTRALIA'S INTERNATIONAL OBLIGATIONS REGARDING THREATENED SPECIES

To satisfy approval requirements under the EPBC Act (specifically, requirements associated with section 146B and 146K of the Act), the Plan must not be inconsistent with Australia's obligations under:

- The Biodiversity Convention
- The Convention of the Conservation of Nature in the South Pacific (Apia Convention)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This section provides an overview of how the Plan is not inconsistent with these obligations. The remainder of Chapter 30 assesses the relevant threatened fauna species in detail.

30.4.1 BIODIVERSITY CONVENTION

The objectives of the Biodiversity Convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the use of genetic resources.

The conservation of biological diversity is a key priority of the Plan, and is achieved through commitments to avoid and minimise impacts (Commitments 2, 3 and 4), commitments to mitigate indirect impacts (Commitments 5, 6 and 7), commitments to conserve flora, fauna and habitat (Commitment 8, 9, 10, 11, 12, 13 and 14), commitments to manage landscape threats (Commitments 15, 16, 17, 18, 19), and commitments to build knowledge and capacity in the community to bolster conservation efforts (Commitments 20, 21, 22 and 23).

Overall, the Plan is not considered to be inconsistent with the Biodiversity Convention.

30.4.2 APIA CONVENTION

The Apia Convention encourages the creation of protected areas which, together with existing protected areas, will safeguard representative samples of natural ecosystems (including endangered species), as well as superlative scenery, striking geological formations, and regions and objects of aesthetic interest or historic, cultural, or scientific value.

The Apia Convention was suspended with effect from 13 September 2006. While this Convention has been suspended, Australia's obligations under the Convention have been taken into consideration.

The Plan will lead to the creation of multiple new protected areas within the Strategic Assessment Area, which will contribute to the protection of a range of MNES (Commitments 8, 9, 10, 11, 12, 13 and 14). A specific example of this is the creation of the Georges River Koala Reserve (Commitment 10), which will safeguard the iconic Koala population of Southern Sydney. Further, the protection of important biodiversity areas within the Strategic Assessment Area will be increased, through the implementation of new mechanisms such as the new SEPP (Strategic Conservation Planning) and Ministerial Direction.

The Plan is not inconsistent with the Convention which has the general aims of conservation of biodiversity.

30.4.3 CITES

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The Plan is not inconsistent with CITES as the actions under the Plan do not involve international trade.

SPECIES AT HIGH RISK OF DIRECT IMPACTS

30.5 *PHASCOLARCTOS CINEREUS* (KOALA)

30.5.1 INTRODUCTION

Phascolarctos cinereus (Koala) is recognised as one of Australia's most iconic animals. There is an important population of the species in Southern Sydney which is the focus of this assessment. The species is currently listed under the:

- EPBC Act as Vulnerable for the combined populations of Queensland, New South Wales and the Australian Capital Territory
- BC Act as Vulnerable

Note that the Koala has been identified under the Finalised Priority Assessment List (FPAL) for the assessment period commencing 1 October 2020, to assess upgrading the species' status to Endangered under the EPBC Act.

This section provides a detailed EPBC Act assessment of the outcomes for Koalas associated with implementation of the Plan in accordance with the requirements of the ToR. Given the extensive information available for the Koala assessment and the complexity of the issues, it is presented differently and, in more detail, than the other threatened species in this chapter.

It is noted that the risk assessment process set out in the previous section (Section 30.3) was not applied to Koalas as they were considered a high-risk species due to the importance of the Southern Sydney population, and the potential for direct and indirect impacts.

The Koala assessment sets out:

- Background to the species
- The regulatory context for assessing impacts to Koalas under the EPBC Act
- A summary of the baseline information
- Occurrence within the Strategic Assessment Area
- The efforts to avoid and minimise impacts
- The direct and indirect impacts to the species
- The proposed outcomes, commitments and actions to protect Koalas
- A detailed evaluation of the outcome for the species against the statutory and policy requirements
- An overview and evaluation of cumulative impacts
- A conclusion

Hyperlinks to maps are provided throughout the text and are not included directly within the document.

In addition, a detailed set of Koala attachments are provided at the end of the chapter. They include:

- Attachment A – Terminology used in this assessment
- Attachment B – Detailed background information on Koalas

The impact assessment for Koalas in relation to the BC Act requirements is provided in Part 5 of the report.

30.5.2 BACKGROUND TO KOALAS

This section provides an overview of the species, its status in NSW, and the implications of the 2019/20 bushfires. More detailed information is provided at Attachment B.

OVERVIEW

Koalas are arboreal marsupials that are distributed within coastal and inland regions of eastern Australia, from South Australia to northern Queensland.

They are specialist folivores, meaning that they eat leaves and are highly selective in their choice of diet. They are known to eat the leaves of over 100 *Eucalyptus* species and over 30 non-*Eucalyptus* species (including genera such as *Angophora* and *Corymbia*) (OEH, 2018a). However, local Koala populations typically tend to select their diet from only a small number of trees in their local area, with the preferred tree species varying between populations (McAlpine, Rhodes et al., 2008).

Overall, Koalas typically preference trees growing on fertile soils, as fertile soils result in higher leaf nutrient content in trees.

They are territorial animals which exist in complex social networks. Males are more prone to dispersal, whereas female Koalas tend to remain close to natal sites (Houlden, Costello et al., 1999). Male ranges typically tend to be significantly larger than female ranges. The average size of a Koala's home range varies significantly between populations and between different areas and habitats (Office of the NSW Chief Scientist & Engineer, 2016).

Koalas had already undergone a series of population bottlenecks prior to European arrival (likely as a result of glacial/interglacial cycles). They therefore already had low genetic diversity prior to the impacts of European activities on the population (Black, Price et al., 2014). Predicting population trends has its challenges but it is thought that the species has declined across most of its range.

Koala populations have been declining as a result of a diverse number of threats, including (McAlpine, Lunney et al., 2015; OEH, 2017):

- Habitat loss
- Habitat modification and fragmentation
- Predation from domestic and feral dogs
- Vehicle strike
- Fire (particularly increased fire intensity which burns the crown of trees)
- Disease (particularly *Chlamydia*)
- Heat stress through drought and heatwaves
- Climate change (which increases drought and heatwaves, but also alters habitat quality)

STATUS OF KOALAS IN NSW

In December 2016, the Office of the NSW Chief Scientist & Engineer released a Report of the Independent Review into the Decline of Koala Populations in Key Areas of NSW. That report described the status of Koalas in NSW as at 2016. The key findings of the report are as follows (Office of the NSW Chief Scientist & Engineer, 2016):

- Koalas were historically distributed throughout the woodlands and forests of NSW, but have experienced significant declines in both numbers and distribution
- Koala numbers continue to decline despite a range of initiatives to protect them
- Surveys indicate that populations of Koalas have disappeared from many areas (particularly from the southern and western edges of their distribution)
- Estimates at 2016 suggested there were approximately 36,000 Koalas in NSW, representing a 26 per cent decline over the past three Koala generations (15-21 years)
- Across 13 regional Koala populations in NSW, nine Koala populations were estimated to be in decline, three stable and one increasing

A recent comprehensive assessment of the status of Koala in NSW found that between 2001-2018 (the last three Koala generations), the total NSW Koala population declined by a minimum of 28.52 per cent up to a possible 65.95 per cent (Lane, Wallis et al., 2020). The report suggests declines are more likely to have occurred towards the upper estimate, and that the ongoing threats of climate change and high frequency fires will severely threaten the species in NSW over the coming years.

In 2020, a parliamentary inquiry into the current status of Koala populations and habitat in NSW found that (NSW Legislative Council, 2020):

- Following the 2019-2020 bushfires and the general trend of population decline, the estimated number of 36,000 Koalas in NSW is now outdated and unreliable

- Given the current trajectory of Koala populations in NSW, without government intervention the Koala will become extinct in NSW before 2050

IMPLICATIONS OF THE 2019/20 BUSHFIRES

As outlined in Part 1 of this report and Supporting Document G, the 2019/20 bushfires in NSW are unprecedented in their extent and intensity. The fires burned 5.4 million hectares of land in NSW, including 37 per cent of the national park estate and 81 per cent of the Greater Blue Mountains World Heritage Area (DPIE, 2020b).

The fires destroyed large areas of habitat and populations across NSW for multiple species. The fires may increase the significance of the impacts of development under the Plan for some species. Supporting Document G contains a detailed assessment of the species which have potential to be impacted under the Plan which have also been impacted by the 2019/20 fires.

Koalas were identified as one of the species that is likely to have been significantly impacted by the fires. Over 3.5 million hectares, or 25 per cent, of the most suitable koala habitat within NSW is located within fire impacted areas (DPIE, 2020b). It is estimated that over 6,000 koalas in NSW were killed by fires between October 2019 and mid-February 2020. Of a total of nine bioregions within NSW which support extant koala populations, the Sydney Basin bioregion is one of the worst impacted in the state, with 35.9 per cent of the total land surface of the region burnt. The total koala population across the Sydney Basin bioregion is thought to have declined by 21 per cent due to the fires (Lane, Wallis et al., 2020).

The full impact of the fires on biodiversity will not be understood for some time (EES, 2020b). The assessment for Koalas in this report incorporates consideration of the implications of the fires as far as possible.

30.5.3 REGULATORY AND POLICY CONTEXT

EPBC ACT APPROVAL CONSIDERATIONS

Section 146K of the EPBC Act sets out the formal approval considerations in relation to threatened species. In summary, the outcomes of the Plan must:

- Not be inconsistent with:
  - Any of the international agreements relating to threatened species
  - A recovery plan
  - A relevant Threat Abatement Plan
- Have regard for a conservation advice

At present, there is no recovery plan for the species recognised under the EPBC Act or relevant Threat Abatement Plans. The key statutory consideration therefore relates to the conservation advice for Koalas (DSEWPC, 2012a).

OFFICE OF THE NSW CHIEF SCIENTIST & ENGINEER'S ADVICE

In 2019-2021, the NSW Government lodged a series of requests to the Office of the NSW Chief Scientist & Engineer (Chief Scientist), to (Office of the NSW Chief Scientist & Engineer, 2020, 2021b, 2021a):

- Assess the adequacy of proposed developments within southern Sydney with regards to their potential impacts to Koalas
- Identify specific conservation measures which should be required of current proposed developments to protect Koalas
- Identify overarching principles for Koala protection

The Office of the NSW Chief Scientist & Engineer published three reports to respond to the NSW Government's requests:

- Advice on the protection of the Campbelltown Koala population (Office of the NSW Chief Scientist & Engineer, 2020) - referred to as the Chief Scientist Koala Report 2020
- Response to questions about advice provided in the Koala Independent Expert Panel Report 'Advice on the protection of the Campbelltown Koala population' (Office of the NSW Chief Scientist & Engineer, 2021b)

- Advice regarding the protection of koala populations associated with the Cumberland Plain Conservation Plan (Office of the NSW Chief Scientist & Engineer, 2021a) - referred to as the Chief Scientist Koala Advice 2021

An overview of each of the reports is outlined below.

The Plan has been developed with detailed consideration of the Chief Scientist's advice. Appendix B of Sub-Plan B provides a detailed analysis of the Plan with regards to the Chief Scientist Koala Report 2020. Further, the Department has prepared a report which analyses how the Plan meets the conservation principles outlined in the Chief Scientist Koala Advice 2021 ('the Department's response to the Chief Scientist Koala Advice 2021') (DPIE, 2021).

Advice provided by the Chief Scientist has formed an integral component of the evaluation of the Plan presented within this assessment.

Chief Scientist Koala Report 2020

In December 2019, the Minister for Energy and Environment and the Minister for Planning and Public Spaces requested that the Chief Scientist provide advice regarding the following:

- The adequacy of measures for koala conservation proposed by the Gilead development and the consistency of these measures with the NSW Koala strategy
- What, if any, additional conservation measures are considered necessary
- What, if any, site specific measures for koala species should be incorporated into the Cumberland Plain Conservation Plan for the Greater Macarthur Growth Area to support the long-term viability of the koala population
- Whether east-west corridors linking the Nepean and Georges Rivers can contribute to the conservation of the Campbelltown koala population; and, if so, which east-west corridors and what measures should be taken to ensure their effectiveness

It is important to note that the Gilead development is outside the scope of the Plan. Further, with regards to the Plan, the terms of reference request that the Chief Scientist provide recommendations for site-specific measures for GMAC only.

The report provided a series of recommendations, which are summarised as follows:

- Recommendation 1 relates to the establishment of the Georges River Koala Reserve
- Recommendation 2 includes a series of recommendations for the protection of habitat and connectivity within GMAC
- Recommendation 3 includes a series of recommendations regarding required monitoring and adaptive management
- Recommendation 4 relates to disease prevention measures

Appendix B of Sub-Plan B provides a detailed analysis of the Plan with regards to the Chief Scientist Koala Report 2020.

Response to questions about advice provided in the Koala Independent Expert Panel Report 'Advice on the protection of the Campbelltown Koala population' (February 2021)

Following on from the first report ('Chief Scientist Koala Report 2020'), the Department of Planning, Industry and Environment requested clarifications regarding the advice which had been provided to date. The questions which were provided to the Chief Scientist are summarised as follows:

- Question 1 relates to the viability of Corridor A for connectivity (note that management of Corridor A is associated with the Gilead development and is outside the scope of the Plan)
- Question 2 relates to the appropriate methodology for calculating average corridor width
- Question 3 seeks advice on whether vegetation on either side of the Nepean River should be considered as one corridor (with the river in the middle) or as two separate corridors (separated by the river)
- Question 4 seeks clarification on the correct interpretation of Recommendation 2 of the first Chief Scientist report

The Chief Scientist provided responses to these questions in the report titled 'Response to the questions about advice provided in the Koala Independent Expert Panel Report 'Advice on the protection of the Campbelltown Koala population''.

Chief Scientist Koala Advice 2021

In April 2021, the Minister for Planning and Public Spaces and the Minister for Energy and Environment requested that the Chief Scientist provide advice on:

- How to consider the recommendations of the first report 'Chief Scientist Koala Report 2020' in relation to the Plan as a whole (noting that recommendations within the first report were constrained to GMAC only)
- The adequacy of the Plan's koala specific measures in supporting a long-term strategic landscape-scale outcome for koalas across Wilton and GMAC
- Conservation principles for koala protection to be applied by consent authorities at a site scale

The Chief Scientist provided responses to the above in the report titled 'Advice regarding the protection of koala populations associated with the Cumberland Plain Conservation Plan'. Key elements of the responses are as follows:

- The koala specific measures within the draft Plan were found to be broadly adequate
- Comments and suggestions were provided to further improve koala specific measures in the draft Plan to improve the outcome for Koalas
- Principles for Koala protection were identified which relate to:
    - Habitat and connectivity
    - Fauna crossings for linear infrastructure
    - Threat mitigation
    - Disease management
    - Adaptive management

Refer to 'the Department's response to the Chief Scientist Koala Advice 2021' for a detailed analysis of the Plan with regard to the principles identified by the Chief Scientist (DPIE, 2021).

Additional instruments and policies in place which relate to Koala

The overall regulatory and policy framework surrounding Koala conservation in NSW is complex, with multiple layers of overlapping instruments, all of which aim to provide for the protection and preservation of the species.

There are multiple instruments and policies in place that regulate and guide Koala conservation activities within NSW. These documents provided a framework for assessing the impacts and commitments for Koalas. They are:

- Conservation Advice for the species
- EPBC Act Koala referral guidelines
- Conserving Koalas in the Wollondilly and Campbelltown Local Government Areas
- Draft Conservation Advice for the species (released for public consultation in 2021)
- Draft Recovery Plan for the species (released for public consultation in 2021)
- NSW Koala recovery plan (not a statutory document under the EPBC Act)
- Koala Habitat Protection SEPP 2021
- Saving our Species program for Koalas
- NSW Koala strategy
- Campbelltown Comprehensive Koala Plan of Management

Table 30-14 provides an overview of the above instruments and policies.

Evaluation approach

The evaluation at the end of this analysis draws together the information from the Koala assessment to provide a robust way of:

- Understanding the predicted outcomes for the Southern Sydney Koala population due to implementation of the Plan
- Determining acceptability of the Plan for Koalas in an EPBC Act context

The evaluation is based on posing a series of questions that are structured around:

- The outcome for Koalas specified in the Plan
- The key regulatory and policy documents:
    - Advice provided by the Office of the NSW Chief Scientist & Engineer, contained within the following reports:
        - Advice on the protection of the Campbelltown Koala population (Office of the NSW Chief Scientist & Engineer, 2020)
        - Response to questions about advice provided in the Koala Independent Expert Panel Report 'Advice on the protection of the Campbelltown Koala population' (Office of the NSW Chief Scientist & Engineer, 2021b)
        - Advice regarding the protection of koala populations associated with the Cumberland Plain Conservation Plan (Office of the NSW Chief Scientist & Engineer, 2021a)
    - Principles from Conserving Koalas in Wollondilly and Campbelltown Local Government Areas (DPIE, 2019a)
    - EPBC referral guidelines for Koalas (DoE, 2014k)
    - The Koala Conservation Advice (DSEWPC, 2012a)

The results of the evaluation are presented at Section 30.5.9.

Table 30-14: Overview of the key regulatory and policy documents for Koalas in NSW

Document	Type	Description
Commonwealth Documents		
Approved Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (Koala Northern Designatable Unit) (DSEWPC, 2012a)	EPBC Act statutory document	The purpose of this document is to provide guidance on immediate recovery and threat abatement activities that can be undertaken to ensure the conservation of the listed species. It provides an overview of broad-scale conservation advice for Koalas across NSW, QLD and the ACT, through distilling key findings of a range of other publications concerning Koala conservation. Given its very broad scope and the diversity of conservation needs of Koala populations across the species' range, the document recognises that in many cases, other more detailed and targeted reports are likely to be more applicable at local and regional scales. Regard for the Conservation Advice in developing the Plan is a statutory consideration under the EPBC Act.
EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DoE, 2014k)	EPBC Act policy document	The purpose of this document is to provide guidance to proponents undertaking impact assessments for the Koala, in accordance with a nationally consistent assessment framework and in accordance with assessment requirements outlined by the EPBC Act. These guidelines are a key document underpinning the current impact assessment of Koalas. The guidelines provide a range of definitions and assessment criteria which have been considered, including: • Definition of 'habitat critical to the survival of the species' • Definition of impacts that 'substantially interfere with the recovery of the species' • A suite of criteria around assessing impacts • Determining the requirements for implementation, monitoring and duration of mitigation measures
Draft Conservation Advice - contained within the document 'Consultation on Species Listing Eligibility and Conservation Actions *Phascolarctos cinereus* (Koala) (DAWE, 2021b)	Draft EPBC Act statutory document released for public consultation	The Koala is currently an FPAL species, with its listing proposed to be upgraded to Endangered. As part of the assessment process for the proposed upgrading of the species' listing, this draft Conservation Advice has been released, containing updated information regarding the species' conservation priorities. If approved, this draft Conservation Advice is expected to replace the currently approved Conservation Advice. This draft document provides information on the species' conservation status, ecology, conservation, and recovery actions.

Document	Type	Description
Draft National Recovery Plan for the Koala *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DAWE, 2021c)	Draft EPBC Act statutory document released for public consultation	The overall goal of the draft Recovery Plan is to "reverse the trend of decline in population size of the listed Koala, by having resilient, connected and genetically healthy metapopulations across its range, and to increase the extent, quality and connectivity of habitat occupied". The draft Recovery Plan contains three specific objectives: 1. The area of occupancy and size of populations that are declining, suspected to be declining and predicted to decline are increased 2. Metapopulation processes are maintained or improved 3. Communities and individuals have a greater role and capability in Koala conservation and management The document outlines national actions for Koala conservation at the metapopulation and population level. The national-level approach will identify areas for priority investment and action, which will improve coordination between State-level and local level actions, and will maximise long-term population recovery. The draft Recovery Plan also provides principles for State-level and local-level governments to support the recovery of Koala populations.
NSW Documents		
Conserving Koalas in Wollondilly and Campbelltown Local Government Areas (DPIE, 2019a)	NSW guidance document	The document provides key ecological context and information for the Southern Sydney population of Koalas around Wollondilly and Campbelltown LGAs. This includes habitat and corridor mapping based on recent Koala tracking. The document sets out four key principles for managing Koalas in the context of residential and urban development Wilton and GMAC. The principles aim to ensure an ongoing healthy population and are: 1. Avoid new residential development within core Koala habitat and primary corridors 2. Separate residential development and Koala populations to minimise ongoing threats from domestic dogs and vehicles 3. Identify critical revegetation zones that will augment and strengthen core habitat and corridors 4. Identify Koala roadkill hotspots requiring roadkill mitigation fencing and/or underpasses to allow safe passage of Koalas

Document	Type	Description
Recovery plan for the Koala (*Phascolarctos cinereus*) (DECC, 2008b)	NSW statutory document	The objective of the Recovery Plan is "to reverse the decline of the Koala in NSW, to ensure adequate protection, management and restoration of Koala habitat, and to maintain healthy breeding populations of Koalas throughout their range." This document has been considered as a background document to help to identify key management considerations regarding the protection of Koalas. The Recovery Plan was originally intended to be implemented over a five-year period commencing in 2008 and reviewed at the conclusion of the five-year period. However, this review did not occur.
State Environmental Planning Policy (Koala Habitat Protection) 2021	NSW planning instrument	The aim of the SEPP is to "…encourage the conservation and management of areas of natural vegetation that provide habitat for Koalas to support a permanent free-living population over their present range and reverse the current trend of Koala population decline" The SEPP includes development control requirements within areas of koala habitat, and outlines the requirements for the preparation of koala plans of management (KPOMs). This SEPP does not apply to land on which biodiversity certification has been conferred, and is in force, under Part 8 of the NSW BC Act.
Securing the Koala in the wild in NSW for 100 years: Saving Our Species Iconic Koala Project 2017-2021 (OEH, 2017g)	NSW funding program for threatened species	The Saving Our Species Iconic Koala Project (SOS Project) aims to secure the Koala in the wild in NSW for 100 years by reducing critical threats to the species, ensuring adequate protection, management and ecological restoration of Koala habitat, and maintaining healthy breeding populations of Koalas through their current range. The SOS Project aims to achieve these objectives through coordinating and funding a range of actions across NSW, including conservation, ecological restoration, research and strategic management actions. This assessment draws upon findings obtained through field surveys and associated research which have been funded and implemented by the SOS Project.
NSW Koala Strategy (OEH, 2018h)	NSW policy document	The NSW Koala Strategy aims to stabilise and increase Koala numbers over the long term, ensuring genetically diverse and viable populations across NSW. The Strategy provides additional resources to enable the completion of a range of actions to assist in conserving the Koala. It builds on the findings of, complements the works undertaken, as part of the SOS Project. This assessment draws upon findings obtained through research sponsored by the NSW Government's investment in conserving Koala populations in the wild.

Document	Type	Description
Campbelltown Comprehensive Koala Plan of Management (Phillips, 2018)	Campbelltown City Council planning document	This is a planning document in relation to the Koala Habitat Protection SEPP. It aims to provide a consistent, landscape-based approach to matters relating to how Koalas and their habitat are managed, and provides a strategic approach to protection, management and ecological restoration of Koala habitat throughout the Campbelltown City Council LGA. It is noted that this document does not apply to land on which biodiversity certification has been conferred, and is in force, under Part 8 of the NSW BC Act.

30.5.4 SUMMARY OF BASELINE INFORMATION

There is a significant amount of information that was used in this assessment. Sources include:

- Literature on the ecology of Koalas
- Species records
- Cumberland subregion species distribution model
- Habitat mapping
- Connectivity analysis

Further details are provided at Attachment B and in Chapter 11, Section 11.5.4.

LITERATURE ON THE ECOLOGY OF KOALAS

Literature on the ecology of Koalas was used to understand the broad context for the species, and the specific values and issues of the Koala populations. Information was gathered from academic publications, government research (e.g. information from the Saving our Species program), planning documents, and studies done specifically for this project.

The work had a particular focus on the Southern Sydney Koala population. For example, information about the population is available regarding:

- Koala home range sizes and densities (DPIE, 2019a; Ward, 2002)
- Potential population size (Biolink, 2016; DPIE, 2019a; Ward, 2002)
- Population trends (Biolink, 2018b; Phillips, 2016)
- Preferred feed tree species (DPIE, 2019; Phillips & Callaghan, 2000; Sluiter, Close et al., 2001; Ward, 2002)
- Habitat connectivity requirements (Biolink, 2018a)
- Population genetics (Kjeldsen, Raadsma et al., 2019; Lee, Zenger et al., 2010)
- Key threats (Phillips, 2016)

The available literature and resources provide a solid foundation with which to understand the key characteristics and conservation needs of the Koalas within (and near) to the Strategic Assessment Area.

SPECIES RECORDS

Koala records within and adjacent to the Strategic Assessment Area were accessed from the NSW BioNet Atlas database.

The BioNet Atlas contains species records within the Plan Area which were obtained during recent research conducted by the Saving Our Species program, and is considered a resource containing contemporary knowledge of Koala distributions within the area.

BioNet records were used in research to assess population trends (Biolink, 2016, 2018b) and identify Koala roadkill locations and hotspots (DPIE, 2019a).

BioNet records have also been used to conduct Species Distribution Model mapping as part of the current assessment process (discussed below).

HABITAT MAPPING

Three types of Koala habitat mapping were prepared for this assessment. They are:

- A species distribution model
- Corridor mapping in a way that is consistent with EES work in the area (DPIE, 2019a)
- Mapping of habitat critical to the survival of the species in accordance with the EPBC Act referral guidelines (DoE, 2014k)

See Chapter 11, Section 11.5.4 for details of the mapping approaches.

Species distribution model

RMIT (see Supporting Document F) prepared a species distribution model (SDM) for the Koala across the Cumberland subregion. SDMs are statistical models used to estimate the relationship between species records at sites and the environmental and/or spatial characteristics of those sites. Once this relationship has been estimated, the model can be used to predict other locations in the landscape where a species is likely to occur. The model was developed using the software 'Maxent'.

The SDM provides useful context about the occurrence of the species within the Strategic Assessment Area. However, given the availability of more detailed habitat mapping (see below) it is not used for detailed analysis of impacts.

Corridor mapping

Corridor mapping was undertaken for each of the nominated areas, as well as areas within the vicinity of Wilton and GMAC for the Southern Sydney population. The process was based on work undertaken by EES (DPIE, 2019a). It mapped movement corridors and supporting habitat.

See Table 30-15 for categories within the mapping and definitions (further definitions are provided at Attachment A).

The NSW Threatened Biodiversity Data Collection requires the assessment of impacts on Koala to be determined on the basis of 'important habitat'. Important habitat comprises the species polygons for Koala as required by the BAM (see Part 5). For this BAM assessment, 'important habitat' was defined as primary, secondary and tertiary corridors. It is important to note that this definition has been updated following the public exhibition period. 'Important habitat' was previously considered to be comprised of primary and secondary corridors. This has been updated to include tertiary corridors.

Table 30-15: Habitat definitions for Koala corridor mapping

Habitat category	Definition
Movement corridors	Areas of habitat (often but not always linear) which facilitate the movement and dispersal of Koalas between habitat patches which would otherwise be disconnected
Movement corridors are comprised of:	
• **Primary corridors**	Defined as connected areas of principal habitat (and associated supporting habitat) that provide for ecological function of a population
• **Secondary corridors**	Defined as corridor areas that become narrowed to less than 50 metres wide across the crown width, or that are not connected at both ends
• **Tertiary corridors**	Smaller corridor areas that are not connected at the landscape level
Supporting habitat	The remaining areas of suitable habitat and vegetation structure that are outside principal habitat. Comprises scattered trees peripheral to and outside of identified Koala movement corridors

Habitat critical to the survival

To provide additional information for the assessment, "habitat critical to the survival" of Koalas was mapped in accordance with the EPBC Act referral guidelines for the species (DoE, 2014k). The mapping process was based on scoring criteria and considered the following key parameters in determining the value of Koala habitat:

- Koala occurrence
- Vegetation composition
- Habitat connectivity
- Existing threats
- The value of the potentially impacted Koalas to the recovery of the wider Koala community

CONNECTIVITY ANALYSIS

In addition to habitat mapping, a connectivity analysis conducted by Biolink (Biolink, 2018a) was undertaken for the Southern Sydney population across Wilton and the southern portion of GMAC. The purpose of the assessment was to assess the current habitat connectivity of the area, and then model projected changes following development within the nominated areas and upgrading of Appin Road.

The analysis was undertaken using the modelling software GAPCLoSR.

30.5.5 OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

There are two known populations of Koalas that occur within or near to the Strategic Assessment Area. The most relevant to this assessment is the Southern Sydney population which occurs within and near to Wilton and GMAC. The other is the Blue Mountains population which has infrequent records in the western portion of the Strategic Assessment Area.

This section:

- Presents the results of the mapping for Koalas that has been undertaken across the Strategic Assessment Area
- Provides a high-level summary of each population

HABITAT IN THE STRATEGIC ASSESSMENT AREA

Table 30-16 presents the areas of habitat within the Strategic Assessment Area and the nominated areas using the three types of mapping. There are significant areas of important habitat (and habitat critical to the survival) within and around Wilton and GMAC. This reflects the fact that the area supports an important and recovering population of the species (see below for details about the Southern Sydney population). There is no important habitat (or habitat critical to the survival) for Koalas in GPEC or WSA. This reflects the lack of use of the area by the species and minimal records (see below for details about the Blue Mountains population).

Please refer to the following maps for information about habitat:

- Map 30-14 - Koala species distribution model with records
- Map 30-15 - Koala corridor mapping for WSA and GPEC
- Map 30-16 - Koala corridor mapping for Wilton and GMAC
- Map 30-17- Habitat critical to the survival for Wilton and GMAC

Table 30-16: Habitat for Koalas in the Strategic Assessment Area

OCCURRENCE	SAA TOTAL (Ha)	GPEC (Ha)	WSA (Ha)	GMAC (Ha)	WILTON (Ha)	NOMINATED AREAS TOTAL (Ha)
SPECIES DISTRIBUTION MODEL						
LIKELY HABITAT	3,269.5	0.0	0.0	1,348.2	178.2	1,526.4
POTENTIAL HABITAT	17,787.1	0.1	24.2	2,903.4	1,954.6	4,882.3
SDM TOTAL	**21,056.6**	**0.1**	**24.2**	**4,251.5**	**2,132.8**	**6,408.7**
CORRIDORS						
PRIMARY CORRIDORS	11,872.5	0.0	0.0	1,142.5	1,532.5	2,675.0
SECONDARY CORRIDORS	2,439.1	0.0	0.0	1,173.0	0.0	1,173.0
TERTIARY CORRIDORS	779.7	0.0	0.0	109.4	88.5	197.9
IMPORTANT HABITAT SUBTOTAL*	**15,091.2**	**0.0**	**0.0**	**2,424.9**	**1,621.0**	**4,046.0**
SUPPORTING HABITAT	4,887.7	3,156.3	823.7	612.1	81.5	4,673.6
CORRIDOR TOTAL	**19,978.9**	**3,156.3**	**823.7**	**3,037.0**	**1,702.5**	**8,719.6**

OCCURRENCE	SAA TOTAL (Ha)	GPEC (Ha)	WSA (Ha)	GMAC (Ha)	WILTON (Ha)	NOMINATED AREAS TOTAL (Ha)
HABITAT CRITICAL						
HABITAT CRITICAL TOTAL	14,768.1	0.0	0.0	2,516.7	1,639.8	4,156.5

* Important habitat comprises primary, secondary, and tertiary corridors

SOUTHERN SYDNEY POPULATION

Overview

The Southern Sydney population includes Koalas in the Campbelltown and Wollondilly Local Government Areas. The population is important and thought to be in recovery.

The exact boundaries of the population are unknown. However, it is likely that it extends:

- East to the coast
- South from Holsworthy until it connects with the Koalas in the Southern Highlands
- An unknown distance to the west. It is unclear whether or not the Hume Highway poses a significant barrier to movement

In this report, the population is assessed in the areas between Campbelltown and Bargo (see Map 30-16 and Map 30-17 for the mapped extent of habitat). It is estimated that there were approximately 433 Koalas living in this region prior to the 2019-20 fires (DPIE, 2019a). The majority of the area was not affected by fire. However, some vegetation within the vicinity of Bargo and Tahmoor was burnt (DPIE, 2020a).

The Southern Sydney Koalas prefer habitat on Wianamatta shale soils (due to the high nutrient content of the shale). As these soils are fertile, much of the area has been heavily cleared for agriculture and associated development. This makes remaining areas of vegetation on Wianamatta shale soils a high conservation priority. While Koalas will live in low densities in forests in sandstone areas (e.g. to the east of the Strategic Assessment Area), these areas are considered to be not as important for conservation.

Historically, Koalas in the Campbelltown area have remained free from infection with *Chlamydia.* However, recent research is showing that the disease is moving north from the Southern Highlands towards Campbelltown (Saving Our Species, 2019). This is likely to be a result of increased connectivity between Koalas in these areas.

The Southern Sydney Koalas are exposed to a range of current threats. They include:

- Vehicle strike. This is particularly relevant to major roads in the area and is an increasing issue as traffic volumes increase
- Dog predation. There are a range of existing developed areas and Koalas would be subject to dog attack (particularly where habitat occurs close to houses)
- Disease (particularly *Chlamydia*). This is an emerging issue. The Koalas around Campbelltown have been recognised as disease free. However, Koalas further to the south have been recorded with the disease

See Attachment B for more detail on the population, and the indirect impacts section below for further discussion about threats.

Habitat and connectivity

There are significant areas of important habitat within the area between Campbelltown and Bargo (see Map 30-16). This includes approximately 11,873 ha of primary corridors, 2,439 ha of secondary corridors, and 780 ha of tertiary corridors. As a subset of this, the two nominated areas provide approximately:

- 1,533 ha of primary corridors and 86 ha of tertiary corridors in Wilton. There is no secondary corridor habitat
- 1,143 ha of primary corridors, 1,173 ha of secondary corridors, and 109 ha of tertiary corridors in GMAC

Koala populations rely upon habitat connectivity in order to be viable. Habitat connectivity permits the dispersal of individuals (particularly for the dispersal of young Koalas to new territories and for reproduction during breeding season) and helps to protect Koala populations from localised extinctions following stochastic events such as fire.

The work by EES (DPIE, 2019a) on corridor mapping emphasised the importance of north to south corridors (particularly to the east of Campbelltown and Appin) for the viability of the population. It also identified the areas of east to west connectivity.

Connectivity analysis conducted by Biolink (Biolink, 2018a) supported the importance of north-south connectivity for Koalas through the area. It also emphasised the importance of east-west connection, and analysed the relative importance of east-west corridors which varied according to factors such as their existing width and barriers to movement.

Further discussion about connectivity is provided below in the section on indirect impacts.

Description of key habitat corridors

Given the existing fragmented nature of the landscape of GMAC and Wilton, Koala habitat within these nominated areas acts as habitat corridors for Koalas to traverse the landscape. As outlined previously, corridor mapping was undertaken in accordance with mapping carried out by EES (DPIE, 2019a). It shows the location and relative importance of Koala habitat corridors in Wilton and GMAC.

Of the corridors that were identified, primary corridors are the most well-connected and important. They are considered important for maintaining the viability of the population. Secondary corridors and tertiary corridors still provide connectivity, yet are narrow or discontinuous and so are not as important as primary corridors. Supporting habitat does not constitute important habitat for landscape connectivity. A more detailed overview of corridor mapping is provided in Section 30.5.4 and in Chapter 11, Section 11.5.4.

Map 30-19 indicates the distribution and location of key habitat corridors within Wilton and southern GMAC.

Map 30-19 shows that primary habitat corridors provide for:

- North-south movements to the east of GMAC along the Georges River
- North-south movements along the Nepean River to the west of GMAC
- North-south movements between GMAC and Wilton along Allens Creek and the Cataract River
- North-south and east-west movements through Wilton along the Nepean River

There are several east-west corridors through GMAC which provide crucial linkages between the Nepean River and Georges River habitat corridors. Map 30-19 shows that these east-west corridors are comprised of secondary corridors, interspersed with small areas of supporting and tertiary habitat.

These east-west corridors through GMAC have been named in different ways by different reports. The name of each corridor identified in each report is identified in Table 30-17.

Table 30-17: Names of east-west habitat corridors through GMAC

Chief Scientist (Office of the NSW Chief Scientist & Engineer, 2020)	**EES** (DPIE, 2019a)
Corridor A: Menangle Creek to Noorumba Reserve	Woodhouse-Menangle, Noorumba
Corridor B: Woodhouse Creek to Beluah Reserve	Woodhouse-Menangle
Corridor C: Nepean Creek to Beluah	
Corridor D: Mallaty Creek to Georges River	Ousedale-Mallaty
Corridor E: Ousedale Creek	
Corridor F: Elladale Creek and Simpsons Creek to the colliery	Simpsons-Elladale

Further, the GAPCLoSR report undertakes an analysis of habitat corridors within the vicinity of GMAC and Wilton. The GAPCLoSR report does not provide names for all east-west corridors through GMAC, but instead frames the discussion around habitat patches and locality names. This report identifies important Koala east-west linkages in the vicinity of the Beluah biobanking site, in addition to Appin, Rosemeadow South/Noorumba Reserve and Ousedale-Mallaty (Biolink, 2018a).

BLUE MOUNTAINS POPULATION

Overview

The Blue Mountains Koala population is the closest population to the northern and western parts of the Cumberland subregion. The majority of the population occurs outside the Strategic Assessment Area.

There is less known about the population compared to the Koalas in Southern Sydney. Most of the research on these Koalas has occurred in the Kurrajong/Richmond/Wollemi area and Kanangra-Boyd/Hartley region. Preliminary surveys have also recently begun in the area between Yarramundi in the north and the Southern Highlands in the south.

The population is known to occur from the north of Kurrajong, and is thought to extend down through national parks to the west of the Cumberland subregion. It has high genetic diversity and is important for conservation purposes. However, it is uncertain how many Koalas are in the Blue Mountains. Prior to the 2019/20 bushfires, increased sightings suggested that the population was expanding. This expansion was occurring even though up to one third of the population is infected with *Chlamydia*.

It is thought that the Blue Mountains Koala population was substantially impacted by the 2019/20 bushfires. 81 per cent of the Greater Blue Mountains World Heritage Area was impacted during the fires (DPIE, 2020b). In February of 2020, it was reported that fire had impacted 75 to 100 per cent of four study sites occupied by Blue Mountains Koalas which were being used to research the population, and that it was unknown how many had survived (NSW Legislative Council, 2020). It is unknown what the long-term implications of this are for the population.

Presence in the nominated areas

GPEC and WSA are heavily cleared and urbanised. Neither nominated area has any important Koala habitat, with only relatively small areas of supporting habitat. Further, both nominated areas have significant existing threats to Koalas, including threats posed by roads and high traffic density, roaming and domestic dogs, barriers to movement (such as fences), and landscape hazards (such as swimming pools). There are very few Koala records in either nominated area, which suggests that Koalas are not living there.

Overall, GPEC and WSA do not contain suitable habitat to support resident Koala populations. Therefore, any Koala records in these areas would comprise dispersing Koalas, travelling between areas of suitable habitat. These Koalas are thought to originate from the Blue Mountains Koala population, which is the closest Koala population.

30.5.6 AVOIDANCE

CONTEXT

Avoidance of impacts within the nominated areas was a key process in developing the Plan. Chapter 14 of the assessment report describes this process in detail and provides the overall results.

Design of the urban capable footprints in each nominated area was an iterative process that involved two broad stages:

- Stage 1:
  - Compilation of data on biodiversity values of each nominated area
  - Development of criteria to identify priorities for avoidance of biodiversity values
  - Workshops to apply the avoidance criteria to each nominated area and refine urban capable footprints
  - Consultation with key stakeholders and resolution of issues
  - Finalisation of initial urban capable footprints
- Stage 2:
  - Public exhibition of initial urban capable footprints and consideration of public feedback

- Consideration of advice regarding initial urban capable footprints received from the Office of the NSW Chief Scientist & Engineer
- Further refinement of initial urban capable footprints to improve Koala protection in line with advice from the Chief Scientist and with consideration of public feedback

Importantly for Koala, the species was specifically identified in the avoidance criteria as a priority. Avoiding areas of important habitat or connectivity was a key driver for refining the footprints to reduce impacts. One of the significant results of the Stage 1 avoidance process was the decision by the Department not to allow intensification of development to the east of Appin Road (which was proposed at one point in the process). This decision was specifically made to protect Koalas and facilitate implementation of the Georges River Koala Reserve.

Further avoidance was undertaken in Stage 2, in which additional land was avoided along the Nepean River in both Wilton and GMAC to protect the integrity and functionality of the habitat corridor along the river, and to meet the Chief Scientist's recommendations for average corridor widths.

It is recognised that Stage 2 of the avoidance process for Koala also included avoiding areas of cleared land adjacent to Koala corridors which will be revegetated to widen and support available habitat within the corridors. As these areas are not vegetated, they are not considered to be Koala habitat in their current state. Subsequently, avoidance of these sites is not reflected in the Koala habitat avoidance statistics. However, avoidance and revegetation of these areas will benefit the local Koala population by supporting corridor habitat and increasing the availability of important Koala habitat.

Two types of avoidance of Koala habitat were undertaken (see Chapter 14 of the report for details):

- Avoidance of land because of its biodiversity value
- Avoidance of land for other reasons. For example, land that is not suitable for development such as steep slopes (>18 degrees) or land within riparian corridors (Strahler stream order 2 and above). Due to the nature of this land the areas identified for avoidance often contain areas of biodiversity value

Information is reported for both types of avoidance.

It is important to note that there are a range of lands which were excluded from the avoidance calculations as they were not considered for certification as part of this project. This means that there is additional habitat for Koalas that may not be impacted that is not included in the avoidance figures. The excluded lands include areas:

- Already assessed as part of another development approval (e.g. Bingara Gorge in Wilton)
- Progressing through an alternate development assessment (e.g. Mount Gilead in GMAC)
- Already developed (e.g. existing urban areas, urban land zones)
- Not available for development (e.g. easements, existing protected lands)

Avoidance of land that is currently cleared which will be revegetated to support Koala habitat in the future is reported as potential Koala habitat restoration areas.

RESULTS

The results of the avoidance processes for Koala habitat are presented in Table 30-18. Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

Approximately 2,908 ha of important Koala habitat (primary, secondary and tertiary corridors) was avoided within the nominated areas as part of the urban capable footprint design. This represents approximately 92 per cent of important habitat within the nominated areas (not including excluded lands). 2,222 ha of was avoided for biodiversity purposes.

It is noted that total avoidance of Koala habitat has decreased since public exhibition of the Plan (at public exhibition, total avoidance of primary, secondary and tertiary corridors was 2,927.4 ha). However, the decrease in avoidance is due largely to the transfer of land from the avoided land category to the excluded land category and does not indicate increased impacts to Koala habitat. As discussed below, the total impacts to important Koala habitat between the public exhibition version of the Plan and the current version of the Plan have decreased by 35.9 ha. The decrease in impacts to important Koala habitat reflect the further avoidance which was completed in Stage 2 of the avoidance process following public exhibition.

In terms of habitat critical to the survival of Koalas, approximately 2,923 ha (approximately 91 per cent of the nominated areas total not including excluded lands) was avoided. 2,235 ha of this was avoided for biodiversity purposes.

Further, there is 624.7 ha of land which has been avoided for potential Koala habitat restoration areas. Of this, 154.1 ha was previously located within the urban capable land footprint for the public exhibition version of the Plan. The additional avoidance of this land for Koala habitat restoration occurred following public exhibition and consideration of the Chief Scientist's advice and will contribute to widening and protecting important Koala corridors in Wilton and GMAC.

Table 30-18: Avoidance of Koala habitat across all nominated areas

AVOIDANCE ACROSS ALL NOMINATED AREAS	HABITAT WITHOUT EXCLUDED LANDS	HABITAT AVOIDED FOR BIODIVERSITY PURPOSES		HABITAT AVOIDED FOR OTHER REASONS		TOTAL AVOIDANCE	
	AREA (ha)	AREA (ha)	% HABITAT WITHOUT EXC. LANDS	AREA (ha)	% HABITAT WITHOUT EXC. LANDS	AREA (ha)	% HABITAT WITHOUT EXC. LANDS
CORRIDORS							
PRIMARY CORRIDORS	2,278.0	1,635.0	71.8%	523.4	23.0%	2,158.3	94.7%
SECONDARY CORRIDORS	795.6	537.2	67.5%	152.8	19.2%	690.0	86.7%
TERTIARY CORRIDORS	76.1	49.9	65.6%	9.3	12.3%	59.3	77.9%
IMPORTANT HABITAT SUBTOTAL*	**3,149.7**	**2,222.1**	**70.5%**	**685.5**	**21.8%**	**2,907.6**	**92.3%**
SUPPORTING HABITAT	1,402.5	346.4	24.7%	197.6	14.1%	544.0	38.8%
CORRIDOR TOTAL	**4,552.1**	**2,568.5**	**56.4%**	**883.1**	**19.4%**	**3,451.6**	**75.8%**
HABITAT CRITICAL							
HABITAT CRITICAL TOTAL	**3,226.6**	**2,235.0**	**69.3%**	**687.7**	**21.3%**	**2,922.8**	**90.6%**

* Important habitat comprises primary, secondary, and tertiary corridors

30.5.7 IMPACT ANALYSIS

The plan will lead to direct and indirect impacts to Koalas. These are addressed in the following sections.

The potential for additional impacts due to essential infrastructure and tunnels are also discussed.

DIRECT IMPACTS

Implementation of the Plan will lead to the loss of some habitat for Koalas. Table 30-19 sets out the impacts to habitat across the four nominated areas.

GPEC and WSA

There is no important habitat (or habitat critical to the survival) within GPEC and WSA. Impacts are therefore limited to supporting habitat.

In GPEC, development will result in the loss of approximately 334 ha of supporting habitat, or 10.6 per cent of the total in the nominated area. In WSA, development will result in the loss of approximately 369 ha of supporting habitat, or 44.7 per cent of the total in the nominated area.

There are very limited to no records of the species in either nominated area, and they do not support a viable population of the species. The impacts to supporting habitat are not considered to be notable for Koalas in this context.

Wilton and GMAC

Impacts in Wilton and GMAC occur for all habitat types. Approximately 242 ha of important habitat (120 ha of primary, 106 ha of secondary, and 17 ha of tertiary corridors) will be lost across the two nominated areas. This equates to:

- 4.5 per cent of primary corridors within the two nominated areas (including excluded lands) (or 1.0 per cent of mapped primary corridors for the Southern Sydney population)
- 9 per cent of secondary corridors within the two nominated areas (or 4.3 per cent of mapped secondary corridors for the Southern Sydney population)
- 8.5 per cent of tertiary corridors within the two nominated areas (or 2.2 per cent of mapped tertiary corridors for the Southern Sydney population)

Total impacts to important Koala habitat have reduced since public exhibition of the Plan. Specifically, the area of impact to primary, secondary and tertiary corridors at public exhibition was 278 ha, whereas the current impacts to important Koala habitat is 242.1 ha. The reduction in impacts to important Koala habitat reflects additional avoidance which has been undertaken following public exhibition.

In terms of habitat critical to the survival of Koalas, approximately 304 ha will be lost which equates to 7.3 per cent within the two nominated areas (or 2.1 per cent of mapped habitat critical to the survival for the Southern Sydney population).

There will also be additional impacts to supporting habitat (859 ha).

Direct impacts to primary corridors are the most significant as these corridors provide for ecological function of the population. Impacts to secondary corridors are also of concern as they have the potential to play a supporting role within the landscape. However secondary corridors are considered less important because they:

- Have narrow points (less than 50 m wide) which can create bottlenecks for movement and expose Koalas to greater edge effects, or
- Are not connected at both ends which means they lack important landscape function at the population level

Impacts to tertiary corridors and supporting habitat are less significant from a landscape perspective given they represent smaller, poorly connected, and lower quality habitats.

Table 30-19: Impacts to Koala habitat across the nominated areas

DIRECT IMPACTS TO HABITAT	GPEC		WSA		GMAC		WILTON		TOTAL	
	AREA (ha)	PERCENTAGE of NOMINATED AREA TOTAL (%)	AREA (ha)	PERCENTAGE of NOMINATED AREA TOTAL (%)	AREA (ha)	PERCENTAGE of NOMINATED AREA TOTAL (%)	AREA (ha)	PERCENTAGE of NOMINATED AREA TOTAL (%)	AREA (ha)	PERCENTAGE of NOMINATED AREA TOTAL (%)
CORRIDORS										
PRIMARY CORRIDORS	0.0	N/A	0.0	N/A	19.3	1.7%	100.3	6.5%	119.6	4.5%
SECONDARY CORRIDORS	0.0	N/A	0.0	N/A	105.6	9.0%	0.0	N/A	105.6	9.0%
TERTIARY CORRIDORS	0.0	N/A	0.0	N/A	10.3	9.4%	6.5	7.3%	16.8	8.5%
IMPORTANT HABITAT SUBTOTAL*	**0.0**	**N/A**	**0.0**	**N/A**	**135.2**	**5.6%**	**106.9**	**6.6%**	**242.1**	**6.0%**
SUPPORTING HABITAT	334.1	10.6%	368.6	44.7%	113.4	18.5%	42.5	52.1%	858.5	18.4%
CORRIDOR TOTAL	**334.1**	**10.6%**	**368.6**	**44.7%**	**248.6**	**8.2%**	**149.3**	**8.8%**	**1,100.6**	**12.6%**
HABITAT CRITICAL										
HABITAT CRITICAL TOTAL	**0.0**	**N/A**	**0.0**	**N/A**	**181.0**	**7.2%**	**122.9**	**7.5%**	**303.8**	**7.3%**

* Important habitat comprises primary, secondary, and tertiary corridors

ACCESSIBILITY OF EAST-WEST CORRIDORS THROUGH GMAC

As identified by the Chief Scientist, there are six east-west corridors through GMAC which provide connectivity between the Nepean River and Georges River habitats. Corridor A and B are located within excluded land and are outside the scope of the Plan.

The Plan proposes to protect Corridor E (Ousedale) and Corridor F (Elladale Creek and Simpsons Creek) from threats to Koalas through installing exclusion fencing at the boundary of koala habitat and urban-capable land. These corridors will remain accessible to Koalas for use as habitat and movement corridors through the landscape.

However, Corridor C (Nepean Creek to Beluah) and Corridor D (Mallaty Creek to Georges River) are currently considered too narrow and fragmented to provide safe habitat for Koalas once development occurs within adjacent areas. While the vegetation within these two corridors will be protected as avoided land under the Plan and will provide other biodiversity and amenity values to the region, exclusion fencing will be erected at either ends of these corridors to prevent Koalas from entering the corridors.

The purpose of excluding Koalas from these areas is to protect Koalas from threats and stresses associated with unsuitable and dangerous habitat. Fencing of these corridors is supported by the Chief Scientist (Office of the NSW Chief Scientist & Engineer, 2021a).

As Corridors C and D will be protected as avoided land under the Plan, there is potential that vegetation in these areas may be expanded through revegetation or otherwise enhanced in the future. If this were to occur to achieve suitable corridor width, then there is potential in the future that these corridors may be opened for Koala use once again.

INDIRECT IMPACTS

The following potential indirect impacts have been identified in relation to Koalas:

- Vehicle strike
- Effects of urban development
- Disruption of connectivity
- Fire
- Disease (Chlamydiosis caused by infection with *Chlamydia*)

These impacts reflect the range of activities associated with implementation of the Plan when considered against the known threats to the species.

Given that GPEC and WSA do not support Koalas, the focus of this section is the Southern Sydney population within the vicinity of Wilton and GMAC.

Vehicle strike

Description

Vehicle strike refers to the collision of road-based vehicles (such as cars) and Koalas and can result in the injury or death of the animal. Vehicle strike occurs when Koalas attempt to cross roads, and motorists are unable to avoid them.

Koalas are at risk from vehicle strike due to multiple factors:

- Koalas do not recognise roads and traffic as a potential threat and therefore are likely to cross roads even in dangerous environments
- Koalas are a highly mobile species prone to dispersal, increasing the likelihood of them crossing barriers in search of areas of new habitat
- Koalas are largely nocturnal, which decreases their visibility to motorists whilst crossing roads

Vehicle strikes are most likely to occur where busy roads cut through areas of Koala habitat, as Koalas will attempt to cross the road to reach habitat present on the other side of the road. Increased roadkill is associated with increased human population densities.

Current context

There are a number of major roads which occur within or adjacent to habitat areas occupied by the Southern Sydney Koala population. Vehicle strikes are increasingly common on these roads.

The distribution of Koala roadkill records is shown in Map 30-18. It is recognised that the total number of Koalas killed by vehicle strike is likely to be higher than the number of records, as not every incident would have been recorded.

Analysis of roadkill records shows that the rate has increased over the last few years, and that this increase has corresponded with increasing traffic densities in the region (DPIE, 2019a). Roadkill hotspots were recognised to occur where greater than four Koalas are killed within a 2 km stretch of road. They are located in the following places (DPIE, 2019a):

- Picton Road between Cordeaux Dam and Wilton
- Macarthur Drive
- Eastern end of Wilton Road
- Appin Road between Appin and Campbelltown
- Hume Highway at the Bargo exit

How might development under the Plan contribute to vehicle strike?

The Plan will result in significant areas of new development. This will include roads within the nominated areas and broader transport corridors (noting the latter generally occur away from Koala habitat). The increasing population in the vicinity of the Southern Sydney population will:

- Lead to substantial increases in the number of vehicles
- Require road upgrades to a range of roads that are not directly part of the Plan

Without mitigation, the risk of vehicle strike to Koalas will increase substantially as development proceeds. The Plan includes measures to address this risk which are outlined below in Section 30.5.8 and evaluated in Section 30.5.9.

Effects of urban development

Description

Urban development in proximity to Koala habitat poses a number of threats to Koalas. These threats can impact dispersing Koalas which travel through urban areas, in addition to locally resident Koalas which live nearby. Threats include:

- Increased Koala predation by domestic and roaming dogs. This threat occurs both within urban areas (in which dispersing Koalas are at risk), and in bushland adjacent to urban areas (in which locally resident Koalas are at risk)
- Increased landscape hazards such as swimming pools (in which Koalas may become trapped and drown). This threat poses a risk to dispersing Koalas travelling through urban areas
- Habitat degradation due to increased edge effects from land clearing and increased risk of disturbance (e.g. slashing, pollution, illegal dumping). This threat may reduce habitat quality and poses a risk to locally resident Koalas

Current context

The vegetation in the western boundary of the Southern Sydney Koala population has been extensively cleared, for urban development in the north and primarily for agricultural development in the south. Whilst there is limited information available regarding mortality rates, it is likely that the northern Koalas would be under greater pressure from proximity to urban development than Koalas further to the south.

How might development under the Plan contribute to the effects of urban development?

The Plan will facilitate large scale urban expansion within the nominated areas. Without mitigation, the risk to Koalas associated with urban areas will increase substantially as development proceeds. The Plan includes measures to address this risk which are outlined below in Section 30.5.8 and evaluated in Section 30.5.9.

Disruption of connectivity

Description

Habitat connectivity refers to the degree of connectedness of areas of habitat. Koalas travel through the landscape primarily through wooded areas, spending large amounts of time in trees. Whilst Koalas will descend to the ground level to move between trees, the time they spend on the ground tends to be limited as they are more exposed to predation on the ground.

Well-connected areas of habitat constitute wooded areas to permit the safe passage of Koalas, preferably with feed trees present to meet the physiological needs of the animal. Whilst Koalas are known to move through large distances of open areas, extended travel on the ground increases the risk of exposure to predation. Large open areas are therefore not considered to be suitable habitat to enable safe movement of Koalas.

Greater habitat connectivity allows for unimpeded movement of Koalas, which enables:

- Safe dispersal of juvenile Koalas searching for territory
- Movement of Koalas during the breeding season throughout the landscape, which increases the probability of Koalas successfully finding suitable mates and decreases the risk of inbreeding
- Areas of suitable habitat to be easily accessed
- Escape routes for Koalas in the event of stochastic threats such as bushfire

Habitat connectivity becomes disrupted when barriers to movement are introduced in the landscape. Common examples of movement barriers include cleared areas, busy roads and fences.

Habitat corridors are areas of connectivity which link two or more areas of habitat which would otherwise be separated by barriers. The characteristics of habitat corridors influence the usefulness of the corridor for Koala movements. Thinner corridors have greater exposure to habitat degradation from edge effects and increase the threat of predation by forcing all Koalas to travel through bottleneck points. Corridors with gaps of open space within them also force Koalas to increase the time spent on the ground, which increases vulnerability to predation. Wide, continuous corridors have lesser impacts from edge effects and provide for greater protection of wildlife from predators.

Current context

Disruption of habitat connectivity is an existing threat for Koalas within Wilton and GMAC. Significant areas of land within both nominated areas have already been cleared and there are a number of barriers to movement (e.g. roads). Remaining habitat patches are linked by habitat corridors with varying degrees of connectivity.

The connectivity analysis undertaken by Biolink (Biolink, 2018a) considered how easily Koalas could traverse different landscape types, and then modelled the locations and importance of different habitat corridors in southern GMAC and Wilton. The key findings of the report are as follows:

- North-south connectivity provided by intact habitat to the east of GMAC and Wilton is the most important area of connectivity for the local Koala population
- Habitat associated with the Beluah biobanking site, Appin, Rosemeadow South/Noorumba and Ousedale-Mallaty localities are recognised as being important for providing east-west connectivity across the southern half of GMAC
- Habitat corridors through Douglas Park (between the Wilton and GMAC nominated area boundaries) are of high importance for habitat connectivity

Further, the Chief Scientist Koala Report 2020 (Office of the NSW Chief Scientist & Engineer, 2020) examines the east-west corridors in southern GMAC, and includes:

- Guidance regarding connectivity outcomes which are required to be met
- An evaluation of the relative importance of each corridor for the local Koala population
- A series of management recommendations for each management corridor

The Chief Scientist Koala Report 2020 outlines the following findings and recommendations (Office of the NSW Chief Scientist & Engineer, 2020):

- The most suitable method of achieving landscape connectivity depends on whether habitat corridors contain high levels of threats for Koalas
    - If threats (such as dogs and traffic) can be separated from Koala habitat in east-west corridors, then the preferred management method is to retain east-west corridors
    - If threats cannot be successfully excluded from east-west corridors and Koala populations are observed to decline due the threats, then consideration should be given to excluding Koalas from threatening habitat, and undertaking active management to move Koalas to safer areas and between sites for breeding purposes
- At least two east-west corridors should be maintained through southern GMAC - one in the north (to prevent the northern Nepean River from becoming a 'dead end') and one in the south
    - The northern corridor should be maintained by the Mt Gilead development
    - The southern corridor should be maintained under the Plan
- For the southern corridor, the Ousedale corridor is preferred, followed by Mallaty. Both corridors require revegetation and rehabilitation to be made suitable for use by Koalas. Which corridor is protected depends upon what revegetation and rehabilitation works are achievable
- Currently, not all east-west corridors are suitable to provide connectivity for Koalas (for instance, some are too narrow or are not fully connected)

The Chief Scientist Koala Advice 2021 (Office of the NSW Chief Scientist & Engineer, 2021a) provides further information and advice regarding habitat connectivity for the Southern Sydney koala population. The advice identified 31 principles for koala protection within Wilton and GMAC and surrounds. Relevant principles which relate to connectivity include:

- Principle 2, which encourages retaining, restoring, increasing and protecting koala habitat and reducing fragmentation
- Principle 3, which recommends that Koala habitat has connectivity in multiple directions to prevent the formation of dead ends and enable Koala movement in multiple directions through the landscape
- Principle 5, which recommends that corridors should be widened to an average minimum width of 390-425 m, and should include a buffer on either side
- Three principles (Principle 12, 13 and 14) which relate to requirements and design considerations for fauna crossings for linear infrastructure

The Chief Scientist Koala Advice 2021 also made the following comments and recommendations on the draft Plan regarding habitat connectivity (Office of the NSW Chief Scientist & Engineer, 2021a):

- "The Georges River and Nepean River Corridors, Ousedale Creek habitat and the Elladale Creek habitat in the GMGA are all important for Koala habitat with multiple subpopulation units building resilience into the population"
- "The east-west connectivity function of Ousedale Creek Corridor is important. [However] the Upper Canal could be an impediment to Koalas moving through the Ousedale Corridor. How Koalas will be able to cross the Upper Canal needs to be considered as if Koalas cannot easily cross the Upper Canal, the Ousedale corridor may not adequately provide east-west connectivity"
- "The habitat in Elladale Creek also provides considerable hectares of habitat that is important to conserve, and to maintain linkages to (for Koalas) in the case that transport corridors dissect the unit"
- "Fencing corridors that are too narrow for Koalas (e.g. Corridor C and D) at east-west ends facilitates use by residents, while bushland would be preserved. The Panel agrees with this approach for these Corridors"
- "The overall east-west connectivity should not rely on one corridor. Multiple corridors must be protected"

It is noted that the Chief Scientist Koala Advice 2021 included an evaluation of the draft Plan's conservation measures for Koala and found the measures to be broadly adequate (Office of the NSW Chief Scientist & Engineer, 2021a).

How might development under the Plan contribute to the disruption of connectivity?

Proposed development under the Plan will not result in the loss of primary or secondary habitat corridors through Wilton or GMAC due to land clearing. However, habitat connectivity has the potential to be impacted through:

- Increased threat pressures within or between areas of koala habitat which may prevent koalas from being able to safely move through the landscape. Threats are associated with vehicle strike and the effects of urban development
- Fencing of Koala habitat to separate Koalas from threats, including:
    - Fencing along Appin Road between Rosemeadow and Appin under the Plan
    - Fencing to exclude koalas from areas of habitat with high threat densities from adjacent urban areas

Proposed measures to mitigate potential impacts to connectivity are outlined in Section 30.5.8 and evaluated in Section 30.5.9.

Fire

Description

Fire poses a threat to Koalas through direct mortality from exposure to fire events, and from starvation due to food shortages immediately following fire events.

The fires which pose the most risk to Koalas are high intensity fires which burn the crowns of trees. The intensity of fire events is impacted by available fuel loads, which are influenced by the length of time between fires, and whether fuel management activities (such as slashing) are carried out.

Fires may be caused by natural (such as lightning strikes) and unnatural (such as cigarette butts, campfires or arson) ignitions. Increased proximity of Koala habitat to developed areas increases the likelihood of more frequent fire events due to an increase in exposure to ignition sources.

The risks posed by fire events to Koalas are significantly increased by habitat fragmentation. Connectivity is required to allow:

- Koalas to escape fire events by moving to areas free from fire until the event has passed
- Koalas to re-colonise habitat following a fire event which may have caused a localised extinction within the area

Current context

The Southern Sydney Koala population occurs in extensive areas of bushland, which spans from Holsworthy in the north down to the Southern Highlands, and east to the coast.

Fire management activities occur in various locations within and on the edges of this bushland, which are conducted by various agencies including the NSW National Parks and Wildlife Service and the Rural Fire Service. However, large areas of bushland remain inaccessible, which limits the capacity for fire management and control. As the forested areas are well connected, there is significant potential for fires to easily grow and spread throughout this region.

The 2019-20 bushfires across NSW provide a clear indication that bushfire is an existing and potentially significant threat to the Southern Sydney Koala population.

Habitat connectivity is important for Koala conservation in Wilton and GMAC, to enable Koalas to access escape routes in the event of fire. Habitat corridors through otherwise cleared areas (such as those within and adjacent to Wilton and GMAC) are also important as such areas can serve as refuge sites for wildlife in the event of a bushfire, because such sites can be more easily protected from fire.

How might development under the Plan contribute to the risks of fire?

The Plan will result in significant urban development, which will increase the exposure of Koala habitat to anthropogenic fire sources. This may increase the frequency of fires occurring within Koala habitat and may result in negative impacts to the species without appropriate mitigation measures. The Plan proposes mitigation measures to manage these risks. These are outlined in Section 30.5.8 and evaluated in Section 30.5.9.

Disease (Chlamydiosis caused by infection with *Chlamydia*)

Description

Chlamydia is a bacterium which has a high infection rate in many Koala populations. However, infection with *Chlamydia* does not always lead to the development of disease symptoms. Some Koalas infected with *Chlamydia* will continue to present and act as healthy Koalas, whereas other Koalas will develop disease symptoms as a result of the infection (known as Chlamydiosis). The reasons why disease develops in some situations yet not in others is still being understood.

Chlamydiosis is a serious disease which results in a range of symptoms and can result in Koala infertility and death. McAlpine et al. (2017) found that proximity to urban development increases the risk that Koalas infected with *Chlamydia* will develop Chlamydiosis. It is thought that increased exposure to environmental pressures results in poorer body condition and weakened immune responses, which increases vulnerability to the disease.

Urban development has the potential to increase the severity of the threat posed by *Chlamydia* to Koala populations, by increasing the occurrence of clinical disease symptoms and therefore increasing infertility and mortality rates of Koalas due to *Chlamydia*.

Current context

To date, Koalas in the Campbelltown area are thought to be free of infection with *Chlamydia,* whilst Koalas in the Southern Highlands are known to have high rates of infection. Recent research conducted by Saving Our Species (2019) suggests that *Chlamydia* infection is moving northward from the Southern Highlands towards the Campbelltown locality.

It is unknown how Koalas within the Campbelltown locality will respond to infection with *Chlamydia.* There is potential for there to be significant rates of disease development, as:

- The Koalas in this locality have not previously been exposed to *Chlamydia* and therefore may not have resistance to the infection
- The strains of *Chlamydia* in the Southern Highlands are known to be virulent

Overall, infection with *Chlamydia* and the development of Chlamydiosis is an emerging threat which is likely to place greater pressures on the Southern Sydney Koala population over the next few years.

How might development under the Plan contribute to the risk of disease?

The Plan will introduce a range of pressures associated with urban development to the Koala population of Wilton and GMAC, which increases the susceptibility of Koalas in these localities to developing Chlamydiosis. A range of mitigation measures are recommended to minimise the pressures placed by urban development on Koala populations (as outlined above), in addition to specific measures associated with the monitoring and management of disease. Proposed measures are outlined in Section 30.5.8 and evaluated in Section 30.5.9.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to Koalas from essential infrastructure and tunnels. Refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels
- Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)

Potential impacts from essential infrastructure

In addition to predicted impacts due to urban development, there is the potential for impacts to Koala habitat to occur due to development of essential infrastructure within nominated areas but outside the urban capable lands.

Significant areas of important Koala habitat occur on avoided lands within Wilton and GMAC, but not WSA or GPEC. It is possible that some of this habitat on avoided land within Wilton and GMAC will be impacted by essential infrastructure.

The Plan includes a range of measures to minimise impacts from essential infrastructure on Koalas. Proposed measures are outlined in Section 30.5.8 and evaluated in Section 30.5.9.

Potential impacts from tunnels

Koala habitat does not occur within the vicinity of the tunnel footprints for transport and is therefore not at risk of additional impacts from tunnels.

30.5.8 MEASURES UNDER THE PLAN TO PROTECT KOALAS

OVERVIEW

The Plan includes a range of measures to protect Koalas. These include Koala-specific measures in addition to more general measures which will indirectly benefit Koalas.

Koala-specific conservation measures include:

- A Koala outcome
- Koala-specific commitments and actions
- Koala-specific conservation measures in Appendix E of the Plan
- Protection of Koala habitat within the SCA

In summary, the Koala-specific measures under the Plan aim to:

- Mitigate indirect and prescribed impacts from urban, transport and agricultural development on biodiversity values. This includes actions such as:
    - Installing Koala-exclusion fencing to protect Koala habitat from threats. Fencing will be installed:
        - Between important Koala habitat and certified urban capable land within GMAC and Wilton
        - Along the western alignment of the Georges River Koala Reserve where existing urban development is a threat to Koalas
        - On both sides of Appin Road where it passes through Koala habitat
    - In areas where exclusion fencing is not feasible, applying development controls adjacent to Koala habitat to minimise urban threats to Koalas
    - Establishing a Koala working group, comprised of Koala experts from across government agencies, to provide input on managing Koalas as development proceeds
- Secure and protect habitat and corridors for the species. This includes establishing a new Koala reserve (the Georges River Koala Reserve) to protect north-south movement on the eastern side of Appin Road
- Implement several other actions to improve knowledge about Koalas, build awareness in the community, and support ecological restoration measures

The NSW Government has committed $114 million to deliver priority conservation actions over the first five years of the Plan's implementation. This includes $84 million committed to:

- Restoring habitat, with a focus on Koala habitat
- Establishing reserves and other conservation areas
- Constructing two Koala crossings at Appin Road
- Installing Koala exclusion fencing

Koala-specific mitigation measures within the Plan have been developed with consideration of advice provided by the Chief Scientist. Specifically, Appendix B of Sub-Plan B provides a detailed analysis and response from the Department to recommendations contained within the Chief Scientist Koala Report 2020. Further, 'the Department's response to the Chief Scientist Koala Advice 2021' (DPIE, 2021) addresses how the Plan considers each of the Koala conservation principles outlined in the Chief Scientist Koala Advice 2021.

Further detail regarding each Koala-specific mitigation measure is outlined below.

More broadly, the Plan includes a range of measures which will indirectly benefit Koalas. These more general measures are outlined in detail elsewhere in this Strategic Assessment Report. General measures include:

- Commitments to manage landscape threats. Refer to Chapter 15 for further details of these measures. These include:
  - Commitment 15 to manage weeds
  - Commitment 16 to manage pests
  - Commitment 17 to manage fire
  - Commitment 18 to manage diseases
  - Commitment 19 to manage impacts of climate change
- Monitoring, evaluation and reporting (MER) measures under the Plan. Refer to Chapter 16 for further details of these measures. The MER program will, amongst other things, will provide information about:
  - The status of Koalas in the Southern Sydney population
  - The Plan's progress in meeting its commitments and actions
- Adaptive management measures which will enable improvements to be made to management decisions over the life of the Plan. Refer to Chapter 16 for further details of these measures

Commitments, actions and other measures in the Plan will be delivered through a range of implementation mechanisms, including a new SEPP (Strategic Conservation Planning), a new Ministerial Direction, an updated DCP template, guidelines to manage infrastructure development under the Plan, and an amendment to the EP&A Regulation 2000. Further information on the Plan's implementation package is presented in Chapter 9.

KOALA-SPECIFIC MITIGATION MEASURES

Outcome

The Plan sets out a number of outcomes for biodiversity which are designed to be a "reported or measurable result of the desired goal of the Plan". The outcome for Koalas is as follows:

> *Condition of important koala habitat is improved, connectivity between Koala sub-populations is maintained, threats to Koalas are managed and the Koala population in South Western Sydney persists and thrives*

Commitments and actions

The Plan provides a series of commitments and actions to deliver the outcome for Koalas (see Table 30-20). These outline how Koalas and their habitat will be protected and as part of the Plan's conservation program.

Appendix E

The Plan includes a range of measures to deliver the outcome, commitments, and actions for Koalas (see Table 30-21). These are comprised of design and management requirements to be incorporated into development and ongoing management activities under the Plan.

Table 30-20: Commitments for Koalas (taken from Sub-Plan A and B)

COMMITMENTS	ACTIONS
CONSERVATION PROGRAM	
Commitments to avoid and minimise impacts	
Commitment 2 Avoid and minimise impacts to 4,505 hectares of high biodiversity value area (the avoided land) through strategic planning of the nominated areas. **Commitment 2.1** Limit cumulative direct impacts[1] over the life of the Plan from essential infrastructure to the following EPBC Act-listed threatened ecological community in the avoided land[2]: • Shale Sandstone Transition Forest • Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • River-Flat Eucalypt Forest • Coastal Swamp Oak (Casuarina glauca) Forest • Cooks River Castlereagh Ironbark Forest Western Sydney Dry Rainforest and Moist Woodland on Shale **Commitment 2.2** Prioritise the avoidance of impacts from essential infrastructure on non-certified land to:	1. Introduce an environmental planning instrument to apply development controls to protect important biodiversity on avoided land under the Plan. 2. Prepare a Ministerial Direction under section 9.1 of the *Environmental Planning and Assessment Act 1979* to restrict rezoning of avoided land from its current zone to a zone that permits a more intensive land use. 3. Introduce Cumberland Plain Conservation Plan Guidelines for Infrastructure Development to manage impacts on biodiversity from infrastructure development, including essential infrastructure development, on avoided land in the nominated areas. 4. Monitor the impacts of development on the avoided land through the Plan's reconciliation accounting process. 5. Notify proponents of essential infrastructure of their obligations under the EPBC Act, including when development does not have Part 10 EPBC Act approval under the Plan. **6.** Locate asset protection zones wholly within certified - urban capable land

[1] Impact thresholds for each threatened ecological community per nominated area are listed in the Plan (Table 3, Cumberland Plain Conservation Plan, page 35).
[2] Distributions of these TECs are mapped in the *Cumberland Plain Assessment Report* and will require confirmation of extent through survey or assessment

COMMITMENTS	ACTIONS
... • Important koala corridors within the Wilton and Greater Macarthur Growth Areas to maintain the function of koala movement corridors	
Mitigating indirect and prescribed impacts	
Commitment 7 Mitigate indirect and prescribed impacts from urban, industrial, infrastructure development on the Southern Sydney koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan.	1. Install koala exclusion fencing, including gates and grids, between koala habitat that can safely support koalas and urban land within the Greater Macarthur Growth Area and Wilton Growth Area, except where exclusion fencing is not feasible or necessary due to slope, heritage or water courses. a) Manage impacts to fences by locating koala exclusion fencing at least three metres from any trees where practical (measured from canopy) b) Apply koala specific mitigation actions in accordance with Appendix E c) Where fencing must cross existing or planned linear infrastructure such as gas and electricity transmission, consider appropriate access treatments such as gates to ensure the integrity of the koala exclusion fencing d) Fence off koala corridors that are too narrow to safely support koalas and relocate koalas out of the unsafe corridors if needed. (Commitment 12 Action 1f) e) Address the requirements of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, as essential infrastructure for EPBC Act approval in the avoided land. 2. Complete a feasibility study on the koala exclusion fencing to help inform the design, locations and construction of the fencing and identify fencing priorities for the first five years. 3. Install koala-exclusion fencing along the western alignment of the Georges River Koala Reserve where existing urban development is a threat to koalas. 4. Install koala-exclusion fencing, in the vicinity of koala habitat, along both sides of Appin Road between Rosemeadow and Appin, to mitigate koala vehicle strikes at roadkill hotspots. Fencing along Appin Rd will be in addition to planned fencing works to be delivered by Transport for NSW. 5. Undertake targeted stakeholder and community engagement to support the delivery of koala-exclusion fencing. 6. Establish a koala working group with representation from relevant government agencies to support implementation of the koala commitments and actions. The working group will support implementation of the koala sub-plan, by providing advice to inform: a) alignment, staging, and design of the koala exclusion fencing and fauna crossing, including advice about providing appropriate koala movement corridors b) priority locations and approach for koala habitat restoration

COMMITMENTS	ACTIONS
	c) monitoring and evaluation of the Plan's koala commitments, including providing advice to support adaptive management based on monitoring and evaluation data d) community and stakeholder engagement for the koala conservation commitments and actions e) research and management actions relating to koalas. 7. Work with local councils, NPWS and OSL to ensure the threats posed by dogs on all public land that is identified as koala habitat protected under the Plan, are managed. a) For land that is not publicly accessible, this will include the installation of signs and/or fences b) For land managed as a reserve or for recreation, this will be achieved by incorporating requirements in a relevant Plan of Management. 8. Provide safe fauna crossings, based on current best practice design, across Appin Road and other linear infrastructure by: a) installing a koala underpass culvert under Appin Road, near the intersection with Brian Road to support east-west koala movement from the Georges River to the Nepean River b) augmenting the existing Kings Falls Bridge at the Georges River by constructing a bench adjacent to the bridge abutments, to allow dry passage for koalas (and other fauna) under Appin Road, supporting north–south koala movement from the Georges River Koala Reserve to the southern koala habitat c) investigation options for enhancing koala movement across the Upper Canal d) address the requirements of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development, as essential infrastructure for EPBC Act approval in the avoided land.
Conserving flora, fauna and habitat	
Commitment 9 Protect threatened species likely to be at risk of residual adverse impacts from development under the Plan (target species) in accordance with the Plan's conservation land selection steps. This includes securing offsets to protect known locations for the following target threatened species: ... • 570 hectares of important habitat for *Phascolarctos cinereus.*	1. Assess and record the habitat attributes of where target species have been located and use the information to establish baseline monitoring data for areas of known habitat for target species and incorporate into the evaluation program (Commitment 25). 2. Protect offset locations and species habitat for the target threatened species through establishing reserves or biodiversity stewardship sites or through the direct purchase of species credits in the Cumberland subregion or across NSW. 3. Achieve the Plan's species targets by applying the conservation land selection steps. 4. Identify species-specific management measures for areas of known habitat for target species, in consultation with future land managers of reserves established under the Plan and incorporate these into management plans for the land. 5. Track progress in meeting species offset targets through the reconciliation accounting process (Commitment 25 Action 2).

COMMITMENTS	ACTIONS
Commitment 10 Establish a reserve to protect the north-south koala movement corridor along the Georges River between Appin and Long Point.	1. Transfer and reserve lots identified for early transfer to National Parks and Wildlife Service as the first stage in establishing Georges River Koala Reserve. 2. Reserve additional areas of the Georges River Koala Reserve between Appin and Kentlyn using NSW government land as a priority and by purchasing additional land (Stages 1a and 1b). 3. Reserve additional areas of the Georges River Koala Reserve between Kentlyn and Long Point using NSW government land as a priority and by purchasing additional land (Stage 2). 4. Restore up to 80 hectares of cleared land for koala habitat in priority areas including the Georges River Koala Reserve to strengthen the north-south koala corridor. 5. Restore additional koala habitat within the Georges River Koala Reserve to strengthen the north-south koala movement corridor. 6. Work with NPWS, OSL and other key stakeholders to prepare a concept plan for the Georges River Koala Reserve.
Commitment 12 Protect koala corridors in the Cumberland subregion, including those along the Nepean River, Georges River, Cataract River and Ousedale Creek.	1. Apply development controls to koala habitat protected under the Plan and ensure safe, functional corridors for koala movement (consistent with advice from the Office of the NSW Chief Scientist & Engineer) including: a) the north-south koala corridor along the Georges River (Commitment 10) b) the north-south koala corridor along the Nepean and Cataract rivers c) the east-west corridor along Ousedale Creek between the Georges River and Nepean River d) Elladale Creek and Simpsons Creek as an area of functional koala habitat. e) the north-south koala corridor along Allens Creek f) excluding koalas from east-west corridors that do not meet the minimum requirements for a functional koala corridor (Corridor C: Nepean Creek to Beulah, and Corridor D: Mallaty Creek to Georges River). 2. Restore koala habitat in the Georges River and Ousedale Creek corridors to ensure they meet requirements for safe and functional koala movement corridors, consistent with advice from the Office of the NSW Chief Scientist & Engineer (Commitment 13).
Commitment 13 Deliver and support ecological restoration activities in conservation land including ecological reconstruction of up to a maximum of 25% of the Plan's offset target for native vegetation (Commitment 8). .	4. Deliver ecological restoration (including reconstruction) to restore koala habitat in the Georges River Koala Reserve and other priority locations in the strategic conservation area including along Ousedale Creek and around Appin.

COMMITMENTS	ACTIONS
BUILD KNOWLEDGE AND CAPACITY	
Commitment 20 Provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation including koala conservation.	4. Invest in the *NSW Koala Strategy* to raise awareness of the Southern Sydney koala population and encourage community participation in koala conservation in Western Sydney.
Commitment 22 Invest in research priorities that will support the implementation of the Plan and help to deliver the Plan's outcomes.	2. Support NSW Government programs for threatened species research in Western Sydney including: o research that increases knowledge of population demographics, life-history and ecology of the Southern Sydney koala population, as part of the *NSW Koala Strategy*'s NSW Koala Research Plan
Commitment 23 Support rehabilitation measures to help maintain koala health and welfare.	1. Invest in the *NSW Koala Strategy* and other potential partners to implement the koala health and welfare program in South Western Sydney with key deliverables including: a) monitoring of koalas including key threats and effectiveness of mitigation measures as part of the NSW Koala Strategy Monitoring Framework b) designating the koalas in South Western Sydney as one of the dedicated monitoring sites for the NSW Koala Strategy c) providing enhanced training in wildlife treatment for veterinarians d) providing grants for community wildlife organisations for resources and carer recruitment and training e) establishing health and welfare programs to support koalas from threats including vehicle strike, fire, disease and climate change. 2. Koalas that are captured and/or handled as part of a monitoring program will be vaccinated against chlamydia and have a tissue sample taken for genetic analysis, with the tissue samples lodged with the NSW Koala Biobank.

Table 30-21: Conservation measures for Koala (taken from Appendix E of the Plan)

Development	Mitigation measure	Rationale for measure	Species	Commitment	Implementation mechanism	Location
HABITAT FEATURES AND CONNECTIVITY						
• Urban and Industrial	Design of subdivision layout including perimeter roads, Asset Protection Zones are to reduce impacts to and protect areas of koala habitat	Minimise the potential impacts of precinct operation to koala habitat	Koala	Commitment 7	DCP template Mitigation Measures Guideline	Wilton, GMAC
• Urban and Industrial	Do not plant koala feed trees, as listed in *Koala SEPP Schedule 2 Koala use tree species* in open space and recreation areas	Koala feed trees and/or Endangered Ecological Communities are contained to open space and recreational areas in precinct design in certified urban-capable land	Koala	Commitment 7	DCP template Mitigation Measures Guideline	Wilton, GMAC
PEST/DOMESTIC ANIMALS						
• Urban and Industrial	Dog proof fenced areas are to be designated within open space and public recreation areas	Dog proof fencing provides protection to fauna including koala upfront in precinct design for public spaces	Koala	Commitment 7	DCP template Mitigation Measures Guideline	Wilton, GMAC
• Urban and Industrial	Dog proof fencing is a design requirement for each residential lot in accordance with Council requirements	Dog proof fencing provided protection to fauna including koala upfront in precinct design for residential areas	Koala	Commitment 7	DCP template Mitigation Measures Guideline	Wilton, GMAC
HUMAN DISTURBANCE						
• Urban and Industrial • Infrastructure (including essential infrastructure)	Site assessment and pre-clearance survey to be undertaken prior to removal of vegetation to undertake koala survey and implement translocation plan if required.	At pre-construction phase of development, a translocation plan and koala survey is to protect any koala on site	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC

Development	Mitigation measure	Rationale for measure	Species	Commitment	Implementation mechanism	Location
• Urban and Industrial • Infrastructure (including essential infrastructure)	Temporary protective fencing to be erected around areas identified for conservation on or immediately adjoining the site at pre-construction phase to ensure adequate protection is in place during construction.	Prior to development, at the pre-construction phase, temporary protective fencing is to be erected to protect koala entering the construction site	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC
• Infrastructure (including essential infrastructure)	Where planned linear infrastructure such as gas and electricity transmission crosses existing koala exclusion fencing, consider appropriate access treatments such as gates to ensure the integrity of the koala-exclusion fencing.	Minimises indirect impacts to koala populations due to urban development. This action is consistent with a critical action for this species under Chief Scientist Koala Report (2020)	Koala	Commitment 7	CPCP Guidelines for Infrastructure Development	Wilton, GMAC
• Infrastructure (including essential infrastructure)	Where public road infrastructure crosses koala corridors, ensure that: • Exclusion fencing is in place to prevent koalas from entering the road • Suitable koala connectivity structures are installed to protect corridor integrity	Maintenance of connectivity in koala corridors, and separation of koalas from landscape threats including traffic, are critical actions for this species under the Chief Scientist Koala Report (2020).	Koala	Commitment 7	CPCP Guidelines for Infrastructure Development	Wilton, GMAC
• Urban and Industrial • Infrastructure (including essential infrastructure)	A tree-felling protocol to be implemented to avoid impacts to koalas in trees that are to be cleared.	A tree felling protocol to protect koalas in trees identified to be cleared on site is to provide protection to koala in the identified trees	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC
• Urban and Industrial • Infrastructure (including essential infrastructure)	Roadside vegetation adjacent to koala habitat areas will be managed to minimise the height of ground cover and therefore increase the visibility of any roadside fauna. Turfed areas will be mown, low ground covers will be trimmed mechanically.	Visibility of koala along roadside vegetation is enhanced along motorways and roadsides for koalas crossing roadways	Koala	Commitment 7	DCP template Mitigation Measures Guideline	Wilton, GMAC

Development	Mitigation measure	Rationale for measure	Species	Commitment	Implementation mechanism	Location
• Urban and Industrial • Infrastructure (including essential infrastructure)	An onsite ecologist present though the duration of pre-clearance surveys and clearing works	To protect koalas in trees identified to be cleared on site	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC
• Urban and Industrial • Infrastructure (including essential infrastructure)	Implement traffic calming measures for all development not subject to wildlife and koala exclusion fencing: Apply speed limit restrictions on local roads for areas adjacent to open space and land identified as avoided under CPCP Signpost perimeter roads and roads adjacent to wildlife habitat areas in accordance with Austroads, RMS technical guidelines, Council Guidelines and relevant Australian Standards. Install traffic calming devices such as speed humps and audible surfacing along perimeter roads adjacent to wildlife habitat	To protect koalas adjacent to or along motorways, roadsides and development	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC
• Urban and Industrial • Infrastructure (including essential infrastructure)	Install koala friendly road design structures such as underpasses, fauna bridges and overpasses consistent with any approval conditions. Reference to the RMS Biodiversity Guidelines is to be made.	To protect koalas along motorways and roadsides for koalas crossing roadways	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC

Development	Mitigation measure	Rationale for measure	Species	Commitment	Implementation mechanism	Location
DISEASE						
• Urban and Industrial • Infrastructure (including essential infrastructure)	Strict enforcement of vehicle wash down points for machinery, equipment and tyres prior to entering and leaving the construction site. Hygiene procedures in instances where vegetation pathogens known to affect koala trees may be spread	Minimises the risk of the spread of pathogens due to construction activities adjacent to potential habitat for the species	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC
• Urban and Industrial • Infrastructure (including essential infrastructure)	All vehicles, machinery, maintenance equipment, tyres and work boots should be free of mud, soil and vegetation prior to entering and leaving a development construction site	During the construction and/or operation phase of a development the risk of pathogens and disease spreading is minimised	Koala	Commitment 7	DCP template Mitigation Measures Guideline CPCP Guidelines for Infrastructure Development	Wilton, GMAC
OTHER						
• Urban and Industrial	Areas adjoining koala habitat are to be signposted with signage that indicates koalas are in the area and permitted/prohibited activities and associated penalties that apply for non-compliance	Clear signage in areas adjoining koala habitat promotes permitted activities and educates public	Koala	Commitment 7	DCP template Mitigation Measures Guideline	Wilton, GMAC

Strategic conservation area

As part of delivering commitments to protect and restore land, the Plan is focusing its efforts into the SCA. The method for defining these areas is described in Section 8.5 of Chapter 8.

The SCA (see Map 30-21) include the proposed Georges River Koala Reserve, as well a number of other areas that provide habitat for the species. See Table 30-22 for the areas of Koala habitat in the SCA.

The Georges River Koala Reserve is described in detail in Sub-Plan B: Koalas. The new park covers approximately 1,800 ha and would secure large parts of the north-south primary corridor to the east of Appin Road. It is proposed to be implemented in stages:

- An initial early stage to transfer and reserve lots identified for early transfer to National Parks and Wildlife Service. This stage will be completed within the first two years of the Plan.
- Stage 1 (including Stage 1a and 1b) to reserve additional areas between Appin and Kentlyn. This stage will be completed within the first 10 years of the Plan.
- Stage 2 further north between Kentlyn and Long Point. This stage will be completed within the first 20 years of the Plan

The Georges River Koala Reserve would also provide for ecological restoration of up to 80 ha of cleared land to increase habitat over time and strengthen the north-south movement corridor. Further additional restoration will also occur within existing areas of Koala habitat.

Table 30-22: Koala habitat (ha) in the Strategic Conservation Area

STRATEGIC CONSERVATION AREA	SAA TOTAL	AREA CURRENTLY PROTECTED IN SAA	AREA IN KOALA RESERVE	AREA REMAINING IN SCA	TOTAL AREA IN SCA
CORRIDORS					
PRIMARY CORRIDORS	11,872.5	1,026.7	1,541.5	4,889.0	6,430.5
SECONDARY CORRIDORS	2,439.1	116.4	5.4	1,052.0	1,057.3
TERTIARY CORRIDORS	779.7	0.0	1.1	145.8	147.0
IMPORTANT HABITAT SUBTOTAL*	**15,091.2**	**1,143.0**	1,548.0	**6,086.8**	**7,634.8**
SUPPORTING HABITAT	4,887.7	998.6	5.5	218.4	224.0
CORRIDOR TOTAL	**19,978.9**	**2,141.7**	1,553.5	**6,305.3**	**7,858.8**
HABITAT CRITICAL			0.0		
HABITAT CRITICAL TOTAL	**14,768.1**	**1,131.0**	1,467.8	**6,107.8**	**7,575.6**

* Important habitat comprises primary, secondary, and tertiary corridors

Protected Koala habitat

Protected Koala habitat includes areas of Koala habitat which are a key focus of the Plan for conservation purposes. It is defined as: "Koala habitat that has been included in the Plan's Strategic Conservation Area and/or the avoided land. It includes some areas of cleared land that may be restored to enhance koala corridors and habitat." The distribution of Protected Koala Habitat is shown in Map 30-20, and relevant statistics are outlined in Table 30-23.

Note that the distribution of Protected Koala habitat reflects the areas of Koala habitat which have been specifically identified for use by Koalas under the Plan. For example, Corridor C and Corridor D, despite being mapped as Koala habitat and being avoided by development, are not included as Protected Koala habitat, as these corridors will be fenced off to exclude Koalas. Further, this layer includes cleared areas which may be revegetated in the future to provide habitat for Koalas.

Protected Koala habitat therefore reflects the future distribution of Koala habitat that will be occupied by Koalas under the Plan.

Table 30-23: Protected Koala habitat (ha) under the Plan

	PROTECTED KOALA HABITAT (CURRENT HABITAT)	PROTECTED KOALA HABITAT (POTENTIAL RESTORATION)	TOTAL PROTECTED KOALA HABITAT
HABITAT IN STRATEGIC ASSESSMENT AREA	**7,542.0**	**667.1**	**8.209.2**
HABITAT IN WILTON	1,220.7	219.6	1,440.2
HABITAT IN GMAC	1,538.9	405.7	1,944.6
TOTAL AVOIDED FOR BIODIVERSITY PURPOSES	2,072.0	601.6	2,673.6
TOTAL AVOIDED FOR OTHER PURPOSES	656.5	20.1	676.6
EXCLUDED LAND	31.0	3.6	34.7
HABITAT IN NOMINATED AREAS	**2,759.6**	**625.3**	**3,384.9**
AREA IN SCA	**7,485.7**	**686.9**	**8,127.6**
AREA TO BE PROTECTED IN GEORGES RIVER KOALA RESERVE	**1,553.5**	**278.7**	**1,832.2**

30.5.9 EVALUATION OF KOALA IMPACTS AND PROTECTIONS UNDER THE PLAN

The evaluation draws together the information from the Koala assessment to provide a way of understanding the predicted outcomes for the Southern Sydney Koala population due to implementation of the Plan. It also provides an evaluation against the relevant EPBC Act approval considerations.

The evaluation is based on understanding:

- If the outcomes for Koala specified in the Plan will be delivered?
- If the Plan addresses recommendations outlined in the Chief Scientist reports?
- If the Plan addresses the EES principles from *Conserving Koalas in Wollondilly and Campbelltown LGAs*?
- If the Plan addresses the EPBC referral guidelines for Koalas?
- If the Plan has had regard for the Koala Conservation Advice?

To address these questions, the evaluation is structured around the following issues:

- Avoidance of impacts
- Extent and quality of habitat
- Landscape connectivity
- Level of threat
- Impacts from essential infrastructure
- Adaptive management

This evaluation is complemented by the Department's analysis of the Plan with regards to the Chief Scientist Koala Report 2020 and the Chief Scientist Koala Advice 2021, which are presented in Appendix B of Sub-Plan B and 'the Department's response to the Chief Scientist Koala Advice 2021'(DPIE, 2021) respectively.

AVOIDANCE OF IMPACTS

As outlined in Chapter 14 and in Section 30.5.6, avoidance of impacts to Koala habitat was a key part of the process for developing the Plan. Design of the urban capable footprints in Wilton and GMAC was specifically guided by efforts to avoid impacts to Koala habitat which resulted in:

- More than 92 per cent of important habitat (not including excluded lands) being avoided within the two nominated areas
- Impacts being constrained to the edges of corridors within the nominated areas rather than cutting through any of the corridors

Following public exhibition of the Plan, further avoidance was undertaken to minimise impacts to important Koala habitat, increase opportunities for revegetation of Koala habitat, and ensure consistency of the Plan with the requirements of the Chief Scientist (Office of the NSW Chief Scientist & Engineer, 2020, 2021a). As a result of this process:

- Total impacts to important Koala habitat decreased by 35.9 ha
- There is an additional 154.1 ha of land which was previously identified as urban capable land, which is now avoided and prioritised for revegetation of Koala habitat

Importantly, avoidance of impacts to Koala habitat and increased restoration areas ensures that Koala corridors in GMAC and Wilton meet the average width requirements identified by the Chief Scientist (Office of the NSW Chief Scientist & Engineer, 2020, 2021a).

This level of avoidance is considered adequate when combined with the measures under the Plan to:

- Mitigate indirect impacts
- Protect important habitat
- Restore habitat

EXTENT AND QUALITY OF HABITAT

As outlined in Section 30.5.7, the Plan will result in the loss of 242 ha of important habitat for Koalas within GMAC and Wilton. This equates to 1.6 per cent of the mapped important habitat for the Southern Sydney population. It is noted that the total impacts to important Koala habitat have decreased by 35.9 ha since public exhibition of the Plan due to additional avoidance.

Further, the Plan will fence off Corridor C and Corridor D within GMAC to prevent Koalas from entering these areas. However, habitat within Corridor C and D will be protected under the Plan as avoided land, and there is potential that Koalas may be permitted to access these areas in future if suitable revegetation and threat mitigation measures are completed. Excluding Koalas from Corridors C and D is a conservation measure which is supported by the Chief Scientist to protect Koalas from threats and minimise mortality (Office of the NSW Chief Scientist & Engineer, 2021a).

In part to address these impacts, the Plan commits to:

- Protecting and managing a minimum of 570 ha of important Koala habitat (Commitment 9)
- Protecting and managing up to approximately 1,800 ha of land within the Georges River Koala Reserve. This includes restoration of up to 80 ha of cleared Koala habitat to strengthen the north-south movement corridor (Commitment 10)
- Restoring Koala habitat in other priority locations including along Ousedale Creek and around Appin (Commitment 13, Action 3)

The measures under the Plan to restore land is consistent with Principle 3 of *Conserving Koalas in Wollondilly and Campbelltown LGAs* (DPIE, 2019a) which is: "Identify critical revegetation zones that will augment and strengthen core habitat and corridors".

These commitments and actions also support a number of priority management actions from the Conservation Advice (DSEWPC, 2012a). These include:

- *Investigate formal conservation arrangements, management agreements and covenants on private land, and for Crown and private land investigate and/or secure inclusion in reserve tenure if possible*
- *Develop and implement options of vegetation recovery and re-connection in regions containing fragmented Koala populations*

It is noted that ecological restoration of habitat takes a significant amount of time, and it will be important for ecological restoration efforts to start as early as possible to ensure the overall carrying capacity of habitat is not substantially reduced for a period of time. In response to this, the NSW Government has committed over $100 million to deliver priority conservation actions over the first five years of the Plan's implementation, which includes restoring 80 hectares of Koala habitat.

Based on these commitments being met, the overall extent and quality of habitat for the population will be similar at the end of the life of the Plan as it is now. In addition, substantially greater areas of important habitat will be under active management. The outcomes for extent and quality of habitat for Koalas are considered adequate.

LANDSCAPE CONNECTIVITY

As outlined in Section 30.5.7, proposed development under the Plan will not result in the loss of primary or secondary habitat corridors through Wilton or GMAC due to land clearing. However, habitat connectivity has the potential to be impacted through:

- Increased threat pressures within or between areas of Koala habitat which may prevent Koalas from being able to safely move through the landscape. Threats are associated with vehicle strike and the effects of urban development
- Fencing of Koala habitat to separate Koalas from threats, including:
    - Fencing along Appin Road between Rosemeadow and Appin under the Plan
    - Fencing to exclude Koalas from areas of habitat with high threat densities from adjacent urban areas

North-south primary corridors

The Chief Scientist (2020, 2021a), EES (DPIE, 2019a), and Biolink (2018a) discuss the importance of habitat associated with the Georges River as a north-south primary corridor to the east of Appin Road. This habitat is anticipated to play a critical role for the population over the life of the Plan, and will be protected as follows:

- A new reserve, the Georges River Koala Reserve, will be established to protect the habitat from development and ensure the habitat is managed for conservation purposes (Commitment 10)
- Available habitat will be increased through restoration of up to 80 ha of cleared land for Koala habitat within the reserve to strengthen the north-south movement corridor (Commitment 10)
- The existing Kings Fall Bridge at the Georges River will be augmented to improve north-south connectivity for Koalas from the Georges River Koala Reserve to southern Koala habitat (Commitment 7)

The habitat associated with the Nepean River is also an important north-south primary corridor through Wilton and GMAC (Biolink, 2018a; DPIE, 2019a; Office of the NSW Chief Scientist & Engineer, 2021a). This corridor will be protected under the Plan through the application of development controls to avoided land and SCA. The Plan also identifies potential restoration opportunities to widen the Nepean corridor to meet width recommendations of the Office of the NSW Chief Scientist & Engineer.

East-west connectivity through Douglas Park (between the Wilton and GMAC nominated area boundaries) is also recognised for its importance to connectivity. This area will not be impacted by the Plan and parts of it are included in the SCA which are targeted for protection.

East-west corridors across GMAC

The main risk to connectivity occurs to the east-west connections through GMAC (refer to Map 30-19). These are all secondary corridors and are currently compromised (from a connectivity perspective) in various ways. For instance, Corridors A through to D are currently too narrow to meet the minimum width requirements for Koala corridors. Corridor E (Ousedale) is bisected by the Upper Canal (which supplies water to Sydney and is heritage listed), which may impede Koala movement. Corridor F is not connected at the eastern end.

Biolink (2018a) suggests the most important of these connections are located in the vicinity of the Beluah biobanking site, in addition to Appin, Rosemeadow South/Noorumba Reserve and Ousedale-Mallaty.

The Chief Scientist identified Corridor E (Ousedale) as the preferred corridor to provide east-west connectivity function through southern GMAC (Office of the NSW Chief Scientist & Engineer, 2020).

Corridors A and B

It is noted that Corridor A and Corridor B are located within excluded land and are outside the scope of the Plan. These corridors are subject to a voluntary planning agreement for the Mount Gilead-Figtree Hill Development. The remaining corridors (C through to F) are within the scope of the Plan.

The Chief Scientist (2020, 2021a) emphasises the importance of maintaining a northern corridor to provide east-west connectivity between the Georges River and the Nepean River, and that providing only one east-west corridor through GMAC would be insufficient. Currently, the Plan commits to providing one east-west corridor (Ousedale, discussed below). The Plan is relying upon the voluntary planning agreement for the Mount Gilead-Figtree Hill Development to deliver the second, northern east-west corridor, to satisfy the requirements of the Chief Scientist.

Corridors C and D

Corridors C and D are both currently too narrow to support safe passage of Koalas. These corridors will be fenced off to exclude Koalas (Commitment 12, Action 1). Habitat within the corridors will be protected as avoided land and will provide insurance habitat which may be expanded through revegetation to support Koalas in the future.

The Chief Scientist supports the approach of fencing of Corridor C and Corridor D to exclude Koalas while protecting habitat within the corridors for other biodiversity and amenity values (Office of the NSW Chief Scientist & Engineer, 2021a).

Corridor E

The Chief Scientist identified Corridor E (Ousedale) as the preferred corridor to provide east-west connectivity function through southern GMAC (Office of the NSW Chief Scientist & Engineer, 2020). However, it is recognised that the Upper Canal could be an impediment to safe Koala movement through the corridor. The Chief Scientist therefore recommends that safe Koala movement across the Upper Canal be guaranteed as part of the delivery of the Ousedale corridor. To address this issue, the Department is currently working with Water NSW to investigate a potential Koala crossing to improve connectivity across the canal. This is associated with Commitment 7, Action 8, which commits to providing safe fauna crossings across linear infrastructure including investigating options for enhancing Koala movement across the Upper Canal.

The Chief Scientist also requires that Koala movement corridors be an average width of 390-425 m. To achieve this, areas of currently cleared land which are adjacent to the Ouesdale corridor have been identified as priority restoration areas for Koala habitat. These areas have been avoided by urban capable land, and are included in the Plan's 'protected Koala habitat' layer. These measures are linked to Commitment 13, Action 3 of the Plan.

The Plan also commits to installing a Koala connectivity structure under Appin Road, near the intersection with Brian Road, to ensure safe passage of Koalas between Ousedale and the Georges River (Commitment 7).

Corridor F

Although Corridor F does not provide east-west connectivity as it is not connected at the eastern end, it is recognised by the Chief Scientist to contain a substantial area of Koala habitat which is important to protect (Office of the NSW Chief Scientist & Engineer, 2021a). The Plan will protect Corridor F and ensure Koalas have continued access to habitat at the site.

It is recognised that the proposed footprint of the Outer Sydney Orbital 2 (OSO2) has recently been released (discussed further below), and that the footprint of this transport corridor bisects Corridor F. While the development of the OSO2 is outside the scope of the Plan, it is noted that the Chief Scientist recommends that the OSO2 in this location be designed in a manner which is compatible with and sympathetic to the aims of the Plan. This includes minimising impacts to Koala habitat and maintaining habitat linkages for Koalas (such as connectivity structures) (Office of the NSW Chief Scientist & Engineer, 2021a).

Summary evaluation of landscape connectivity

Overall, the outcomes for connectivity are considered adequate as the Plan:

- Avoids disruptions to, and enhances, primary movement corridors (the Georges River and the Nepean River), consistent with the recommendations of the Chief Scientist
- Commits to delivering the Ousedale corridor (Corridor E) to provide east-west connectivity through southern GMAC, consistent with the recommendations of the Chief Scientist
- Excludes Koalas from dangerous habitat within east-west corridors (Corridor C and Corridor D) in GMAC, consistent with the recommendations of the Chief Scientist
- Commits to protecting Koala habitat within Corridor F, consistent with the recommendations of the Chief Scientist

However, it is noted that the Chief Scientist requires that two corridors to provide east-west connectivity across GMAC are secured and protected (one in the north and one in the south). Currently, the Plan commits to delivering one east-west corridor (the southern one).

To meet the Chief Scientist's recommendations, a northern corridor must also be secured and protected. Suitable corridors for protection (which will require revegetation to meet minimum corridor widths) are either Corridor A and Corridor B (Office of the NSW Chief Scientist & Engineer, 2020).

Corridor A and Corridor B are in excluded land, and are outside the scope of the Plan. Both corridors are subject to a voluntary planning agreement for the Mount Gilead-Figtree Hill Development. The Plan currently assumes that at least one of these corridors will be delivered and protected as part of the voluntary planning agreement.

LEVEL OF THREAT

As outlined in Section 30.5.7, development under the Plan has the potential to increase the level of threat to the Southern Sydney Koala population. This includes threats associated with:

- Vehicle strike
- Effects of urban development, including:
  - Increased Koala predation by domestic and roaming dogs
  - Increased landscape hazards such as swimming pools
  - Habitat degradation due to increased edge effects from land clearing and increased risk of disturbance
- Fire
- Disease

Each of these is discussed below.

Vehicle strike

The primary measure that the Plan will use to minimise the risk of vehicle strike is exclusion fencing, both along Appin Road, and between urban-capable land and Koala habitat (Commitment 7). Exclusion fencing provides a physical barrier which prevents Koalas from entering the roadway, and is recognised as the most effective method of reducing Koala road mortality.

Where it is not feasible for exclusion fencing to be constructed between urban-capable land and Koala habitat, a range of mitigation measures contained within Appendix E of the Plan will be applied to minimise the risk of road mortality. These include the following measures:

- Roadside vegetation adjacent to koala habitat areas will be managed to minimise the height of ground cover and therefore increase the visibility of any roadside fauna. Turfed areas will be mown, low ground covers will be trimmed mechanically.
- Implement traffic calming measures for all development not subject to wildlife and koala exclusion fencing:
  - Apply speed limit restrictions on local roads for areas adjacent to open space and land identified as avoided under CPCP
  - Signpost perimeter roads and roads adjacent to wildlife habitat areas in accordance with Austroads, RMS technical guidelines, Council Guidelines and relevant Australian Standards.
  - Install traffic calming devices such as speed humps and audible surfacing along perimeter roads adjacent to wildlife habitat
- Install koala friendly road design structures such as underpasses, fauna bridges and overpasses consistent with any approval conditions. Reference to the RMS Biodiversity Guidelines is to be made.

Further, it is recognised that there is potential for roads to be constructed (as essential infrastructure) within areas of Koala habitat that are contained within avoided land. To ensure that such roads do not increase the risk of Koala mortality in these areas, Appendix E of the Plan contains the following measure:

- Where public road infrastructure crosses koala corridors, ensure that:
  - Exclusion fencing is in place to prevent koalas from entering the road

- Suitable koala connectivity structures are installed to protect corridor integrity

These measures are considered to be sufficient to mitigate the risk of road mortality to Koalas under the Plan.

Effects of urban development

Increased Koala predation by domestic and roaming dogs

The Plan contains multiple measures to minimise the risk of predation from domestic and roaming dogs. Exclusion fencing between urban-capable land and Koala habitat is a key mechanism to minimise the risk of predation, by providing a barrier which prevents dogs from entering Koala habitat.

In areas where exclusion fencing is not feasible, additional development controls outlined in Appendix E of the Plan will be applied which will minimise the risk of dog predation to Koalas. These include the following measures:

- Dog proof fenced areas are to be designated within open space and public recreation areas
- Dog proof fencing is a design requirement for each residential lot in accordance with Council requirements
- Areas adjoining koala habitat are to be signposted with signage that indicates Koalas are in the area and permitted/prohibited activities and associated penalties that apply for non-compliance

These measures are supported by Action 7 associated with Commitment 7, which is as follows: "Work with local councils, NPWS and OSL to ensure the threats posed by dogs on all public land that is identified as Koala habitat protected under the Plan, are managed.

a) For land that is not publicly accessible, this will include the installation of signs and/or fences
b) For land managed as a reserve or for recreation, this will be achieved by incorporating requirements in a relevant Plan of Management."

Further, the Plan incorporates a range of general measures to manage the risks associated with pest animals, including wild dogs. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
  - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
  - Preparation of a Pest Animal Control Implementation Strategy
  - A process to enter into written agreements with delivery partners to implement the pest animal control program
  - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
  - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
  - Require appropriate management and control of pest animals relevant to development sites

Overall, the Plan has a range of species-specific and general measures to address the risk of predation of Koalas by dogs. These measures are considered to be adequate to appropriately mitigate this threat.

Increased landscape hazards such as swimming pools

Landscape hazards pose the biggest threat to roaming Koalas who enter environments which are dangerous for them. The Plan includes a range of measures to address this threat, as outlined in Table 30-24.

Overall, the Plan contains multiple measures to address threats posed by landscape hazards for Koalas who may disperse out of Koala habitat into more dangerous environments. These measures are considered to be adequate to mitigate this threat.

Table 30-24: Measures in the Plan to protect Koalas from landscape hazards

Approach adopted by the Plan to protect Koalas	Relevant measures in the Plan
Create barriers to movement to prevent Koalas from entering dangerous areas	• Installation of exclusion fencing between Koala habitat and urban-capable land (Commitment 7) • Temporary protective fencing to be erected around areas identified for conservation on or immediately adjoining the site at pre-construction phase to ensure adequate protection is in place during construction. (Appendix E)
Improve the safety of urban design for Koalas	• Design of subdivision layout including perimeter roads, Asset Protection Zones are to reduce impacts to and protect areas of Koala habitat (Appendix E) • Dog proof fenced areas are to be designated within open space and public recreation areas (Appendix E) • Dog proof fencing is a design requirement for each residential lot in accordance with Council requirements (Appendix E) • Implement traffic calming measures for all development not subject to wildlife and koala exclusion fencing (Appendix E): o Apply speed limit restrictions on local roads for areas adjacent to open space and land identified as avoided under CPCP o Signpost perimeter roads and roads adjacent to wildlife habitat areas in accordance with Austroads, RMS technical guidelines, Council Guidelines and relevant Australian Standards. o Install traffic calming devices such as speed humps and audible surfacing along perimeter roads adjacent to wildlife habitat
Reduce habitat features in urban areas which may act as lures to attract Koalas into these areas	Do not plant Koala feed trees, as listed in *Koala SEPP Schedule 2 Koala use tree species* in open space and recreation areas (Appendix E)

Habitat degradation due to increased edge effects from land clearing and increased risk of disturbance

Edge effects is a general term which relates to the decline in habitat condition which occurs in vegetation close to disturbed areas. Specifically, habitat degradation associated with edge effects can occur via the following pathways:

- Spread of weeds
- Altered hydrology
- Spread of disease which affects Koala habitat

Further, increased habitat disturbance is a process which can result in habitat degradation.

The measures adopted in the Plan to address these threatening processes to Koala habitat are outlined below. Overall, the measures in the Plan are considered to adequately mitigate the risk of degradation of Koala habitat.

Spread of weeds

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for Koala:
  - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans

  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Altered hydrology

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

Spread of disease which affects Koala habitat

Appendix E of the Plan includes the following Koala-specific measures which minimise the risk of spread of diseases which may disturb Koala habitat (such as *Phytophthora*):

- Strict enforcement of vehicle wash down points for machinery, equipment and tyres prior to entering and leaving the construction site. Hygiene procedures in instances where vegetation pathogens known to affect koala trees may be spread
- All vehicles, machinery, maintenance equipment, tyres and work boots should be free of mud, soil and vegetation prior to entering and leaving a development construction site

Further, The Plan incorporates a range of general measures to manage the risks associated with diseases. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:

  - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
  - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

Increased habitat disturbance

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (such as within the Georges River Koala Reserve)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas. This commitment includes a specific action to invest in the NSW Koala Strategy to raise awareness of the Southern Sydney Koala population and encourage community participation in Koala conservation in Western Sydney

Fire

Koalas are threatened by fire, particularly high intensity fires which burn the crowns of trees. The Plan includes a range of measures to manage this risk.

A major step towards protecting Koalas from the threat of fire is the creation of the Georges River Koala Reserve. This reserve primarily follows the riparian zone of the Georges River. This area provides important heat and refuge habitat for a range of biodiversity, including Koalas, as the cooler and wetter microclimate created by the river decreases the risk of high intensity fires from occurring. Managing this area for conservation purposes as a reserve also decreases the risk posed by fire to Koalas, as the reserve will implement appropriate fire management strategies.

Another priority of the Plan has been to maintain connectivity between the Georges River and the Nepean River. The Nepean River is also a substantial river which provides a potential climatic refuge site from extreme heat and fire risk. Further, ensuring connectivity between the two rivers ensures adequate provision of habitat for Koalas, and supports their capacity to find a place of refuge in the event of a bushfire.

The Plan further incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for Koala being:
  - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
  - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
  - A process to work with delivery partners to implement the fire management strategy
  - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:

- Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
- Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for Koala. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

Overall, it is considered that the Plan adequately addresses the risk posed by fire to Koalas.

Disease

The potential northward progression of Chlamydia from the Southern Highlands Koala population to into the Southern Sydney Koala population is a serious potential threat. While the Plan does not include measures to control the movement of disease through the Koala populations (as this is outside the scope of the Plan), the Plan nonetheless contains a number of measures to help to minimise this risk and protect the local Koala population. These include:

- Action 3, Commitment 22: Support NSW Government programs for threatened species research in Western Sydney including research that increases knowledge of population demographics, life-history and ecology of the Southern Sydney koala population, as part of the NSW Koala Strategy's NSW Koala Research Plan
- Commitment 23, which includes the following actions:
  1. Invest in the *NSW Koala Strategy* and other potential partners to implement the koala health and welfare program in South Western Sydney with key deliverables including:
     a) monitoring of koalas including key threats and effectiveness of mitigation measures as part of the NSW Koala Strategy Monitoring Framework
     b) designating the koalas in South Western Sydney as one of the dedicated monitoring sites for the NSW Koala Strategy
     c) providing enhanced training in wildlife treatment for veterinarians
     d) providing grants for community wildlife organisations for resources and carer recruitment and training
     e) establishing health and welfare programs to support koalas from threats including vehicle strike, fire, disease and climate change.
  2. Koalas that are captured and/or handled as part of a monitoring program will be vaccinated against chlamydia and have a tissue sample taken for genetic analysis, with the tissue samples lodged with the NSW Koala Biobank.

These commitments and actions under the Plan are considered to be adequate to minimise the risks posed by Chlamydia.

Evaluation of the Plan's mitigation of threats

The Plan includes a range of measures to mitigate threats to Koalas which are associated with development. These measures are consistent with official advice regarding best practice Koala conservation measures. For example, the EPBC Act Koala referral guidelines (DoE, 2014k) recognise exclusion fencing as one of the most important threat mitigation measures for Koala. Further, conservation measures under the Plan are consistent with a number of priority management actions from the Conservation Advice (DSEWPC, 2012a), such as:

- *Develop and implement a management plan to control the adverse impacts of predation on Koalas by dogs in urban, peri-urban and rural environments*
- *Development plans should explicitly address ways to mitigate risk of vehicle strike when development occurs adjacent to, or within, Koala habitat.*

The package of measures to address indirect impacts is considered adequate when combined with the supporting measures around monitoring, evaluation and adaptive management.

IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The Plan includes two commitments that will limit the potential impacts to Koala habitat from essential infrastructure:

- The first (Commitment 2.2) prioritises the avoidance of impacts from essential infrastructure on non-certified land to protected Koala habitat within Wilton and GMAC to maintain the function of Koala movement corridors
- The second (Commitment 2.1) relates to the EPBC Act listed TEC Shale Sandstone Transition Forest in the Sydney Basin Bioregion. This TEC occurs extensively on avoided lands in Wilton and GMAC and provides large parts of the important habitat for Koalas. The commitment limits the potential impacts to the TEC to a cumulative maximum over the life of the Plan to no more than 16.50 ha in Wilton and 23.80 ha in GMAC

Appendix E of the Plan includes the following measures:

- A measure to ensure that appropriate access treatments such as gates are considered to maintain the integrity of existing Koala exclusion fencing where planned linear infrastructure such as gas and electricity crosses Koala exclusion fencing
- A measure to ensure that exclusion fencing is in place to prevent Koalas from entering the road, and that suitable Koala connectivity structures are installed to protect corridor integrity, for public road infrastructure that crosses Koala corridors
- A number of measures which relate to construction and tree-felling protocols, including site survey, temporary fencing and tree felling protocols, to protect Koalas during construction of essential infrastructure

These measures will be implemented and supported by the *Cumberland Plain Conservation Plan Guideline for Infrastructure Development*.

Further, as outlined in Chapter 37, any proposed essential infrastructure developments on avoided lands in the nominated areas will be subject to the processes of the NSW BAM and require approval under the BC Act. These processes will include:

- On-ground surveys to determine the biodiversity values that are present
- Measures to avoid impacts to Koalas through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Based on the application of these commitments, actions and measures and the overall requirements of the BAM process, impacts from essential infrastructure are not considered likely to substantially effect the scale, condition or functionality of Koala habitat within Wilton or GMAC. See Section 37.6 in Chapter 37 for more details.

ADAPTIVE MANAGEMENT

The Plan includes a commitment (Commitment 25) to "implement an evaluation program for the Plan that sets out requirements for monitoring, evaluation, reporting and adaptive management". The approach to adaptive management is set out in Sub-Plan A. Chapter 16 of this Strategic Assessment Report provides a detailed overview and assessment of the Plan's general approach to adaptive management.

In addition to this, the Plan includes a further, species-specific action to support adaptive management for Koala. Commitment 7, Action 6 is as follows:

6. Establish a koala working group with representation from relevant government agencies to support implementation of the koala commitments and actions. The working group will support implementation of the koala sub-plan, by providing advice to inform:
    a) alignment, staging, and design of the koala exclusion fencing and fauna crossing, including advice about providing appropriate koala movement corridors
    b) priority locations and approach for koala habitat restoration
    c) monitoring and evaluation of the Plan's koala commitments, including providing advice to support adaptive management based on monitoring and evaluation data
    d) community and stakeholder engagement for the koala conservation commitments and actions
    e) research and management actions relating to koalas

This measure further supports the general adaptive management measures in the Plan and will ensure that the outcome for Koalas is delivered.

Further, it is noted that the current conservation package within the Plan assumes that at least one northern east-west corridor (either Corridor A or Corridor B) will be delivered through external processes in a manner which is consistent with the requirements of the Office of the NSW Chief Scientist & Engineer. Subsequently, the Plan only provides guarantees for the delivery of one east-west corridor across GMAC (Ouesdale corridor in the south).

As a requirement of the Office of the NSW Chief Scientist & Engineer, the acceptability of the Plan depends upon the delivery of the northern corridor.

30.5.10 OVERVIEW AND EVALUATION OF CUMULATIVE IMPACTS

There are a number of developments in the locality of GMAC and Wilton which have the potential to increase threats to Koala associated with indirect impacts, including:

- Vehicle strike
- Effects of urban development
- Impacts to connectivity
- Fire

The developments which have been assessed in this section are outlined in Table 30-25.

It is noted that the Plan has been developed with consideration of the known locations of other major developments, including areas which are already developed for urban use, and areas which have already been assessed or are progressing through an alternative development assessment process. Such areas have been excluded from the NSW strategic biodiversity certification and strategic assessment under the EPBC Act, and are located on excluded lands.

The developments of Figtree Hill, Gilead, Bingara Gorge, the OSO2 and Link Road Corridor Study are all located within excluded lands under the Plan. These developments will therefore do not pose a risk of additional direct impacts to land included within the strategic biodiversity certification or strategic assessment under the Plan.

Table 30-25: Major developments in the locality of GMAC and Wilton

Development	Description	Current Stage
Bingara Gorge	An urban development which covers a footprint of 130.1 ha within Wilton which is expected to provide approximately 1,500 new homes (Eco Logical Australia, 2014)	The development was approved in 2018 (DoEE, 2018a)
Figtree Hill development, Stage 1	An urban development in the locality of Mt Gilead within GMAC, which covers a footprint of 128.5 ha and is expected to provide approximately 1,300 dwellings (Eco Logical Australia, 2015)	The development was approved in 2018 (DoEE, 2018b)
Gilead development, Stage 2:	An urban development which covers a footprint of 332 ha to the west of the Stage 1 Figtree Hill development within GMAC, which is expected to provide approximately 4,500 new dwellings (Eco Logical Australia, 2019). This development is proposing to deliver two east-west Koala movement corridors between the Nepean River (referred to in the Chief Scientist's report as Corridor A and Corridor B), to ensure northern connectivity between the Nepean and the Georges River (Lendlease, 2020).	The development application has been lodged and is currently being assessed
Appin Road upgrade between	An upgrade to a section of Appin Road from Mount Gilead in the south, and the intersection of St Johns Road, Ambarvale in the north. This area occurs	The project is currently in the detailed design phase. Approval of designs is

Development	Description	Current Stage
Rosemeadow and Mt Gilead	partly within and outside of GMAC and comprises one of the Koala roadkill hotspots (between Appin and Campbelltown). As part of this project, Transport for NSW (TfNSW) are proposing to install Koala exclusion along sections to Appin Road with the aim of reducing fauna mortality (RMS, 2018b)	required before construction may commence (Transport NSW, 2020a)
Appin Road safety improvement between Mt Gilead and Appin	TfNSW are also undertaking targeted safety improvements to parts of Appin Road between Mt Gilead and Brian Road just north of Appin to improve safety for residents, motorists and freight operators, as well as create further traffic efficiencies. This project will also involve installation of fauna fencing on Appin Road to minimise fauna mortality (RMS, 2018a)	The project is currently in the detailed design phase. Approval of designs is required before construction may commence (Transport NSW, 2020a)
Outer Sydney Orbital 2 (OSO2)	TfNSW is currently in the early stages of investigating options to develop a major east-west transport corridor through GMAC, to provide an improved connection between the Hume Motorway and Appin Road (Transport NSW, 2020c)	An Options Report has been released which presents a range of options for the alignment of the road (Transport NSW, 2020c). Following public consultation on the Options Report, a preferred alignment for the OSO2 has recently been identified. This alignment bisects Corridor F within GMAC
Link Road Corridor Study	TfNSW is currently in the early stages of investigating options to develop a major east-west transport corridor through GMAC, to provide an improved connection between Menangle Road and Appin Road within the Campbelltown LGA (Transport NSW, 2020b)	An Options Report has been released which presents a range of options for the alignment of the road (Transport NSW, 2020b). The likely preferred alignment has not yet been publicly exhibited, yet has been incorporated within the excluded lands footprint of the Plan

CUMULATIVE IMPACTS: VEHICLE STRIKE

The Bingara Gorge, Figtree Hill (Stage 1), and Gilead (Stage 2) developments have the potential to increase the risk of vehicle strike to Koalas within Wilton and GMAC due to increased urban development leading to more roads and higher traffic densities. These developments include a range of mitigation measures to minimise the risk of traffic impacts to koalas, including speed limits, fencing of Koala habitat, and management of roadside vegetation to increase fauna visibility (Eco Logical Australia, 2017; Lendlease, 2020). Concurrently, planned upgrades for Appin Road (which include installation of wildlife fencing to exclude Koalas from the road) will further assist in reducing Koala mortality on the wider road network (RMS, 2018a, 2018b), despite increases in traffic densities as a result of increased development.

Overall, the mitigation measures associated with the Bingara Gorge, Figtree Hill (Stage 1), and Gilead (Stage 2) developments, in conjunction with the proposed upgrades to Appin Road, will minimise the risk of increased vehicle strike as a result of urban developments within GMAC and Wilton.

The footprint options outlined for the Link Road Corridor Study and OSO2 all intersect areas of Koala habitat, and have the potential to increase the risk of road mortality for Koalas. However, as these developments are in very early planning stages, it is not currently possible to assess the risk of increased vehicle strike posed by each transport corridor. The magnitude of risk will depend upon the final alignment and design of the transport corridors, including whether mitigation measures such as exclusion fencing are included as part of the road design. However, given the importance of the Koala population in the locality, it is considered likely that each of these corridors will be suitably designed to minimise potential impacts to Koalas.

Overall, given the contribution that the Plan will make towards reducing Koala mortality at known roadkill hotspots, the potential risk of cumulative impacts associated with vehicle strike is considered acceptable.

CUMULATIVE IMPACTS: EFFECTS OF URBAN DEVELOPMENT

Bingara Gorge, Figtree Hill (Stage 1), and Gilead (Stage 2) are all urban developments, which have potential to increase urban threat pressures to Koalas. Each of these developments will implement a range of measures to minimise urban threats to koalas, such as the use of exclusion fencing to separate dogs from Koala habitat and education campaigns for residents of the new development areas (Eco Logical Australia, 2017; Lendlease, 2020). The use of mitigation measures will minimise the risk of increased urban threats to Koalas.

CUMULATIVE IMPACTS: IMPACTS TO CONNECTIVITY

Impacts from urban development

Urban areas pose potential barriers to connectivity to Koalas, as high threat densities and low habitat availability prevent Koalas from moving safely through urban environments.

Development associated with Bingara Gorge does not fragment areas of Koala habitat, and therefore this development is unlikely to disrupt Koala connectivity.

The Figtree Hill (Stage 1) and Gilead (Stage 2) developments are together located between the Nepean River primary corridor and Georges River primary corridor and have potential to disrupt connectivity between these areas without appropriate mitigation.

As outlined previously, the Chief Scientist's report recommends that two east-west habitat corridors linking the Nepean River with the Georges River corridors be secured and protected within GMAC to protect Koala habitat connectivity from urban development within the nominated area. The report recommends that that (Office of the NSW Chief Scientist & Engineer, 2020):

- Gilead (Stage 2) be responsible for the delivery of the northern corridor (which includes requirements to install suitable Koala connectivity structures across Appin Road and a range of measures to protect corridors from threats and widen them where feasible)
- The Plan be responsible for the delivery of the southern corridor (with Ousedale identified as the preferred corridor)

The measures outlined by the Chief Scientist's report are sufficient to protect Koala connectivity within GMAC from cumulative impacts of development associated with the Plan, Figtree Hill (Stage 1) and Gilead (Stage 2).

The Plan will deliver the southern corridor (Ousedale) consistently with the requirements of the Chief Scientist. However, it is noted that the acceptability of the Plan depends upon the delivery of the northern east-west corridor.

Fencing of Appin Road

Safety improvements are being undertaken by TfNSW along Appin Road between Mt Gilead and Appin, which involves the installation of fauna fencing to minimise fauna mortality. Fencing without accompanying connectivity structures can result in habitat fragmentation.

To avoid habitat fragmentation and ensure connectivity, the following fauna crossing structures are proposed for Appin Road:

- Commitment 7 under the Plan will deliver a connectivity structure across Appin Road to connect Ousedale with the Georges River habitat
- The Mt Gilead - Figtree Hill development is proposing to install suitable connectivity structures across Appin Road, to connect Koala habitat in Corridor A/Corridor B with the Georges River habitat

Through installing suitable habitat connectivity structures, the Plan will ensure that fencing along Appin Road will not result in habitat fragmentation for Koalas. It is further noted that the use of fauna fencing to minimise road mortality will benefit the local Koala population, as Appin Road is recognised as a Koala road mortality hotspot.

Potential impacts from transport corridors

Without suitable mitigation measures, the Link Road Corridor Study and the OSO2 each have the potential to result in fragmentation of Koala habitat. It is noted that the Chief Scientist recommends that the OSO2 be designed in a manner which is compatible with and sympathetic to the aims of the Plan. This includes minimising impacts to Koala habitat and

maintaining habitat linkages for Koalas (such as connectivity structures) (Office of the NSW Chief Scientist & Engineer, 2021a).

It is recommended that the Link Road Corridor Study and the OSO2 each include suitable connectivity structures (as required) to protect Koala habitat connectivity within the region.

CUMULATIVE IMPACTS: FIRE

Bingara Gorge, Figtree Hill (Stage 1), and Gilead (Stage 2) all have potential to increase the risk of fire within Koala habitat due to increased exposure to ignition sources from urban areas. All three developments will utilise APZs to separate vegetated areas from urban areas, which will minimise fire risk (Eco Logical Australia, 2018; Lendlease, 2020). Further, Figtree Hill (Stage 1) and Gilead (Stage 2) will minimise bushfire risk through undertaking controlled ecological burns within conservation areas, to reduce the overall risk and severity of intense wildfires (Lendlease, 2020).

It is also possible that the Link Road Corridor Study and the OSO2 could increase the risk of fire within Koala habitat, through increasing ignition sources. However, given the early stage of each of these proposals, it is not possible to undertake detailed assessment of the risk posed by each development. It is considered likely that the environmental assessment and approval process for these corridors will ensure that the risk of fire is minimised.

30.5.11 OVERALL CONCLUSION

The efforts to avoid impacts to Koala habitat, and the commitments and actions in the Plan provide a strong framework for addressing the risks to the population from development under the Plan. The commitments and actions provide a range of positive contributions to the population (in particular the establishment of the Georges River Koala Reserve). They also address the key risks to the population and are designed to be implementable as development proceeds. Importantly, the measures under the Plan are broadly consistent with the requirements of the Chief Scientist (Office of the NSW Chief Scientist & Engineer, 2020, 2021a).

However, given the long timeframes associated with implementation there is uncertainty at this time about the ultimate effectiveness of these measures. This uncertainty can only be addressed in implementation, and it will be critical that monitoring, evaluation and adaptive management measures are effective. Ongoing review of the success of the Plan in protecting Koalas will be critical.

SPECIES AT MEDIUM RISK OF DIRECT IMPACTS

30.6 *LATHAMUS DISCOLOR* (SWIFT PARROT)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	*Lathamus discolor* (Swift Parrot) is a medium-sized bright green parrot. It has dark-blue patches on the crown and a red face. It grows to approximately 25 cm in length, with a wingspan of 32-36 cm. It weighs around 65 g (TSSC, 2016e)
ECOLOGY	Swift Parrots breed in Tasmania in summer and migrate to mainland Australia in winter, where they disperse widely to forage. Swift Parrots forage on flowers, seeds, fruit, and psyllid lerps in *Eucalyptus* species. The species forages preferentially on larger trees, as larger trees provide more reliable resources than younger trees (Saunders & Tzaros, 2011). Swift Parrots are adept at foraging in a variety of habitats, from continuous intact vegetation, through to vegetation remnants, scattered trees and vegetation in urban areas (Brereton, Mallick et al., 2004). It is not a guarantee that more disturbed environments (such as urban or agricultural environments) contain fewer foraging resources than intact vegetation. For instance, within the species' breeding range in Tasmania, Swift Parrots have been observed to forage in higher densities in urban areas than in neighbouring bushland as the trees in urban areas flower more prolifically than the trees in bushland (Hingston & Piech, 2011). It is thought that trees in disturbed areas including suburban and agricultural environments may produce more food than trees in areas of native vegetation because (Brereton, Mallick et al., 2004; Hingston & Piech, 2011): • More isolated trees have greater light penetration in the canopy • Suburban trees typically have less fire damage • Farmland/parkland/garden sites are typically managed for soil enrichment • Agricultural sites are more likely to have more fertile soil than uncleared remnant vegetation which typically occurs on less fertile soil However, the Swift Parrot's distribution is also strongly influenced by the presence of aggressive competitors (Saunders & Heinsohn, 2008). Aggressive competitors are more likely to be present in disturbed environments. Urban environments also have higher threat densities which reduce habitat suitability for Swift Parrots (Saunders & Tzaros, 2011a).

	Within NSW, higher densities of Swift Parrots have been recorded in remnant vegetation than in scattered trees or continuous forest (Saunders & Heinsohn, 2008). Saunders & Heinsohn (2008) found that the distribution of Swift Parrots in NSW was primarily associated with food availability and the presence of non-aggressive competitors. Swift Parrots are usually seen in groups of up to 30 birds, although it may also occur in larger flocks (of hundreds of individuals) around abundant food sources. There are a small number of records of over 1,000 birds (TSSC, 2016e). The species shows high site fidelity (at both breeding and non-breeding sites) and return to the same locations on an irregular cyclic basis (TSSC, 2016e).
DISTRIBUTION AND HABITAT	**Overview** The Swift Parrot breeds in Tasmania in summer and migrates to mainland Australia in winter to forage (TSSC, 2016e). On the mainland, the species mainly occurs in Victoria and eastern NSW (including the ACT), but may also be found in south-eastern Queensland or south-eastern South Australia (TSSC, 2016e). In NSW, the species forages in forests and woodlands throughout the coastal and western slopes regions (TSSC, 2016e). The distribution of Swift Parrots is driven by food availability. Food availability, in turn, is driven by climatic conditions. It is considered important to maintain a broad range of habitats across the mainland foraging range of the species, as resource availability in any one locality may increase or decrease depending on local conditions each year (Saunders & Tzaros, 2011a). During periods of drought, higher densities of the species occurs in coastal habitats in NSW and Victoria, suggesting these areas function as drought refuge habitat (Saunders & Tzaros, 2011a). In the Cumberland subregion, the following TECs contain habitat suitable for the Swift Parrot (Saunders & Tzaros, 2011a): • Cumberland Plain Woodland • River-Flat Eucalypt Forest on Coastal Floodplains • Shale Sandstone Transition Forests • Shale Gravel Transition Forests • Swamp Sclerophyll Forest on Coastal Floodplains **Habitat critical to the survival of the species** There is an approved Recovery Plan for the Swift Parrot which was published in 2011. This Recovery Plan outlines the currently accepted definition of habitat critical to the survival of the species (Saunders & Tzaros, 2011a). A review of that Recovery Plan was undertaken by the Swift Parrot Recovery Team in 2016-17, which recommended that a new Recovery Plan for the species be prepared to account for the recently-discovered threat of predation by Sugar Gliders in breeding habitat, and to address the ongoing loss of breeding habitat in Tasmania (Commonwealth of Australia, 2019). The draft Recovery Plan proposes an updated definition of habitat critical to the survival of the species. While this definition has yet to be approved, the proposed new definition has also been considered in this assessment. The current and proposed definitions of habitat critical to the survival of the species are outlined below. *Current habitat critical definition* The current Recovery Plan identifies habitat critical to the survival of the species as "those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team" (Saunders & Tzaros, 2011a) The Recovery Plan identifies priority habitats of the Swift Parrot as sites which are used (Saunders & Tzaros, 2011a): • For nesting • By large proportions of the population • Repeatedly between seasons (site fidelity)

	• For long periods of time (site persistence) The Recovery Plan notes that habitat mapping within NSW has been limited, and subsequently the location of priority habitats for the species in NSW are unknown. However, the Hawkesbury-Nepean and Sydney Metro Catchment Management Authority areas (which contain the Strategic Assessment Area) are identified as localities which are likely to contain priority habitats. In total, the Recovery Plan identifies eight Catchment Management Authority areas in NSW which are likely to contain priority habitats for the species (Saunders & Tzaros, 2011a). *Proposed habitat critical definition* The draft Recovery Plan identifies habitat critical to the survival of the species as follows (Commonwealth of Australia, 2019): "Habitat critical to the survival of the Swift Parrot includes: • Any nesting sites or foraging areas where the species is known or likely to occur (as shown in figure 1) • Any newly discovered breeding or important foraging areas" Figure 1 of the draft Recovery Plan identifies large areas across south-eastern Australia which have been mapped as areas where the species is known/likely to occur, including the majority of the Strategic Assessment Area and the surrounding region (Commonwealth of Australia, 2019).
POPULATIONS	The species occurs as one single, migratory population (Saunders & Tzaros, 2011a). The population of swift parrots was estimated to be approximately 2,000 in 2010. It is likely to have declined since then (TSSC, 2016e). Population modelling published in 2015 predicted that the Swift Parrot's total population was likely to decline by over 80 per cent over the next three generations (12-18 years), primarily driven by nest predation from Sugar Gliders (Heinsohn, Webb et al., 2015). More recent research using genetic analysis to estimate likely population size found that the total number of Swift Parrots in the wild may, at a minimum, be below 300 individuals (Olah, Stojanovic et al., 2020).
SOS SITES	The following SOS priority management sites for the species have been identified: • Central Coast • Tarcutta Hills • Riverina A number of priority management areas have also been identified under the SOS program within NSW. These include: • A locality stretching from Nowra in the south through to north of Newcastle, which extends from the coast inland to the lower slopes of the Great Dividing Range and which includes the entirety of the Strategic Assessment Area • The coastal area from Batemans Bay in the north to the NSW-Victorian border in the south • A locality to the south of Cowra • A locality to the north of Lithgow, on the western side of the Blue Mountains • A locality in southern NSW between Albury in the south, Temora in the north, Tumut in the east and Wagga Wagga in the west (EES, 2021)
RELEVANT PLANS AND POLICIES	Conservation Advice for *Lathamus discolor* (Swift Parrot) (TSSC, 2016e) National recovery plan for the Swift Parrot *Lathamus discolor* (Saunders & Tzaros, 2011a) Draft national recovery plan for the Swift Parrot (*Lathamus discolor*) (Commonwealth of Australia, 2019) Threat abatement plan for predation by feral cats (DoE, 2015g)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=744

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">Yes</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>No</td><td>No</td><td>No</td><td>Yes</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report for this species.</td></tr>
<tr><td rowspan="2">HABITAT MAPPING</td><td colspan="5">WITHIN THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Three habitat maps have been used to represent the distribution of habitat for the Swift Parrot within the Strategic Assessment Area:
• Potential foraging habitat mapping, prepared as a knowledge based map (KBM) (prepared by the consulting team)
• Important areas mapping (prepared by EES)
• Potential important areas mapping (prepared by the consulting team)
An overview of each mapping method is provided below.
No targeted surveys were undertaken; however, the species was recorded in Wilton in 2019 during surveys for this project.
Potential foraging habitat (Knowledge based map (KBM))
Habitat maps for the Swift Parrot were generated using BioNet PCT associations of intact and thinned vegetation, and scattered trees.
The KBM represents the distribution of potential foraging habitat for the Swift Parrot within the Strategic Assessment Area.
Important areas mapping
Important areas mapping has been produced by EES as part of the BAM process. Mapping was completed as follows:
Swift Parrot sighting records from 1990-2018 were extracted from BioNet and BirdLife Australia Atlas. Records were checked and cleaned. Records were filtered to include only sightings with five or more birds. A 2 km radial buffer was applied.
Important areas were defined by:
1. Areas with five or more records, where observations have occurred over two or more years and are within 2km of one another, or
2. Areas with a single record of 40 or more birds
The NSW State Vegetation Type Map (including draft East Coast classification) was used to select Plant Community Types associated with the swift parrot within the buffers. Any areas of vegetation less than one hectare were excluded.
It is noted that the important areas map prepared by EES will be updated over time.
Potential important areas mapping
The important areas mapping produced by EES only includes Swift Parrot records up to 2018. It is noted that a substantial number of new records for the Swift Parrot were recorded within the</td></tr>
</table>

	Strategic Assessment Area in 2019 which fit the criteria identified in the important areas mapping method, and which are important to consider as part of the assessment process for this species. Therefore, potential important areas were identified through replicating the important areas mapping method and including new records from 2019, to indicate the localities which are likely to be included in the important areas mapping by EES when the map is next updated.
	OUTSIDE THE NOMINATED AREAS
	Potential foraging habitat (knowledge based map (KBM)), important areas mapping and potential important areas mapping. As above. No targeted surveys as part of this project were undertaken outside the nominated areas.
POPULATION MAPPING	**RECORD SELECTION**
	Species records were compiled from BioNet. All available records were considered in the assessment.
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *Lathamus discolor* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *Lathamus discolor* were downloaded in October 2020.
	POPULATION DEFINITION
	The species is considered to be a single migratory population. All records within the Strategic Assessment Area are therefore considered part of the same population.
	IMPORTANT POPULATION CRITERIA
	The population was considered to be important as the species is critically endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-26 for a map of records and habitat across the Strategic Assessment Area. See Map 30-27 for a map of important areas for the Swift Parrot across the Strategic Assessment Area. It is important to note that the records for this species are sensitive and have been denatured for representation on the map.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-27 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Swift Parrot in the Strategic Assessment Area. **Records** The species has been recorded throughout the Cumberland subregion and is associated with flowering woodland areas. There are 266 BioNet records within the Strategic Assessment Area, with records ranging from the early 1900s to the present day. While there are scattered records of the species throughout the Strategic Assessment Area, there are some localities where larger numbers of Swift Parrots (flocks of 40 or more birds) have been recorded, or where the species has been recorded to return on a periodic basis. These include: • Scattered areas within GPEC, where numerous records identify large flocks of Swift Parrots

- To the north of GPEC, including the Londonderry, North Richmond, and Hawkesbury Heights localities
- To the west of GPEC in the Glenmore Park/Mulgoa locality
- To the east of GPEC near Prospect Reservoir
- To the south of WSA in the Camden and Cobbitty localities
- To the north-west of GMAC near Denman Prospect
- Adjacent to GMAC in the locality of Mount Annan
- Just outside the northern boundary of the Strategic Assessment Area in the Cattai locality

It is noted that multiple records of Swift Parrots were observed in and around the Australian Botanic Garden at Mount Annon in 2019. One record, in the vicinity of the Australian Botanic Gardens at Mount Annon, identifies a flock of 200 individuals. As it is estimated that less than 2000 individual Swift Parrots remaining, this record could be more than 10 per cent of the entire species population (TSSC, 2016e).

Potential foraging habitat

The baseline mapping for this assessment has mapped 59,369.2 ha of potential foraging habitat within the Strategic Assessment Area (see Table 30-27 for further details). Potential foraging habitat broadly aligns with the locations of all remnant vegetation within the Strategic Assessment Area. This area is large because of the broad associations the species has with flowering woodland.

Important areas

5,626.1 ha of important areas have been mapped by EES within the Strategic Assessment Area.

Mapped important areas identified by EES correspond with the areas where larger numbers of Swift Parrots have been identified or where the species has been recorded to return on a period basis, based on records of the species between 1990-2018. Important areas have been identified as follows:

- Scattered areas within GPEC
- To the north of GPEC, including the Londonderry, North Richmond, and Hawkesbury Heights localities
- To the west of GPEC in the Glenmore Park/Mulgoa locality
- To the east of GPEC near Prospect Reservoir
- To the south of WSA in the Camden locality
- To the north-west of GMAC near Denman Prospect

Potential important areas

731.7 ha of potential important areas have been mapped by the consulting team, based on the mapping method used by EES, incorporating more recent records of the species within the Strategic Assessment Area. Potential important areas occur:

- To the south of WSA in the Cobbitty locality
- Adjacent to GMAC in the locality of Mount Annan
- In the north of the Strategic Assessment Area in the Cattai locality

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.6.1 NOMINATED AREAS

A breakdown of avoidance of potential foraging habitat across each nominated area is provided in Table 30-28.

In addition, Appendix E of the Plan includes a species-specific measure for the Swift Parrot to retain large trees (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction. This measure applies across all nominated areas and will be implemented via the DCP template, Mitigation Measures Guideline, and *Cumberland Plain Conservation Plan Guidelines for Infrastructure.*

It is important to note that the avoidance calculations in Table 30-28, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-28 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

AVOIDANCE OF POTENTIAL FORAGING HABITAT

The potential foraging habitat mapping for this assessment has mapped 4,514.3 ha of potential foraging habitat for the Swift Parrot within the nominated areas (not including excluded lands). Approximately 3,414.6 ha (75.6 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,568.9 ha was avoided for biodiversity purposes
- 845.8 ha was avoided for other purposes

AVOIDANCE OF IMPORTANT AREAS

The important areas mapping prepared by EES based on 1990-2018 records for the species has mapped 83.7 ha of important areas for the Swift Parrot within the nominated areas (not including excluded lands). Approximately 40.4 ha (48 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 19.9 ha was avoided for biodiversity purposes
- 20.6 ha was avoided for other purposes

AVOIDANCE OF POTENTIAL IMPORTANT AREAS

The potential important areas mapping prepared by the consulting team for this assessment to include 2019-20 records for the species has mapped 2.8 ha of potential habitat for the Swift Parrot within the nominated areas (not including excluded lands). None of this area was avoided.

30.6.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.6.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will lead to the loss of:

- Potential foraging habitat
- Important areas
- Potential important areas

Given the species breeds only in Tasmania, there will be no impacts to breeding habitat under the Plan.

LOSS OF POTENTIAL FORAGING HABITAT

Approximately 1,270.5 ha of potential foraging habitat will be lost as a result of the implementation of the Plan (1,099.8 ha within the nominated areas and 170.7 ha within transport corridors outside the nominated areas). This habitat represents 2.1 per cent of mapped potential foraging habitat across the Strategic Assessment Area.

A summary of these impacts is provided in Table 30-29.

LOSS OF IMPORTANT AREAS

Approximately 101.1 ha of important areas will be lost as a result of the implementation of the Plan (43.3 ha within the nominated areas and 57.8 ha within transport corridors outside the nominated areas). This habitat represents 1.8 per cent of mapped important areas across the Strategic Assessment Area.

It is noted that of the 43.3 ha of impacts within nominated areas, 13.2 ha of this mapped habitat is mapped over areas of waterbodies, while 4.1 is mapped over areas of exotic vegetation. Therefore, 17.3 ha of this impacted area is not likely to contain real habitat for the Swift Parrot. Total impacts to real habitat within this mapped area is therefore closer to 26 ha.

LOSS OF POTENTIAL IMPORTANT AREAS

Approximately 3.1 ha of potential important areas will be lost as a result of the implementation of the Plan (2.8 ha within the nominated areas and 0.4 ha within transport corridors outside the nominated areas). This habitat represents 0.4 per cent of mapped potential important areas across the Strategic Assessment Area.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk assessment method outlined in Section 30.3.5 has been applied with regards to mapped potential foraging habitat for the species (as mapped by the KBM). This is because the potential foraging habitat map is considered to be more accurate and precautionary in capturing the range of potential habitats which the species may utilise across the Strategic Assessment Area. It is noted that important areas mapping is more likely to be subject to potential bias associated with the identification of species records across the Strategic Assessment Area.

The risk of residual adverse impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be medium. This is because:

- The likelihood of substantial impacts occurring to the species has been categorised as possible. There will be moderate impacts to areas of potential foraging habitat where the species has been observed
- The consequence of any impacts to the species has been categorised as major. There will be loss of approximately 2 per cent of mapped potential foraging habitat in the Strategic Assessment Area and records occur close to and within areas that will be impacted

30.6.4 FRAGMENTATION OF HABITAT

Given the wide-ranging nature of the species and broad availability of potential habitat, it is considered unlikely that development within the nominated areas or transport corridors would lead to any fragmentation effects.

30.6.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the medium risk of residual adverse impacts to the species, the Plan provides offsets for the Swift Parrot.

The Plan commits to protecting 4,410 ha of potential foraging habitat (including 100 ha of important habitat as defined under the BAM) for the Swift Parrot (Commitment 9).

Offsets will be located within the SCA which identify well-connected, high-quality vegetation across the Strategic Assessment Areas. These areas contain 17,178 ha of potential foraging habitat for the species and provide the best opportunity for improving conservation planning across the subregion and delivering real benefits for the Swift Parrot.

It is noted that 2,847.2 ha of potential foraging habitat for the Swift Parrot is located within the three conservation reserves proposed by the Plan, including:

- 1,536.8 ha within the Georges River Koala Reserve

- 66.2 ha within the Confluence Reserve investigation area
- 1,244.2 ha within the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.6.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice and Recovery Plan (and other key documents) for the Swift Parrot identify a range of threats to the species (Saunders & Tzaros, 2011b; TSSC, 2016e). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Collision mortality
- Inappropriate fire regimes
- Predation by feral cats

Predation by sugar gliders, competition from honeyeaters, Psittacine Beak and Feather Disease, and illegal wildlife capture and trade are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the threat across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Swift Parrot are discussed below for each identified indirect impact.

Note that 2,847.2 ha of potential foraging habitat for the Swift Parrot is contained within the three conservation reserves proposed by the Plan. The protection of habitat for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

COLLISION MORTALITY

Mortality from collisions with human-made objects in urban areas is an identified threat to the species (TSSC, 2016e). The Conservation Advice states that:

- Continuing urban encroachment into breeding and foraging habitat is increasing the threat
- Collisions are a particular concern in the greater Hobart and Melbourne areas, and the New South Wales central and north coast regions where fatalities have been recorded

There are no records in BioNet of collision mortalities in the Strategic Assessment Area. However, expanding urban development within the nominated areas and development of transport corridors has the potential to increase the threat of collision mortality to the species.

The OSO footprint to the south of WSA occurs through a mapped important area for the Swift Parrot. The development of the OSO has the potential to increase the risk of collision mortality for the Swift Parrot at this site.

However, while the threat will remain (and potentially increase), it is unlikely to significantly affect the species in the Strategic Assessment Area because:

- Western Sydney is not identified as a key area of concern with regards to this threat
- Large parts of Western Sydney are already subject to current development, and so the threat is not a novel threat to the species in the Strategic Assessment Area
- The area of Swift Parrot habitat intersected by the OSO is a reasonably small area in the context of the species' distribution

Further, the range of measures under the Plan to protect the Swift Parrot, including commitments to offset potential foraging habitat and important areas for the species, are likely to benefit the species as these localities will be managed for conservation purposes.

On balance, the package of measures in the Plan is expected to adequately manage the risk to the Swift Parrot from increased collision mortality as a result of development.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes, in particular frequent fire, is identified as a threat to the species (Saunders & Tzaros, 2011b; TSSC, 2016e). Fire can reduce tree flowering events and affect maturation of nectar rich plant species, resulting in reduced foraging resources (Saunders & Tzaros, 2011b).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact Swift Parrot habitat. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Swift Parrot being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Swift Parrot. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the Swift Parrot from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the Swift Parrot and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

PREDATION BY FERAL CATS

Predation from feral cats is identified as a threat to the Swift Parrot in the species recovery plan. New urban development within the nominated areas is very likely to increase the number of domestic cats in the local area, which in turn, may lead to an increase in feral cat populations within adjacent areas of potential Swift Parrot habitat.

Existing land use within the nominated areas and surrounding region includes residential areas and farming, which means cats are unlikely to pose a novel threat to the species in the area. However, the extent of proposed new urban development under the Plan means the threat is likely to be exacerbated.

The Plan incorporates a range of measures to manage the risks associated with predation by cats. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

These measures are considered to adequately mitigate the threat to the species.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.6.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The Swift Parrot has been recorded in avoided land in three of the nominated areas (GMAC, GPEC, and WSA). Potential foraging habitat has been mapped on avoided lands in all nominated areas. As a result, the species may be subject to additional impacts from essential infrastructure.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land

- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.6.8 POTENTIAL IMPACTS FROM TUNNELS

The tunnel footprint for the Metro Rail Future Extension intercepts:

- 67.4 ha of potential foraging habitat
- 38.4 ha of potential important areas

The tunnel footprint for the Outer Sydney Orbital intercepts:

- 99.2 ha of potential foraging habitat
- 59.4 of potential important areas

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.6.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice and Recovery Plan (and other key documents) identify the following key issues that are likely to have the greatest influence on the long-term viability of the Swift Parrot in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts such as:
    - Collision mortality
    - Inappropriate fire regimes
    - Predation by feral cats

HABITAT LOSS AND FRAGMENTATION

Development under the Plan will lead to the clearing of:

- 1,270.5 ha of Swift Parrot potential foraging habitat
- 101.1 ha of Swift Parrot important areas (noting some areas of this mapped habitat are unlikely to constitute real habitat for the species)
- 3.1 ha of Swift Parrot potential important areas

Some of this clearing will be mitigated by the retention of large trees (≥50cm DBH) during precinct planning. However, all together the impact assessment has concluded that the scale of clearing presents a medium risk of residual adverse impacts to the species, which will be addressed through the protection of 4,410 ha of potential foraging habitat (including 100 ha of important habitat as defined under the BAM) (Commitment 9).

Importantly, the clearing of potential foraging habitat is unlikely to lead to fragmentation of connectivity for the species given its highly mobile nature and the availability of potential foraging resources throughout the landscape.

It is relevant to note that the offsets for the Swift Parrot support a management priority included in the species conservation advice to *increase the area of habitat for the species that is secured and managed for conservation.*

In summary, the loss of potential habitat under the Plan is not expected to negatively influence the long-term viability of the species because the impacts:

- Will not fragment landscape connectivity
- Are compensated for through a strategic offset program designed to improve the conservation outcome within the subregion

INDIRECT IMPACTS

The potential indirect impacts associated with collision mortality, inappropriate fire regimes and predation from feral cats have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

Development under the Plan will lead to potential impacts to Swift Parrot potential foraging areas, important areas and potential important areas. However, implementation of the Plan is not expected to adversely influence the long-term viability of the species for the following key reasons:

- Direct impacts comprise a small proportion (2.1 per cent) of potential foraging habitat within the Strategic Assessment Area. These impacts will not affect any identified priority sites/regions, generally focus on poorer condition habitat, and will not lead to fragmentation
- The Plan commits to the delivery of a 4,410 ha of potential foraging habitat (including 100 ha of important habitat as defined under the BAM) for the Swift Parrot which will be located in the SCA. These areas have been designed to pick-up well-connected vegetation in the best condition in order to improve landscape scale conservation across the subregion
- Potential indirect impacts are addressed through management measures in the Plan

30.6.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan is to prevent further decline of the Swift Parrot population, and achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat to increase carrying capacity (Saunders & Tzaros, 2011b).

Specific actions have been identified to support the overall objective. These are:

- Identify the extent and quality of habitat
- Manage and protect Swift Parrot habitat at the landscape scale
- Monitor and manage the impact of collisions, competition, and disease
- Monitor population and habitat
- Increase community involvement in, and awareness of, the recovery program
- Coordinate, review, and report on recovery process

The outcome for the Swift Parrot under the Plan will not make it impossible to the achieve any of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to be implemented in order to deliver on the objectives. The Plan will not prevent implementation of any of the actions.

The commitment to strategically protect large patches of well-connected, high-quality vegetation across the Strategic Assessment Area offers real conservation benefits for the Swift Parrot. This process is consistent with one of the main strategies in the Recovery Plan to "manage and protect Swift Parrot habitat at the landscape scale".

30.6.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-26 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan has been developed to ensure that it is not inconsistent with any relevant TAPs. This analysis around consistency is presented in Chapter 15.

Table 30-26: Relevant Key Threatening Processes and associated Threat Abatement Plans for Swift Parrot

KEY THREATENING PROCESS	THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-27: Occurrence of the Swift Parrot in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	59,369.2	6,699.9

Table 30-28: Avoidance of Swift Parrot potential foraging habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	1,663.7	3,036.4	823.0	3,155.9	8,679.0
HABITAT WITHIN EXCLUDED LANDS (ha)	299.2	1,081.3	107.6	2,676.7	4,164.8
HABITAT WITHOUT EXCLUDED LANDS (ha)	**1,364.5**	**1,955.2**	**715.4**	**479.3**	**4,514.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	960.2	1,305.7	203.7	99.2	2,568.9
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	70.4	66.8	28.5	20.7	56.9
AVOIDANCE FOR OTHER REASONS (ha)	255.0	400.9	143.7	46.1	845.8
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	18.7	20.5	20.1	9.6	18.7
TOTAL AVOIDANCE (ha)	**1,215.2**	**1,706.6**	**347.4**	**145.4**	**3,414.6**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**89.1**	**87.3**	**48.6**	**30.3**	**75.6**

Table 30-29: Direct impacts to Swift Parrot potential foraging habitat within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	149.3	248.6	368.0	333.9	170.7	**1,270.5**

SPECIES AT LOW RISK OF DIRECT IMPACTS

30.7 *ANTHOCHAERA PHRYGIA* (REGENT HONEYEATER)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	*Anthochaera phrygia* (Regent Honeyeater) is a predominantly black, medium sized honeyeater with yellow trimming on the tail and wing feathers. Its head and breast are black, transitioning to pale yellow trimming and a pure pale yellow belly (DoE, 2015a, 2016).
ECOLOGY	Breeds mostly throughout spring and summer, from August to January. Breeding times appear to have a correlation with the flowering of certain eucalypt and mistletoe species. Primary food source is nectar from eucalypts and mistletoe as well as invertebrates (DoE, 2015a). Movement patterns have been associated with the regional flowering of certain eucalypt species and the species is capable of travelling large distances (DoE, 2015a). However, there is still a high level of variability with these patterns. Some individuals have been found to return to the same area in successive breeding seasons, while others have not (DoE, 2016). The area of occupancy is approximately 300 km^2 (DoE, 2015a).
DISTRIBUTION AND HABITAT	Endemic to the south-eastern Australian mainland and is patchily distributed. Its distribution extends from south-east Queensland to central Victoria. The species is observed widely across its range, but it is only known to occur regularly to breed and forage at four locations (DoE, 2015a). These are identified in the recovery plan (along with surrounding subsidiary areas) as Bundarra-Barraba (NSW), Capertee Valley (NSW) and Hunter Valley (NSW), and the Chiltern area (VIC) (DoE, 2016). A recent paper on the breeding ecology of the species (Crates, Rayner et al., 2019) also identifies breeding sites at the Severn River (northern NSW) and in the Burragorang Valley in the Blue Mountains to the west of the Strategic Assessment Area. At the end of 2019, a breeding pair was observed near Mulgoa within the Strategic Assessment Area. Mostly associated with box ironbark eucalypt woodland and dry sclerophyll forest and has also been found in riparian corridors with she-oak *(Casuarina* spp.*)*. The species has a preference for trees that are taller and have a larger diameter, as they typically produce more nectar (DoE, 2015a). Nesting generally occurs in the canopy of mature trees. The breeding areas often consist of a nest tree and the food sources surrounding it (DoE, 2015a). The species is thought to prefer larger, better quality patches that support all woodland structural elements, including large trees which are important for breeding and foraging. Better quality patches buffer against the negative impacts of edge effects and provide the necessary productive

	resources. The quality of remnants is also thought to influence the species' ability to undertake large-scale movements, as degraded vegetation is likely to be missing important ecological features, such as the larger trees and/or high quality nectar flows (DoE, 2016). Habitat critical to the survival is defined in the recovery plan (DoE, 2016) as: • *Any breeding or foraging habitat in areas where the species is likely to occur, and* • *Any newly discovered breeding or foraging locations*
POPULATIONS	Occurs as a single population that was estimated to be 350-400 mature individuals in 2010 (DoE, 2016).
SOS SITES	The following SOS sites for the species have been identified: • Capertee Valley • Lower Hunter Valley • Taronga Zoo • Bundarra – Barraba • Mudgee / Wollar • Western Plains Zoo (Proposed)
RELEVANT PLANS AND POLICIES	Conservation Advice *Anthochaera phrygia* Regent Honeyeater (DoE, 2015a) National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia)* (DoE, 2016) Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for the Regent Honeyeater.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82338

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	Yes	No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map. Habitat maps outside the nominated areas for the Regent Honeyeater were generated using BioNet associations of intact and thinned vegetation conditions, and scattered trees. Targeted surveys for this species were not undertaken and the species was not recorded during surveys for this project.				

	OUTSIDE THE NOMINATED AREAS
	Knowledge based map. As above. No targeted surveys as part of this project were undertaken outside the nominated areas.
POPULATION MAPPING	**RECORD SELECTION**
	All available BioNet records were considered in the assessment.
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *Anthochaera phrygia* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *Anthochaera phrygia* were downloaded in October 2020.
	POPULATION DEFINITION
	The Regent Honeyeater comprises a single population (DoE, 2016).
	IMPORTANT POPULATION CRITERIA
	The population was considered to be important as the species is critically endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-24 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-31 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Regent Honeyeater in the Strategic Assessment Area. **Records** The Regent Honeyeater occurs throughout the Strategic Assessment Area with the majority of records associated with the larger patches of vegetation towards the north. There is a total of 93 records within the Strategic Assessment Area. Until very recently, all records related to foraging birds. However, at the end of 2019 a pair was observed successfully breeding near Mulgoa at Fernhill Estate, just west of the boundary between the WSA and GPEC. The nest was recorded in vegetation mapped as Shale Sandstone Transition Forest. It is connected to the much broader areas of intact vegetation west of the Strategic Assessment Area; although the nest site itself is towards the interface of this vegetation and cleared rural land. The site is protected and managed in perpetuity under a biobanking agreement. **Potential habitat** The baseline mapping for this assessment has mapped approximately 59,369.2 ha of potential habitat across the Strategic Assessment Area. This area is so large because of the broad associations the species has with a variety of PCTs. However, it is noted that the actual area of suitable habitat is likely to be smaller given the species preference for larger, high-quality patches of woodland which are generally more limited within the subregion due to historical clearing and land degradation. EES has mapped important habitat for the Regent Honeyeater as part of the BAM process. There is no mapped important habitat within the nominated areas or transport corridors for the species. The known breeding site near Mulgoa has been mapped as important as part of this BAM process.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.7.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 4,514.3 ha of potential habitat for the Regent Honeyeater within the nominated areas (not including excluded lands). Approximately 3,414.6 ha (75.6 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,568.9 ha was avoided for biodiversity purposes
- 845.8 ha was avoided for other purposes

In addition, Appendix E of the Plan includes a specific measure for the Regent Honeyeater to retain large trees (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction.

A breakdown of avoidance across each nominated area is provided in Table 30-32.

It is important to note that the avoidance calculations in Table 30-32, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-32 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.7.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.7.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will lead to the loss of potential habitat for the species. It will not result in direct impacts to any known breeding habitat or key areas identified in the species recovery plan and conservation advice.

LOSS OF POTENTIAL HABITAT

Approximately 1,270.5 ha of potential habitat will be lost as a result of the implementation of the Plan (1,099.8 ha within the nominated areas and 170.7 ha within transport corridors outside the nominated areas). This habitat represents 2.1 per cent of mapped potential habitat across the Strategic Assessment Area. As identified below, potential habitat within each of the nominated areas and the transport corridors is unlikely to be used much or at all by the species due to the level of clearing and fragmentation.

Impacts are proposed to occur as follows:

- GPEC: Loss of 333.9 ha of potential habitat. Most of which occurs as fragmented patches in an existing urbanised environment. Unlikely that the nominated area is used or important to the species. Only two post-1990 records are present which occur in cleared or developed locations
- WSA: Loss of 368 ha of potential habitat. Most of which occurs as fragmented patches in an existing, heavily cleared rural landscape. Unlikely that the nominated area is important to the species. No records of the species
- GMAC: Loss of 248.6 ha of potential habitat. Most of which occurs to the edges of vegetated areas. Unlikely that the nominated area is used or important for the species. One record is present within the nominated area
- Wilton: Loss of 149.3 ha of potential habitat. Most of which occurs to the edges of vegetated areas. Unlikely that the nominated area is used or important for the species. No records of the species
- Transport outside the nominated areas: Loss of 170.7 ha of potential habitat. Occurs to mostly fragmented vegetation patches across the Outer Sydney Orbital

A summary of these impacts is provided in Table 30-33.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential habitat is considered to be low. This is because:

- The likelihood of substantial impacts occurring to the species has been categorised as unlikely. There will be no impacts to known breeding habitat or key areas identified in the species Recovery Plan or Conservation Advice. While the extent of clearing of mapped potential habitat for the Regent Honeyeater is large, the likely impacts to the species are considered to be minor. Impacts generally focus on the more fragmented and degraded remnants which are unlikely to provide the ecological elements preferred or needed by the species. This is reflected in the almost complete absence of records within the impacted areas and the lack of important habitat mapping by EES within the nominated areas or transport corridors. The Cumberland subregion more broadly has been subject to large levels of historical clearing and land use practices that have reduced its capacity to support the species, and this is again reflected in relatively low number of records across the subregion
- The consequence of any impacts to the species has been categorised as major. There will be loss of approximately 2.1 per cent of mapped potential foraging habitat in the Strategic Assessment Area, however, there are very few records close to and within areas that will be impacted

30.7.4 FRAGMENTATION OF HABITAT

Given the wide-ranging nature of the species, it is considered unlikely that development within the nominated areas or transport corridors would lead to any fragmentation effects. The lack of records within the nominated areas and transport corridors suggests that these mapped potential habitat areas may already be in too degraded a state to contain enough of the important ecological features needed to support foraging movements (DoE, 2016).

30.7.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for the Regent Honeyeater.

However, it is worth noting that mapped habitat prepared for this project for Regent Honeyeater and the Swift Parrot are the same. Under Commitment 9, the Plan commits to protecting 4,410 ha of potential foraging habitat for the Swift Parrot, which may provide benefits to the Regent Honeyeater.

Further, it is noted that the SCA contain 17,178 ha of potential foraging habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 2,847.2 ha of potential foraging habitat for the Regent Honeyeater is contained within the three conservation reserves proposed by the Plan, including:

- 1,536.8 ha within the Georges River Koala Reserve
- 66.2 ha within the Confluence Reserve investigation area
- 1,244.2 ha within the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.7.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice and Recovery Plan (and other key documents) for the Regent Honeyeater identify a range of threats to the species (DoE, 2015a, 2016). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts.

The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan: degradation of habitat especially through the removal of large mature trees, firewood collection, spread of weeds, and inappropriate fire regimes.

Eucalypt dieback, grazing by livestock and rabbits, competition with other nectivorous birds and honeybees, increased predation by native nest predators, and loss of genetic diversity are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The main area of concern for indirect impacts is the Mulgoa region west of GPEC and WSA where the species has recently been observed breeding. Importantly, this site is protected and managed in perpetuity as part of a biobanking agreement. Management of this site will substantially minimise the threat of any indirect impacts on the species associated with development.

More broadly across the Strategic Assessment Area, the level of historical clearing and degrading land uses has reduced the value of habitat. This limits the extent that any threatening processes potentially exacerbated under the Plan, might lead to actual impacts on the species.

However, it is recognised that the package of commitments and actions under the Plan will lead to the protection and management of large areas of the better-quality, better-connected vegetation within the SCA. Although the protection of these areas is required to compensate for the impacts of development on other threatened species and ecological communities, there is considerable overlap with vegetation types that have the potential to provide foraging resources for the Regent Honeyeater. With greater protection and management, these areas are likely to improve the foraging capacity of the subregion to the species. This means the potential indirect impacts from development on these areas is likely to become more relevant in the future as the species' numbers begin to recover within these areas as they are managed and protected.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Regent Honeyeater are discussed below for each identified indirect impact.

It is noted that the Plan commits to protecting of 4,470 ha of potential foraging habitat for the Swift Parrot, which is equivalent to potential foraging habitat for the Regent Honeyeater. Further, 2,847.2 ha of potential foraging habitat for the Regent Honeyeater is contained within the three conservation reserves proposed by the Plan. The protection of habitat for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

REMOVAL OF TREES AND FIREWOOD COLLECTION

Removal of large, mature trees and the collection of firewood are identified in the Conservation Advice and Recovery Plan as threats to the Regent Honeyeater. These threats have the potential to increase within the Strategic Assessment Area due to development within the nominated areas. Habitat considered most at risk are areas that occur in close proximity to new urban development.

Appendix E of the Plan includes a species-specific measure to retain large trees (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction. This measure will be implemented through the DCP template, Mitigation Measures Guideline, and the *Cumberland Plain Conservation Plan Guidelines for Infrastructure*, and will apply across all four nominated areas. The measure will minimise the risk of impacts to the species occurring due to the removal of large mature trees.

Collection of firewood is considered to be a form of habitat disturbance. The Plan incorporates a range of measures to mitigate the risks associated with habitat disturbance which will mitigate the risk of firewood collection. These include:

- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers could assist in ensuring compliance with firewood collection threats where it is identified as an issue
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the species from tree removal and firewood collection. This is because:

- Conservation lands will be actively managed which will address disturbance and illegal activities in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

SPREAD OF WEEDS

Invasive weeds are identified as a threat to the Regent Honeyeater as they degrade foraging remnants. Weed incursion in the habitat areas is associated with agricultural activities as well as urban development.

Key weeds that occur within the subregion include: African Olive (*Olea europaea* subsp. *cuspidata*), Fireweed (*Senecio madagascariensis*), Spear Thistle (*Cirsium vulgare*), Cat's Ear (*Hypochaeris radicata*), Pigeon Grass (*Setaria gracilis*), Plantain (*Plantago lanceolata*), Paddy's Lucerne (*Sida rhombifolia*), Bridal Creeper (*Myrsiphyllum asparagoides*), Sow Thistle (*Sonchus oleraceus*), and Broad-leafed and Small-leaf Privet (*Ligustrum lucidum* and *L. Sinense*) in wetter areas.

The most serious threats are from Bridal Creeper and African Olive as they are highly competitive and difficult to manage.

These weeds are already present within the Strategic Assessment Area. However, urban development and transport have the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

Foraging habitat is most susceptible to the threat of weeds from development under the Plan where new urban development occurs adjacent to the habitat and introduces edge effects.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for the Regent Honeyeater:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Weeds will be actively managed within all areas added to conservation as part of the offset program.

The package of measures in the Plan is expected to adequately manage the risk posed to the Regent Honeyeater from invasive weeds. This is because:

- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program which is expected to provide large areas of potential foraging habitat for the Regent Honeyeater
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes, in particular frequent fire, is identified as a threat to the Regent Honeyeater. Where fire intervals are too frequent, flowering events and maturation of nectar rich plant species can be reducing, leading to a reduction in foraging resources (DoE, 2016).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact Regent Honeyeater habitat. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Regent Honeyeater being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values

  - A process to work with delivery partners to implement the Fire Management Strategy
  - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Regent Honeyeater. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the Regent Honeyeater from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the Regent Honeyeater and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.7.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

While mapped potential habitat for the Regent Honeyeater occurs on avoided land, and these areas may be subject to impacts from essential infrastructure, it is very unlikely the species will be adversely affected. There are no records of the Regent Honeyeater on avoided land and very few elsewhere in the nominated areas, the species is highly mobile and wide-ranging, and the scale of impacts is not expected to be significant.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
  - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
  - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

Further, under Commitment 5, the Department will prepare the *Cumberland Plain Conservation Plan Guideline for Infrastructure* which will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.7.8 POTENTIAL IMPACTS FROM TUNNELS

Potential habitat for the Regent Honeyeater occurs within the tunnel footprints for the Metro Rail Future Extension (67.4 ha) and the Outer Sydney Orbital (108.2 ha). These areas are not associated with records and are not considered important to the species.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.7.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice and Recovery Plan identify the following key issues that are likely to have the greatest influence on the long-term viability of the Regent Honeyeater in relation to implementation of the Plan:

- Habitat loss and fragmentation
- Indirect impacts associated with degradation of habitat through the removal of large mature trees, firewood collection, spread of weeds, and inappropriate fire regimes

HABITAT LOSS AND FRAGMENTATION

Loss and fragmentation of Regent Honeyeater habitat within the Strategic Assessment Area is not likely to be an issue and the risk of residual adverse impacts to the species has been assessed here as low. Although the Plan authorises the clearing of 1,270.5 ha of potential habitat, this does not relate to any key breeding or foraging areas identified in the Conservation Advice or Recovery Plan and predominantly occurs:

- In already fragmented and degraded areas that offer low habitat value
- In areas where the species has not been recorded recently (or at all)
- In areas that have not been mapped as important habitat by EES as part of the BAM process

More generally, the Cumberland subregion has been subject to extensive historical clearing and land use practices that have reduced its capacity to support the species.

The package of commitments and actions under the Plan will lead to the protection and management of large areas of the better quality, well-connected vegetation within the SCA. The protection of these areas is required to compensate for the impacts of development on other threatened species and ecological communities (including Swift Parrot which shares the same areas of mapped habitat). With greater protection and management, these areas are likely to improve the foraging capacity of the subregion to the Regent Honeyeater.

This outcome directly supports one of the conservation and management actions in the Conservation Action to *improve the extent and quality of regent honeyeater habitat*, as well as a number of the on-ground actions identified to achieve the strategies and objectives in the Recovery Plan.

INDIRECT IMPACTS

The potential indirect impacts associated with degradation of habitat will be managed and mitigated through a specific measure and generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

There is a low risk that development under the Plan will adversely impact the Regent Honeyeater and any long-term impacts to viability in the subregion have the potential to be positive for the following key reasons:

- There will be no direct impacts to areas identified as important for breeding or foraging
- The nominated areas and transport corridors offer limited habitat values, and the Regent Honeyeater has barely been observed in these areas
- The majority of the Cumberland subregion is currently likely to offer only marginal habitat for the species due to extensive levels of historical vegetation clearing and degrading land use practices. However, the protection and management of large areas of vegetation types associated with foraging habitat is expected to improve the capacity of the subregion to support the species
- Potential indirect impacts are addressed through management measures in the Plan

30.7.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The objectives of the Recovery Plan for the Regent Honeyeater are to:

- Reverse the long-term population trend of decline and increase the numbers of regent honeyeaters to a level where there is a viable, wild breeding population, even in poor breeding years; and to
- Enhance the condition of habitat across the Regent Honeyeater's range to maximise survival and reproductive success, and provide refugia during periods of extreme environmental fluctuation (DoE, 2016)

Specific strategies have been identified to support the overall objectives. These are:

- Improve the extent and quality of Regent Honeyeater habitat
- Bolster the wild population with captive-bred birds until the wild population becomes self-sustaining
- Increase understanding of the size, structure, trajectory, and viability of the wild population
- Maintain and increase community awareness, understanding, and involvement in the recovery program (DoE, 2016)

The outcome for the Regent Honeyeater under the Plan will not prevent achievement of any of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of strategies in order to deliver on the objectives. The Plan will not prevent implementation of any of the strategies.

The commitment to strategically protect large patches of well-connected, high-quality vegetation across the Strategic Assessment Area offers potential conservation benefits for the Regent Honeyeater. This process is consistent with one of the main strategies in the Recovery Plan to "improve the extent and quality of regent honeyeater habitat".

30.7.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-30 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan has been developed to ensure that it is not inconsistent with any relevant TAPs. This analysis around consistency is presented in Chapter 15.

Table 30-30: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Regent Honeyeater

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Competition and land degradation by rabbits	Threat abatement plan for competition and land degradation by rabbits (DoEE, 2016a)
Land clearance	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-31: Occurrence of the Regent Honeyeater in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	59,369.2	6,699.9

Table 30-32: Avoidance of Regent Honeyeater habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	1,663.7	3,036.4	823.0	3,155.9	8,679.0
HABITAT WITHIN EXCLUDED LANDS (ha)	299.2	1,081.3	107.6	2,676.7	4,164.8
HABITAT WITHOUT EXCLUDED LANDS (ha)	**1,364.5**	**1,955.2**	**715.4**	**479.3**	**4,514.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	960.2	1,305.7	203.7	99.2	2,568.9
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	70.4	66.8	28.5	20.7	56.9
AVOIDANCE FOR OTHER REASONS (ha)	255.0	400.9	143.7	46.1	845.8
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	18.7	20.5	20.1	9.6	18.7
TOTAL AVOIDANCE (ha)	**1,215.2**	**1,706.6**	**347.4**	**145.4**	**3,414.6**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**89.1**	**87.3**	**48.6**	**30.3**	**75.6**

Table 30-33: Direct impacts to Regent Honeyeater within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	149.3	248.6	368.0	333.9	170.7	**1,270.5**

30.8 *BOTAURUS POICILOPTILUS* (AUSTRALASIAN BITTERN)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Botaurus poiciloptilus* (Australasian Bittern) is a large heron-like bird. It has mottled brown, dark brown to black feathers, a straw-yellow bill and pale green to olive legs. The average male weighs 1.4 kg and the average female weighs 0.9 kg (TSSC, 2019a).
ECOLOGY	Breeding occurs from October to February. Females usually lay four to five olive-brown eggs. Nests are built on a bed of reeds in densely-vegetated wetlands, and placed about 30 cm above the water level (TSSC, 2019a). Feeds mainly at night on fish, eels, frogs, freshwater crayfish and aquatic insects (Garnett et al., 2011). The species is mainly solitary but has been seen in pairs or groups of up to 12 birds (TSSC, 2019a).
DISTRIBUTION AND HABITAT	The Australasian Bittern occurs in New Zealand, New Caledonia, and Australia. In Australia the species occurs in south-eastern Australia: throughout Tasmania, south east of South Australia, Victoria, NSW (excluding the north west), and up to Yeppoon in Queensland. It also occurs in the south-west of Western Australia between Moora and Cape Arid (TSSC, 2019a). In NSW it occurs along the coast and has been recorded in the Murray-Darling Basin, in the floodplain wetlands of the Murray, Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers. The species has been recorded in the Cumberland subregion. The area of occupancy in Australia is estimated to be 1,150 km^2 (TSSC, 2019a). The species inhabits freshwater or brackish swamps that are shallow and vegetated, with a preference for the presence of sedges, rushes, and reeds (Garnett et al., 2011). The species is less often found in estuaries or tidal wetlands (TSSC, 2019a). The species moves between habitats as suitability changes and has been observed to use coastal wetlands during periods of drought and ephemeral wetlands when wet (TSSC, 2019a). All natural habitat where the species is known or likely to occur is considered habitat critical to the survival of the species (TSSC, 2019a).
POPULATIONS	The Australasian Bittern occurs as two sub-populations: one in south-eastern Australia and the other in south-western Australia (TSSC, 2019a). The total Australian population is estimated at 1,000 mature individuals (Garnett et al., 2011).
SOS SITES	This species has been assigned to the landscape species management stream because it is distributed across large areas and is subject to threatening processes that generally act at the landscape scale rather than at distinct, definable locations (OEH, 2018c).

	The following SOS site for the species has been identified: • Gayini
RELEVANT PLANS AND POLICIES	Conservation Advice *Botaurus poiciloptilus* Australasian Bittern (TSSC, 2019a) Threat abatement plan for predation by the European red fox (DEWHA, 2008n) Threat abatement plan for predation by feral cats (DoE, 2015g)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for the Australian Bittern.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1001

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	Yes	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps were generated using BioNet PCT associations, vegetation condition parameters (intact, thinned), 40 m buffer to hydrolines (based on preferred habitat comprising wetlands, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water) (TSSC, 2019a). No targeted surveys were undertaken as part of this project.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). As above. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	Records restricted to post 2007 to account for estimated 11-year lifespan of the species.				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *Botaurus poiciloptilus* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *Botaurus poiciloptilus* were downloaded in September 2019.				

	POPULATION DEFINITION
	The south-eastern Australian subpopulation of the species is considered as one population for this assessment. All records within the Strategic Assessment Area are therefore considered part of the same population.
	IMPORTANT POPULATION CRITERIA
	All populations were considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-1 for a map of records and habitat across the Strategic Assessment Area
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-35 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Australasian Bittern in the Strategic Assessment Area. **Records** There are five records of the species within the Strategic Assessment Area: • Four occur at Pitt Town Lagoon in the north of the Strategic Assessment Area near to the Hawkesbury River (approximately 15 km from the nearest development area) • One occurs near Wianamatta (South Creek) in Oran Park (approximately 9 km from the nearest development area) **Potential habitat** The baseline mapping for the assessment has mapped 2,534.5 ha of potential habitat within the Strategic Assessment Area. Based on the limited number of records, this mapping is considered to be highly precautionary as it is based on all mapped streams with the appropriate PCTs. While some records occur in the Strategic Assessment Area, the area is not recognised as a key location for the species. In NSW the species primarily occurs along the coast and is frequently recorded in the Murray Darling Basin, notably in floodplain wetlands of the Murray, Murrumbidgee, Lachlan, Macquarie, and Gwydir Rivers (TSSC, 2019a). Notable observations within proximity of the Strategic Assessment Area include Sydney Olympic Park approximately 9 km to the east of the Strategic Assessment Area, and Towra Point Wetlands approximately 20 km from the Strategic Assessment Area.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.8.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 186 ha of potential habitat within the nominated areas (not including excluded lands). Approximately 105.9 ha (56.9 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluding lands). Of this:

- 12.3 ha was avoided for biodiversity purposes
- 93.5 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 30-36.

It is important to note that the avoidance calculations in Table 30-36, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-36 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.8.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.8.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will not lead to direct impacts to known habitat. However, it will result in impacts to some potential habitat.

LOSS OF POTENTIAL HABITAT

Approximately 97.7 ha of potential habitat will be lost as a result of the implementation of the Plan (80.1 ha within the nominated areas and 17.6 ha within transport corridors outside the nominated areas). This habitat represents 3.9 per cent of mapped potential habitat across the Strategic Assessment Area. The majority of potential habitat (54.6 ha) to be impacted occurs within GPEC and is associated with the proposed alignment of the Outer Sydney Orbital within the vicinity of Wianamatta (South Creek).

The Conservation Advice notes that the major threat to the species from habitat loss relates to *the long-term diversion of water away from wetlands and floodplains to support irrigated agriculture and urban water supplies; and the permanent loss of wetlands through conversion to other purposes, such as agricultural and urban development* (TSSC, 2019a). Development under the Plan will not involve any of these types of impacts. The loss of potential habitat relates to clearing of vegetation mapped as potential habitat due to broad PCT associations or development that occurs within the 40 m buffer of hydrolines.

A summary of these impacts is provided in Table 30-37.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be low. This is because:

- The likelihood of substantial impacts occurring to the species has been categorised as unlikely. There will be no impacts to areas known to support the species and only minor impacts to potential foraging habitat. The Strategic Assessment Area represents more marginal habitat for the species, which is more frequently recorded along the coast and within the Murray Darling Basin when in NSW. The potential habitat mapping is considered to be highly precautionary
- The consequence of any impacts to the species has been categorised as moderate. There will be loss of approximately 3.9 per cent of mapped potential habitat in the Strategic Assessment Area. There is low confidence that the species occurs in the impact areas

30.8.4 FRAGMENTATION OF HABITAT

Given the lack of records and wide-ranging nature of the species, it is considered unlikely that development within the nominated areas or transport corridors would lead to any fragmentation effects.

30.8.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for the Australasian Bittern.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.8.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for the Australasian Bittern identifies a range of threats to the species (TSSC, 2019a). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Hydrological changes
- Predation by introduced vertebrates
- Weed invasion
- Inappropriate fire regimes

Transition from ponded rice to other farming systems, impacts from grazing animals and salinization of coastal wetlands are also identified in the conservation advice as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for Australasian Bittern are discussed below for each identified indirect impact.

HYDROLOGICAL CHANGES

Habitat degradation from increased salinity, siltation and pollution is identified as a threat to the Australasian Bittern (TSSC, 2019a). This is a particular threat where important habitat areas are in the proximity of development and well connected hydrologically. The likelihood of adverse impacts to the species due to development under the Plan is low as mapped potential habitat in the Strategic Assessment Area within the vicinity of development lacks records and is not considered to be critical for the species.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

While the threat to the species is already low, the package of measures in the Plan manages any residual risk to the species from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to habitat for the species

PREDATION BY INTRODUCED VERTEBRATES

Predation by introduced vertebrates such as foxes and cats is a key threat to the Australasian Bittern (noting that the extent of the impacts on this species is unknown) (DSEWPC, 2011).

Cats and foxes are already well established in the Strategic Assessment Area and are unlikely to pose a novel threat to the species. However, the extent of proposed new urban development under the Plan means that the threat, particularly associated with cats, is likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats in the local area, which, in turn, may lead to an increase in feral cat numbers. The main areas of concern relate to new urban development in Wilton and the southern section of GMAC, where the current density of houses is low.

While the actual impact on the Australasian Bittern is expected to be minimal due to their limited use of the Strategic Assessment Area, the Plan incorporates a range of measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
  - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
  - Preparation of a Pest Animal Control Implementation Strategy
  - A process to enter into written agreements with delivery partners to implement the pest animal control program
  - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces

- Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
- Require appropriate management and control of pest animals relevant to development sites

WEED INVASION

Weed invasion and changes in abundance of certain plant species can reduce wetland productivity, which may impact on the quality of habitat for the Australasian Bittern (DSEWPC, 2011).

Many weeds are already present within the Strategic Assessment Area and pose a threat to habitat for the Australasian Bittern. However, urban development and transport have the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The species is most susceptible to the threat of weeds from development under the Plan where new development occurs adjacent to habitat areas or connected waterways. However, the extent of impacts on the species is generally expected to be low given the limited use of the Strategic Assessment Area by the species and lack of records within proximity to development.

The Plan also incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for the Australasian Bittern:
  - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes are identified as a key threat to the Australasian Bittern. Fire can reduce the quality of habitat features that are important to the species (DSEWPC, 2011).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Australasian Bittern being:
  - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
  - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
  - A process to work with delivery partners to implement the Fire Management Strategy
  - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Australasian Bittern. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.8.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There are no records and limited potential habitat for the Australasian Bittern on avoided land in the nominated areas.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land

- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.8.8 POTENTIAL IMPACTS FROM TUNNELS

Potential habitat for the Australasian Bittern occurs within the tunnel footprints for the Metro Rail Future Extension (4.6 ha) and the Outer Sydney Orbital (8.2 ha). These areas are not associated with records and the habitat mapping for the species is considered to be highly precautionary.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.8.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DSEWPC, 2011) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the Australasian Bittern in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts such as:
  - Reduced water quality
  - Predation by introduced vertebrates
  - Weed invasion
  - Inappropriate fire regimes

HABITAT LOSS

This assessment has identified the risk of residual adverse impacts to the Australasian Bittern from habitat loss as being low. Although development under the Plan will lead to the loss of 97.7 ha of mapped potential habitat, impacts on the species are likely to be minimal given:

- The areas being impacted are not known to support the species and the potential habitat mapping is very precautionary
- The importance of the Strategic Assessment Area more broadly is marginal. When in NSW, the species is more frequently recorded along the coast and within the Murray Darling Basin
- The loss of habitat does not involve the types of impacts or activities identified in the Conservation Advice as particularly problematic, which include *the long-term diversion of water away from wetlands and floodplains to support irrigated agriculture and urban water supplies; and the permanent loss of wetlands through conversion to other purposes, such as agricultural and urban development*. Instead, direct impacts under the Plan relate to clearing of vegetation mapped as potential habitat due to broad PCT associations, or development that occurs within the 40m buffer of hydrolines

As a result, habitat loss under the Plan is not expected to affect the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with the identified threats will be managed and mitigated through the generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

Development under the Plan will not affect areas known to support the Australasian Bittern but will lead to the loss of a small proportion of areas mapped as potential habitat. However, implementation of the Plan is not expected to adversely influence the long-term viability of the species for the following key reasons:

- Habitat known to support the species within the Strategic Assessment Areas occurs some distance from development and will not be affected by implementation of the Plan
- Areas of potential habitat that will be directly affected has been mapped using highly precautionary assumptions and impacts are not expected to affect the species' use of the Strategic Assessment Area
- Potential indirect impacts will be addressed through management measures in the Plan

30.8.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.8.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-34 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan has been developed to ensure that it is not inconsistent with any relevant TAPs. This analysis around consistency is presented in Chapter 15.

Table 30-34: Relevant Key Threatening Processes and associated Threat Abatement Plans for Australasian Bittern

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008n)
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-35: Occurrence of the Australasian Bittern in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	2,534.5	303.4

Table 30-36: Avoidance of Australasian Bittern habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	124.6	89.6	445.3	659.4
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	106.8	9.0	357.6	473.4
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**17.8**	**80.6**	**87.6**	**186.0**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	3.2	4.4	4.7	12.3
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	17.9	5.5	5.4	6.6
AVOIDANCE FOR OTHER REASONS (ha)	0.0	7.7	57.5	28.3	93.5
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	43.3	71.3	32.3	50.3
TOTAL AVOIDANCE (ha)	**0.0**	**10.9**	**61.9**	**33.1**	**105.9**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**61.1**	**76.8**	**37.7**	**56.9**

Table 30-37: Direct impacts to Australasian Bittern habitat within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	6.9	18.7	54.6	17.6	**97.7**

30.9 *CHALINOLOBUS DWYERI* (LARGE-EARED PIED BAT)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing upgraded to Endangered (DAWE, 2021d)
DESCRIPTION	*Chalinolobus dwyeri* (Large-eared Pied Bat) is a small to medium-sized insectivorous bat with shiny, black fur on its body. Has a total length of up to 10 cm and weighs 7-12 g (DoEE, 2018f).
ECOLOGY	It is a nocturnal species and forages for insects below the canopy and can travel several kilometres from roost sites. Breeding occurs in early winter and young are born in early summer. Females normally carry one or two pups and give birth once a year. The species has been recorded in groups of up to 50 breeding females at maternity roosts (DoEE, 2018f) .They have high site fidelity and visit the same maternity site over many years (OEH, 2019f)
DISTRIBUTION AND HABITAT	Records are poor for the species but occur from Shoalwater Bay in south Queensland to Ulladulla in south-eastern NSW. In NSW, it is found in areas of volcanic strata in the north-east at Coolah Tops, Mt Kaputar and Warrumbungle National Park and in sandstone areas of the Sydney Basin and the western slopes and plains including Pilliga Nature Reserve (DERM, 2011). The area of occupancy is estimated to be 9,120 km^2 (DoEE, 2018f). Inhabits well-timbered areas and low to mid-elevation dry open forests and woodland near preferred roosting locations of sandstone caves, crevices in cliffs, old mine workings, and disused mud nests of the Fairy Martin (*Petrochelidon ariel*). Requires very specific nursery roosts with deep roofs that allow juveniles to learn to fly and roof indentations, which are likely to capture the heat. The species is not associated with tree hollows. Habitat is associated with the following TECs: • Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • Shale Sandstone Transition Forest • Brigalow (*Acacia harpophylla* dominant and co-dominant) • White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland • Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley • Temperate Highland Peat Swamps on Sandstone • Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

	• New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands. (DERM, 2011) The species Recovery Plan identifies the following as habitat critical to survival of the Large-eared Pied Bat (DERM, 2011): • Any maternity roosts • Sandstone cliffs and fertile wooded valley habitat within close proximity of each other
POPULATIONS	There is insufficient information to estimate total population. The species is thought to exist in a number of small populations, with colonies containing up to 50 individuals. Important populations in NSW exist in the sandstone escarpments of the Sydney basin and north west slopes of NSW (DERM, 2011).
SOS SITES	There are no SOS sites identified for the species because there is insufficient information available for effective management.
RELEVANT PLANS AND POLICIES	National recovery plan for the Large-eared Pied Bat *Chalinolobus dwyeri* (DERM, 2011)
SPECIES-SPECIFIC GUIDELINES	There are no specific guidelines for this species.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=183

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		Yes	Yes	No	Yes
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps within the nominated areas for the Large-eared Pied Bat were generated using BioNet associations of intact and thinned vegetation conditions. Mapping was also restricted to sandstone areas and cliffs within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines/tunnels. No targeted surveys as part of this project were undertaken for this species.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). As above. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	All BioNet records for the Strategic Assessment Area were included in the assessment.				

	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *Chalinolobus dwyeri* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *Chalinolobus dwyeri* were downloaded in September 2019.
	POPULATION DEFINITION
	The species is known to breed in very few locations across NSW and the distance bats move from the maternity roost to over wintering roosts has not been established, but is likely to be less than 100 km (DoEE, 2018f). As such all records within the Cumberland subregion are considered likely to be from the same breeding population
	IMPORTANT POPULATION CRITERIA
	The population of Large-eared Pied Bats was considered important within the Strategic Assessment Area because it is a population identified or inferred in a Commonwealth conservation advice, recovery plan, final determination, or other relevant policy document as being important.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-22 for a map of records and potential habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-39 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Large-eared Pied Bat in the Strategic Assessment Area. **Records** The Large-eared Pied Bat has been recorded in the Strategic Assessment Area and surrounding region. There are 49 records for the species within the Strategic Assessment Area, with the majority of observations from the last 10 years. The records occur along the boundary of the Strategic Assessment Area in the south (where the largest cluster of records occurs within Wilton), east and west and are generally associated with areas of sandstone geology. These records are all considered to form part of a single population and which, more broadly, form part of the important population associated with the sandstone escarpments of the Sydney Basin. **Potential habitat** The baseline mapping for this assessment has mapped approximately 25,451.4 ha of potential habitat across the Strategic Assessment Area. The majority of the potential habitat occurs in the south of the Strategic Assessment Area and along the western and south-eastern edges, again in association with areas of sandstone. Habitat within the Strategic Assessment Area is likely to be used predominantly for foraging. Interrogation of the observation codes of records for the species indicate there are no known roost or breeding sites for the species within the Strategic Assessment Area. Bat surveys for the species within a part of the northern section of Wilton did not confirm the presence of breeding habitat or breeding individuals. However, there are a number of suitable caves in the Appin and Wilton areas which may be used for roosting (Bruce Mullins, pers com).

	The habitat mapped within the Strategic Assessment Area forms part of a much larger area of the species' known distribution. Records occur from Nowra in the south, up the coast to Newcastle and inland to Kanangra-Boyd National Park and Wollemi National Park.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.9.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 3,150.3 ha of potential habitat for the Large-eared Pied Bat within the nominated areas (not including excluded lands). Approximately 2,868.8 ha (91.1 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,189.6 ha avoided for biodiversity purposes
- 679.2 ha avoided for other purposes

The majority of avoidance occurs in GMAC (1,632.5 ha or 90.4 per cent) and Wilton (1,236.2 ha or 92.1 per cent).

A breakdown of avoidance across each nominated area is provided in Table 30-40.

It is important to note that the avoidance calculations in Table 30-40, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-40 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.9.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.9.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will lead to a loss of potential habitat for the species. There will be no impacts to known roosting or breeding areas.

LOSS OF POTENTIAL HABITAT

Approximately 285 ha of potential Large-eared Pied Bat habitat will be lost, predominantly in Wilton and GMAC. This represents 1.1 per cent of potential habitat within the Strategic Assessment Area.

At a broader landscape level, direct impacts are proportionally smaller still, given the areas of foraging habitat within the Strategic Assessment Area forms a relatively small part of much larger and intact areas of habitat to the north and west of the Strategic Assessment Area and to the south of Sydney.

A summary of these impacts is provided in Table 30-41.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be low. This is because:

- The likelihood of substantial impacts occurring to the species has been categorised as possible. There will be no impacts to known breeding or roosting areas, and moderate impacts to foraging habitat. However, impacts to foraging habitat relates to small sections on the fringes of habitat corridors. These corridors are associated with canopied vegetation along riparian corridors in an otherwise cleared landscape. The corridors themselves will be maintained which is important as the Recovery Plan notes that narrow connecting riparian strips in otherwise cleared habitat are sometimes quite heavily used. The species is wide-ranging and potential foraging habitat in the Strategic Assessment Area forms part of a much larger area of the species' known distribution
- The consequence of any impacts to the species has been categorised as moderate. There will be loss of approximately 1.1 per cent of mapped potential foraging habitat in the Strategic Assessment Area

30.9.4 FRAGMENTATION OF HABITAT

Loss of potential habitat relates to foraging habitat mainly within GMAC and Wilton and relates to small sections on the fringes of habitat corridors. Development will not increase the level of habitat fragmentation in these areas.

30.9.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for the Large-eared Pied Bat.

However, it is noted that the SCA contain 11,613.9 ha of potential habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 2,413.1 ha of potential habitat for the Large-eared Pied Bat is contained within the three conservation reserves proposed by the Plan, including:

- 1,501 ha within the Georges River Koala Reserve
- 0.2 ha within the Confluence Reserve investigation area
- 911.9 ha within the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.9.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan for the Large-eared Pied Bat identifies a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Disturbance of roosts from human recreational activities
- Fire in the proximity of roosts
- Predation by introduced predators

Mining of roosts, mine induced subsidence of cliff lines, habitat disturbance from livestock, and loss of genetic diversity are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Large-eared Pied Bat are discussed below for each identified indirect impact.

It is noted that 2,413.1 ha of potential habitat for the Large-eared Pied Bat is contained within the three conservation reserves proposed by the Plan. The protection of habitat for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

DISTURBANCE OF ROOSTS FROM HUMAN RECREATIONAL ACTIVITIES

Disturbance of roosts from recreational activities such as bushwalking, caving and abseiling is identified as a threat to the Large-eared Pied Bat. Regular disturbance can lead to bats abandoning roosts or depleting essential fat reserves (DERM, 2011).

Areas considered most at risk from increased disturbance due to recreational activities are those that occur in close proximity to development within Wilton and GMAC. Roosting and maternity caves are most likely to be located within the sandstone areas adjacent to and surrounding the Strategic Assessment Area. Much of this land is protected for conservation or as part of Sydney's drinking water catchment and should have existing management frameworks to prevent inappropriate access and use.

The Plan incorporates a range of measures to mitigate the risks associated with recreational disturbance within the Strategic Assessment Area, including:

- A commitment (Commitment 7) to mitigate indirect impacts from urban, infrastructure and major infrastructure (transport) development on Koalas. This is relevant to the species because a lot of the mapped habitat for the Large-eared Pied Bat is identified as important Koala habitat. Of particular relevance to habitat disturbance are associated actions around the use of exclusion fencing which will assist in controlling access to Koala habitat. These measures will help minimise inappropriate habitat disturbance to potential habitat within both Wilton and GMAC
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 2,413.1 ha of potential habitat for the Large-eared Pied Bat is contained within the three conservation reserves proposed by the Plan
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan, combined with existing management of protected areas adjacent to the Strategic Assessment Area is expected to adequately manage the risk to the species from inappropriate recreational use.

FIRE IN THE PROXIMITY OF ROOSTS

Bushfires and prescribed burning are identified as a key threat to the Large-eared Pied Bat as they are potentially susceptible to direct mortality from heat and smoke if the fire is close to their relatively shallow cave roosts (DERM, 2011). Changes in foraging resources and prey species as a result of altered fire regimes may also impact the species (DERM, 2011).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Large-eared Pied Bat being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Large-eared Pied Bat. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

PREDATION BY INTRODUCED PREDATORS

Predation by introduced predators such as cats, foxes and rats has been identified in the Recovery Plan as a possible, but unknown, threat to the Large-eared Pied Bat. Concerns relate to predation on individuals where they are forced to roost close to the ground (DERM, 2011).

Roosting within the Strategic Assessment Area is either absent or very limited. However, new urban development within GMAC and Wilton is in close proximity to areas of likely roosting outside the Strategic Assessment Area in surrounding sandstone areas. New urban development within these nominated areas is very likely to increase the number of domestic cats in the local area, which in turn, may lead to an increase in feral cat populations within adjacent areas of likely roosting habitat.

Existing land use within the nominated areas and surrounding region includes residential areas and farming, which means cats are unlikely to pose a novel threat to the species in the area. However, the extent of proposed new urban development under the Plan means the threat is likely to be exacerbated.

Appendix E of the Plan contains the following measure: "Where permitted and appropriate, contain domestic cats and dogs in new residential areas during operation of the development at the urban/bushland interface consistent with relevant Council guidelines." This measure will be implemented via the Mitigation Measures Guideline and DCP template and applies in Wilton and GMAC. Although this measure does not specifically identify the Large-eared Pied Bat as a target species, it nonetheless is likely to benefit the species through mitigating the threat of increased densities of domestic cats.

The Plan incorporates a range of measures to manage the risks associated with introduced predators. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

These measures are considered to adequately mitigate the threat to the species.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.9.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There is potential habitat for the species on avoided land within Wilton and GMAC. Therefore, the species may be subject to impacts from essential infrastructure. However, the species is mobile and wide-ranging, and the scale of impact is not expected to be significant.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.9.8 POTENTIAL IMPACTS FROM TUNNELS

Foraging habitat (13.3 ha) of the Large-eared Pied Bat occurs within the tunnel footprint for the Metro Rail Future Extension tunnel. The area is unlikely to support breeding habitat (the site is not within 1 km of areas likely to contain caves, crevices and cliffs - see Map 24-1) and only a small amount of potential foraging habitat has the potential to be impacted.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels

- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.9.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Recovery Plan for the Large-eared Pied Bat describes the species' reliance on very specific maternity roosts with physical characteristics that are uncommon in the landscape as an important limiting factor in the distribution of the species (DERM, 2011). The communal nature of the species when they roost and raise young, means that a reasonable proportion of a local population can be in one location, and this makes them more vulnerable to impacts to these sites.

Implementation of the Plan will not directly affect any known roosting sites. Potential indirect impacts to roosting sites have been assessed and the generic management strategies in the Plan are considered adequate in addressing these risks. Altogether, impacts from development under the Plan are not expected to affect roosting or maternity sites and this substantially minimises the potential to adversely influence the species' long-term viability.

However, foraging habitat within proximity to roosting areas will be affected by development. These areas constitute habitat critical to survival, which suggests that any substantial impacts to these areas have the potential to affect the long-term viability of the species.

There are a number of factors relating to the impacts on these foraging areas which minimise the severity of impacts. These factors make it very unlikely that the species long-term viability will be affected by development under the Plan and include:

- Loss of foraging habitat represents a small proportion (1.1 per cent) of potential habitat within the Strategic Assessment Area. At a broader landscape level, these impacts are proportionally smaller still, given the much larger and intact areas of habitat to the north and west of the Strategic Assessment Area and to the south of Sydney
- Loss of potential foraging habitat predominantly occurs within GMAC and Wilton. The potential foraging habitat within these nominated areas is mostly associated with canopied vegetation along riparian corridors in an otherwise cleared landscape. The Recovery Plan notes that these types of corridors can be heavily used by the species. Impacts to this habitat will involve the loss of small sections on the fringes of the corridors. The corridors themselves will be retained, minimising any functional loss on potential foraging habitat. In fact, these areas will be protected as follows:
    - Under the SEPP (Strategic Conservation Planning), which sets out development controls to avoid and minimise impacts to biodiversity in these areas
    - As important Koala habitat (which overlaps with habitat for the Large-eared Pied Bat), which will be prioritised for protection and rehabilitation under the Plan, and which will benefit from additional conservation measures such as exclusion fencing to separate areas of habitat from urban threats such as domestic animals

In addition, the Plan will lead to the protection and management of large areas of vegetation within the SCA. Two of the reserves currently proposed by the Plan are suitably located to support foraging within proximity of potential sandstone roosting areas. They are:

- The Georges River Koala Reserve which is on the eastern side of the Strategic Assessment Area near GMAC where the Large-eared Pied Bat has been recorded. Note that 1,501 ha of potential habitat for the Large-eared Pied Bat has been recorded within this reserve area
- The Gulguer Reserve investigation area which occurs on the western side of the Strategic Assessment Area where the Large-eared Pied Bat has been recorded. Note that 911.9 ha of potential habitat for the Large-eared Pied Bat has been recorded within this reserve area

Altogether, it is considered very unlikely that implementation will adversely influence the long-term viability of the Large-eared Pied Bat.

30.9.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan is to ensure the persistence of viable populations of the Large-eared Pied Bat throughout its geographic range (DERM, 2011). Specific objectives have been identified to support the overall objective; these are:

- Identify priority roost and maternity sites for protection
- Implement conservation and management strategies for priority sites
- Educate the community and industry to understand and participate in the conservation of the large-eared pied bat
- Research the large-eared pied bat to augment biological and ecological data to enable conservation management
- Determine the meta-population dynamics throughout the distribution of the large-eared pied bat

The outcome for the Large-eared Pied Bat under the Plan will not make it impossible to the achieve any of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions in order to deliver on the objectives. The Plan will not prevent implementation of any of the actions.

The commitment to strategically protect large patches of well-connected, high-quality vegetation across the Strategic Assessment Area offers potential conservation benefits for the Large-eared Pied Bat. This process is consistent with one of the main actions in the Recovery Plan to "identify priority colonies and sites for conservation management and protection".

30.9.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-38 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For the Large-eared Pied Bat there are no relevant Threat Abatement Plans.

Table 30-38: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Large-eared Pied Bat

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-39: Occurrence of the Large-eared Pied Bat in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	25,451.4	3,261.5

Table 30-40: Avoidance of Large-eared Pied Bat habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	1,610.4	2,575.9	0.0	68.9	4,255.1
HABITAT WITHIN EXCLUDED LANDS (ha)	267.4	769.5	0.0	67.9	1,104.8
HABITAT WITHOUT EXCLUDED LANDS (ha)	**1,343.0**	**1,806.4**	**0.0**	**0.9**	**3,150.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	946.1	1,243.4	0.0	0.0	2,189.6
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	70.5	68.8	0.0	0.0	69.5
AVOIDANCE FOR OTHER REASONS (ha)	290.1	389.1	0.0	0.0	679.2
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	21.6	21.5	0.0	0.0	21.6
TOTAL AVOIDANCE (ha)	**1,236.2**	**1,632.5**	**0.0**	**0.0**	**2,868.8**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**92.1**	**90.4**	**0.0**	**0.0**	**91.1**

Table 30-41: Direct impacts to Large-eared Pied Bat within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	106.7	173.9	0.0	0.9	3.5	**285.0**

30.10 *DASYURUS MACULATUS MACULATUS* (SPOT-TAILED QUOLL) – SE MAINLAND POPULATION

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Dasyurus maculatus maculatus* (Spot-tailed Quoll) is a cat sized marsupial. It has reddish-brown fur with a cream-white stomach and irregular sized white spots covering its back, sides, and tail. The large size and spotted tail are distinguishing features (DELWP, 2016). Males grow to around 1.3 m long and weigh up to 7 kg, and females can grow to 85 cm and weigh up to 4 kg (DELWP, 2016).
ECOLOGY	Spot-tailed Quolls are generalist predators, which eat a range of prey including small to medium sized mammals, birds, reptiles, fish, amphibians, and invertebrates. Mammals comprise the majority of their diet (TSSC, 2020). Otherwise, the relative proportion of different prey sources within an individual's diet varies based on age, sex, season, site characteristics and prey availability (DELWP, 2016). The species is solitary and can travel large distances (several kilometres during a day). Females have smaller home ranges of several hundred hectares, while males have larger home ranges of up to a few thousand hectares. Female home ranges are non-overlapping, while male home ranges can encompass multiple female home ranges. The size of home ranges varies depending on habitat quality, with smaller home ranges occurring in areas of better habitat quality. Overall, the species typically occurs at low densities (DELWP, 2016; TSSC, 2020). The species is nocturnal, and shelters in dens during the day. The species uses multiple den sites (possibly over 20 den sites), and generally moves between den sites every 1-4 days (DELWP, 2016). Breeding occurs annually in winter. Sexual maturity is reached at one year of age, although some females do not breed until their second year. Females produce litters of (on average) five young. Life expectancy in the wild is 3-5 years, and generation length is thought to be approximately 2.5 years (DELWP, 2016; TSSC, 2020).
DISTRIBUTION AND HABITAT	Has a wide, patchy distribution in eastern Australia, where it is currently known from Victoria, NSW, and Queensland. The species historically occurred in South Australia, although it is now presumed extinct in the state. The mainland range of the species is thought to have declined by 50 to 90 per cent since European settlement (DELWP, 2016). Based on mapping of point records from 1997 to 2017, the species' EOO is estimated to be 596,344 km^2, and its AOO is estimated to be 2,512 km^2 (TSSC, 2020). The species is mainly a forest dependent species but can be found in a variety of habitat types, including rainforest, open forest, woodland, coastal heath, and inland riparian forest. All habitats

	seem to be characterised by predictable seasonal rainfall over 600 mm. The highest densities of the species have been recorded in both wet and dry forest habitats (DELWP, 2016; TSSC, 2020). In some studies, preferred habitat of the species has been shown to be determined by den site availability and prey availability. However, further research is required to determine whether these factors are key drivers of preferred habitat types in all parts of the species' range (given the wide distribution and diverse habitat usage by the species) (DELWP, 2016). Den sites have been recorded in tree hollows, rock crevices, hollow logs, hollow tree buttresses, clumps of vegetation, windrows, caves and boulder tumbles, and under buildings. Maternal den sites include rock crevices, caves, boulder tumbles, hollow logs, hollow tree roots, and burrows (DELWP, 2016). The species is also known to use communal latrine sites, often in rocky environments such as cliff faces, rocky stream beds, and boulder fields. Such sites may be utilised by several individuals (EES, 2020a). The species' Recovery Plan notes that habitat critical to the survival of the species includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey. However, the required thresholds for each of these habitat elements is currently unknown, and it is therefore not possible to map habitat critical to the survival of the species. The Recovery Plan notes that, given the threatened status of the species, all habitats within its current distribution where quolls are known to be present are considered to be important (DELWP, 2016). There is not sufficient information to identify potential habitats where reintroduction of or recolonisation by the species may be successful (DELWP, 2016).
POPULATIONS	Given the cryptic nature of the species, its wide range, and limited extent of research which has been conducted for most of the species' range, it is difficult to develop reliable estimates of the total population size of the species, or an understanding of the dynamics, size and characteristics of populations of the species (DELWP, 2016; TSSC, 2020). Currently, the species is thought to have less than 10,000 mature individuals in total (and may possibly be as low as less than 2,500), although the reliability of this estimate is characterised as moderate to low. The recent 2019/20 bushfire season is thought to have accelerated the rate of the species' decline (TSSC, 2020). Up to 2019 (prior to the 2019/20 fire season), a number of abundant and stable populations of the species were known to occur in a number of locations in NSW, which are thought to be strongholds for the species, and which are likely to have bolstered the total population size of the species. The impact of the 2019/20 fire season on these areas has not yet been fully examined (TSSC, 2020). Populations of the species are generally fragmented and isolated (TSSC, 2020). The Recovery Plan provides the following criteria for identifying important populations for the long-term survival and recovery of the species (DELWP, 2016): • Stronghold populations (i.e. areas with high abundance) • Populations which are genetically disparate • Populations on the edge of the species' range, such that their loss would result in a range contraction • Populations which have been the focus of long-term research and therefore have good baseline data which increase the understanding of the species' ecology There is limited information available regarding genetic diversity within and between populations of the species. Further, there is insufficient information available to identify the locations of functional population boundaries in many areas, and subsequently populations are generally described based on geographical location rather than ecological principles (DELWP, 2016). The species' Recovery Plan recognises that, given the lack of available information throughout most of the species' range, some researchers are hesitant to identify important populations. While the Recovery Plan identifies a range of regions which are thought to contain important populations of the species, it notes that the list is expected to be modified over time as further information becomes available (DELWP, 2016). Overall, the Recovery Plan identifies important populations across a number of regions, including (DELWP, 2016): • 3 regions in Victoria

	• 6 regions in NSW • 6 regions in Queensland In NSW, the Recovery Plan identifies important populations in a range of locations to the north, west and south of the Central Coast. However, the Central Coast itself is not currently identified by the Recovery Plan as supporting an important population (DELWP, 2016).
SOS SITES	The following SOS sites for the species have been identified: • Northern Tablelands • Jenolan-Kanangra • Crookwell Reserves • Barren Grounds/Budderoo • Byadbo (EES, 2021)
RELEVANT PLANS AND POLICIES	National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus* (DELWP, 2016) Conservation Advice *Dasyurus maculatus maculatus (southeastern mainland population)* Spotted-tailed Quoll, south eastern mainland (TSSC, 2020)
SPECIES-SPECIFIC GUIDELINES	EPBC Act Policy Statement 3.4 Significant impact guidelines for *Dasyurus maculatus maculatus* (DEWHA, 2009d) - noting that this guideline relates only to proposed 1080 baiting programs and is not relevant to the activities under the Plan
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=75184

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	Yes	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps for Spot-tailed Quoll were generated using BioNet PCT associations of intact and thinned vegetation in areas with greater than 600 mm rainfall. Patch size of greater than 1,000 ha was used in order to restrict habitat to areas of very large intact bushland remnants around, and connected to the edges of the Cumberland subregion. Under the BAM, the species was removed as a candidate species in in all nominated areas because there are no known breeding sites in the urban capable land.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). As above. No targeted surveys as part of this project were undertaken outside the nominated areas.				

POPULATION MAPPING	**RECORD SELECTION**
	BioNet records from 1999 onwards were considered current for the assessment.
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *Dasyurus maculatus maculatus* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *Dasyurus maculatus maculatus* were downloaded in September 2019.
	POPULATION DEFINITION
	All records within an area covered by the average male home range (up to 5,512 ha) were considered a single population.
	IMPORTANT POPULATION CRITERIA
	All populations were considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-25 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-43 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Spot-tailed Quoll in the Strategic Assessment Area. **Records** Records of the Spot-tailed Quoll are widespread in the regions surrounding the Strategic Assessment Area, including from the Blue Mountains to the west, the northern beaches and central coast to the north and the Illawarra/Wollongong area to the south. Within the Strategic Assessment Area, records primarily occur around the edges where some level of landscape connectivity remains with the large areas of surrounding wilderness to the north and west of the Strategic Assessment Area and south of Sydney. Eight populations within or immediately adjacent to the Strategic Assessment Area have broadly been identified from the BioNet records, as follows: • Population 508 - in the north-east of the Strategic Assessment Area, approximately 20 km north of GPEC where there are two BioNet records • Population 200 - on the north-west boundary of the Strategic Assessment Area, almost 20 km north of GPEC near Bowen Mountain where there are two BioNet records • Population 495 - along the western boundary of the Strategic Assessment Area adjacent to and just north of GPEC where there are a large number of records along the Great Western Highway through to the Blue Mountains and following the Nepean River. One record associated with the Nepean River is in the Strategic Assessment Area • Population 509 - two post 1999 records within GPEC – one located in the Wianamatta Regional Park and one in the middle of an existing urban area in Cambridge Park (with a low level of accuracy) • Population 496 - in the west of the Strategic Assessment Area near Orangeville, where there are two BioNet records from 2004

	• Population 498 - in the southern section of the Strategic Assessment Area, to the west of Wilton where there are two relatively recent BioNet records • Population 201 – south of Wilton where there are three BioNet records, all outside of the Strategic Assessment Area • Population 500 - east of the southern section of GMAC where there are four relatively recent BioNet records (one within the Strategic Assessment Area and the others adjacent) **Potential habitat** The baseline mapping for this assessment has mapped 32,445.4 ha of potential habitat within the Strategic Assessment Area. This habitat is predominantly associated with creek lines which the Spot-tailed Quoll may use for dispersal (Bruce Mullins, pers com).

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.10.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 3,701.7 ha of potential habitat for the Spot-tailed Quoll within the nominated areas (not including excluded lands). Approximately 3,090.4 ha (83.5 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 2,330.5 ha was avoided for biodiversity purposes
- 759.9 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 30-44.

It is important to note that the avoidance calculations in Table 30-44, including 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-44 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.10.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred. Avoidance within the transport corridors will occur during the detailed design phase as each project is brought forward.

The Plan includes a specific commitment (Commitment 3) to support the Spot-tailed Quoll which is to avoid and minimise impacts to the Spot-tail Quoll within certified major infrastructure corridors, including the tunnels sections, in the nominated areas through detailed planning and design. This includes avoiding areas of potential habitat connectivity for the Spot-tail Quoll within riparian corridors where possible.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.10.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will lead to the loss of potential habitat for the Spot-tail Quoll. A breakdown of impacts across the Strategic Assessment Area is given in Table 30-45.

The potential for fragmentation of habitat is also discussed below.

LOSS OF POTENTIAL HABITAT

Approximately 639.9 ha of potential habitat will be lost as a result of the implementation of the Plan, or 2 per cent of potential habitat mapped across the Strategic Assessment Area.

These direct impacts include potential habitat areas within the vicinity of:

- Population 509, where the Outer Sydney Orbital passes through the Wianamatta Regional Park within GPEC. The species primarily uses the much larger areas of intact habitat surrounding the Cumberland subregion. The habitat area within GPEC is not immediately connected to these areas and is unlikely to be as important due to the level of fragmentation associated with existing urban and rural development
- Populations 498 and 201, where urban development in Wilton will lead to the loss of isolated areas of potential habitat on the fringes of riparian corridors. The species may disperse along creek lines within the Strategic Assessment Area (Bruce Mullins, pers com). The corridors and associated vegetation have largely been avoided and the ecological function of each corridor within Wilton in terms of dispersal and connectivity will be maintained
- Population 500, where urban development in GMAC will lead to the loss of isolated areas of potential habitat on the fringes of riparian corridors. Again, the riparian corridors and associated vegetation that may be used for dispersal have largely been avoided and the ecological function of each corridor within GMAC will be maintained

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential habitat is considered to be low. This is because:

- The likelihood of substantial impacts occurring to the species has been categorised as possible. There will be moderate impacts to potential habitat. The majority of impacts occur along the edges of habitat corridors ensuring that the corridors themselves are maintained, and the species has access to a much larger network of intact habitat surrounding the Strategic Assessment Area
- The consequence of any impacts to the species has been categorised as minor. There will be loss of approximately 2 per cent of mapped potential habitat in the Strategic Assessment Area

30.10.4 FRAGMENTATION OF HABITAT

The majority of mapped potential habitat is associated with riparian corridors. Corridors such as these may be important landscape components for the species as they are more likely to contain the necessary den and prey resources (DELWP, 2016) and might be used within the Strategic Assessment Area for dispersal.

The urban capable land within the nominated areas has been specifically designed to avoid and minimise impacts to these corridors. Impacts that do occur are associated with small sections of fringing habitat.

Otherwise, habitat corridors within the nominated areas are generally not impacted and will be protected under the Plan. Protection of these areas will occur as follows:

- A new SEPP (Strategic Conservation Planning) will be introduced, which sets out development controls to avoid and minimise impacts to avoided land and land within SCA, which includes habitat corridors for the Spot-tail Quoll
- Within GMAC and Wilton, habitat corridors will be protected as important Koala habitat (which overlaps with habitat for the Spot-tail Quoll). These areas will be prioritised for protection and rehabilitation under the Plan, and which will benefit from additional conservation measures such as exclusion fencing to separate areas of habitat from urban threats such as domestic animals

The transport corridors have the potential to fragment habitat in the following locations:

- Potential habitat within Wianamatta Regional Park due to the development of the OSO. The species has been recorded in this area
- Fragmentation of small areas of potential habitat further south in GPEC, also due to the development of the OSO. There have been no historical records of the species using this area

The Plan includes a specific commitment (Commitment 3) to design the certified major infrastructure corridors in the nominated areas to avoid and minimise impacts to the Spot-tail Quoll and its habitat, with particular focus on avoiding areas of potential habitat connectivity for the species within riparian corridors. Designing creek crossings in these areas to maintain movement of the Spot-tail Quoll will significantly minimise any effects on the species. The area is also likely to be less important compared with the large areas of intact habitat surrounding the Strategic Assessment Area, due to the extent of existing urban and rural development within GPEC.

Altogether, direct impacts associated with development under the Plan are not expected to interfere with the movement of the Spot-tailed Quoll within the Strategic Assessment Area.

30.10.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, offsets were not considered necessary for the Spot-tailed Quoll.

It is noted that the SCA contain 11,894.9 ha of potential habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 2,423.4 ha of potential habitat for the Spot-tail Quoll is contained within the three conservation reserves proposed by the Plan, including:

- 1,500.1 ha within the Georges River Koala Reserve
- 11.4 ha within the Confluence Reserve investigation area
- 911.9 ha within the Gulguer Reserve investigation area

Further, one important population of the species is known to occur within the Georges River Koala Reserve.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.10.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan for the Spot-tailed Quoll identifies a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Competition and predation from introduced predators
- Road mortality
- Inappropriate fire regimes

Timber harvesting, poison baiting, deliberate killing, and poisoning by cane toads are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Spot-tailed Quoll are discussed below for each identified indirect impact.

It is noted that 2,423.4 ha of potential habitat for the Spot-tail Quoll is contained within the three conservation reserves proposed by the Plan. Further, an important population of the species is known to occur within the Georges River Koala Reserve. The protection of habitat and a known population for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

COMPETITION AND PREDATION FROM INTRODUCED PREDATORS

Competition and predation from introduced vertebrates such as cats and dogs is identified as a key threat to the Spot-tailed Quoll (DELWP, 2016).

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the species.

However, the extent of proposed new urban development under the Plan means that the threat associated with cats and dogs is likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers. The main areas of concern relate to new urban development in Wilton and the southern section of GMAC, where the current density of houses is lower.

Appendix E of the Plan contains the following species-specific measure for the Spot-tail Quoll: "Where permitted and appropriate, contain domestic cats and dogs in new residential areas during operation of the development at the urban/bushland interface consistent with relevant Council guidelines." This measure will be implemented via the Mitigation Measures Guideline and DCP template and applies in Wilton and GMAC. This measure will benefit the species through mitigating the threat of increased densities of domestic cats.

The Plan further incorporates a range of measures to manage the risks associated with introduced predators. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

These measures are considered to adequately address any potential increased threat from introduced predators due to implementation of the Plan.

ROAD MORTALITY

The Spot-tailed Quoll is susceptible to vehicle strike, and mortality on roads has been identified as a key threat to the species. The populations of Spot-tailed Quoll within and surrounding the Strategic Assessment Area are already exposed to a number of major roads, including from the Hume Highway, Wilton/Appin Road, Picton Road, Great Western Highway and Bells Line of Road.

Despite this exposure, none of the BioNet records for the area and surrounding region relate to vehicle strikes, which suggests that:

- The species is not regularly moving across existing roads to get from known habitat areas in the south into the more marginal habitat areas within the Strategic Assessment Area, and/or
- The species is dispersing along creek lines and passing under the roads where the crossings provide suitable conditions for an underpass (such as adequate vegetation cover), and/or
- Cases of roadkill are not being reported; although given the tendency for people to report Koala vehicle strikes within the area, this factor is unlikely to be the main contributor

Implementation of the Plan will lead to new roads and an increase in the volume of cars on these roads within and surrounding the nominated areas. The potential level of increased risk from these roads is difficult to predict. However, factors that reduce the potential risk include:

- The availability of much larger areas of intact vegetation outside of the Strategic Assessment Area, which is likely to reduce the species' need to cross roads in order to move into potential habitat areas within the Strategic Assessment Area
- The existing corridors of habitat within the nominated areas will be avoided and maintained. The only potential disruption relates to the development of the OSO within GPEC. However, the Plan includes a specific commitment (Commitment 3) to design the transport corridors to avoid and minimise impacts to Spot-tailed Quoll populations and habitat and connectivity, particularly along riparian corridors. This measure should ensure safe passage for the Spot-tailed Quoll under creek crossings in this area

The Plan also incorporates a range of measures to manage the increased threat from road mortality. In summary, these include:

- Installation of exclusion fencing along both sides of Appin Road, and the installation of a fauna crossing at Appin Road, to exclude wildlife from the road while maintaining connectivity (Commitment 7). While this commitment is designed to mitigate impacts of road mortality for Koala, it is also likely to benefit the Spot-tail Quoll as the Quoll's habitat overlaps considerably with Koala in this area
- Installation of exclusion fencing along Koala corridors within Wilton and GMAC to separate Koalas from urban threats (Commitment 7). Installation of such fences will prevent species from entering urban areas where they may be vulnerable to road mortality. This measure will benefit the Spot-tail Quoll as the species shares this habitat with Koalas
- Where exclusion fencing is not feasible, implementing development controls adjacent to Koala habitat (such as installing traffic calming devices, lowering speed limits, and signposting perimeter roads) (Commitment 7, in addition to measures in Appendix E of the Plan). These measures will benefit the Spot-tail Quoll as the species shares this habitat with Koalas

These measures are considered to adequately address any potential increased threat from road mortality due to implementation of the Plan.

INAPPROPRIATE FIRE REGIMES

Bushfires and prescribed burning are identified as a key threat to the Spot-tailed Quoll as they can reduce the availability of prey and habitat features that provide protection from predation (DELWP, 2016).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for Spot-tailed Quoll being:
  - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
  - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
  - A process to work with delivery partners to implement the Fire Management Strategy
  - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for Spot-tailed Quoll. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.10.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There is potential habitat on avoided land within Wilton and GMAC. The species may therefore be subject to impacts from essential infrastructure. However, the species is mobile and wide-ranging, and the scale of impact is not expected to disrupt habitat use or movement.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.10.8 POTENTIAL IMPACTS FROM TUNNELS

Potential habitat of the Spot-tail Quoll occurs within the footprints for the Metro Rail Future Extension (23.5 ha) and OSO (42.6 ha) tunnels. This habitat is disconnected from other mapped potential habitat and is not associated with any known records of the species. Therefore, it is considered unlikely that the species would be substantially impacted by development of the tunnels.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels

- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.10.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Recovery Plan identifies the major threatening processes relevant to the Spot-tailed Quoll and these should be considered most likely to affect the long-term viability of the species. They include:

- Habitat loss, modification, and fragmentation
- Timber harvesting
- Poison baiting
- Competition and predation by introduced predators
- Deliberate killing
- Road mortality
- Bushfire and prescription burning
- Poisoning by cane toads
- Climate change

Of these threats, implementation of the Plan has the potential to:

- Lead to habitat loss, modification and fragmentation, and
- Exacerbate the threat from competition and predation by introduction predators, road mortality and bushfires

HABITAT LOSS, MODIFICATION AND FRAGMENTATION

The Recovery Plan describes the aspects of the biology and ecology of the Spot-tailed Quoll that make the species particularly vulnerable to threatening processes. To summarise, Spot-tailed Quoll populations are limited to large, relatively intact patches of forest due to:

- Their generally solitary nature and large home ranges
- Their low population densities
- Their short lifespan and low reproductive output
- Juvenile dispersal being focussed on males, as females tend to remain near their birthplace. This limits the ability of the species to recolonise areas of fragmented habitat

The species is subsequently very sensitive to impacts that reduce, degrade, and fragment their habitat (DELWP, 2016).

Development associated with implementation of the Plan will lead to the loss of areas of habitat for the Spot-tailed Quoll, including 639.9 ha of potential habitat. The risk of residual adverse impacts from this has been assessed as low for the following key reasons:

- Loss of habitat represents a small proportion (2 per cent) of potential habitat within the Strategic Assessment Area. At a broader landscape level, these impacts are proportionally smaller still, given the much larger and intact areas of habitat surrounding the Strategic Assessment Area
- Habitat surrounding the Strategic Assessment Area is vast and intact and therefore considered much more important to the viability of the species. Mapped potential habitat within the Strategic Assessment Area is predominately associated with creek lines within an otherwise cleared landscape. The species may use these creek lines for dispersal
- Where impacts to habitat occur within the nominated areas, they are associated with small sections of habitat that fringes the corridors. The integrity of the corridors themselves will be maintained. These corridors are currently unmanaged and vulnerable to edge effects. Under the Plan, these corridors will be protected as follows:
    - A new SEPP (Strategic Conservation Planning) will be introduced, which sets out development controls to avoid and minimise impacts to avoided land and land within SCA, which includes habitat corridors for the Spot-tail Quoll
    - Within GMAC and Wilton, habitat corridors will be protected as important Koala habitat (which overlaps with habitat for the Spot-tail Quoll). These areas will be prioritised for protection and rehabilitation under the Plan, and which will benefit from additional conservation measures such as exclusion fencing to separate areas of habitat from urban threats such as domestic animals
- The one exception to this is the potenital for impacts to a habitat corridor within GPEC associated with the OSO. However, there is a species-specific commitment (Commitment 3) in the Plan to specifically address impacts to habitat and movement for the Spot-tailed Quoll during detailed design of this infrastructure. This area of habitat is also considered more marginal due to the extent of existing urban and rural development and disconnection from the surrounding, intact habitat areas

In addition, the Plan will lead to the protection and management of large areas of vegetation within the SCA. Three of the reserves currently proposed by the Plan will protect habitat considered very likely to support the Spot-tailed Quoll, including:

- The Georges River Koala Reserve which is on the eastern side of the Strategic Assessment Area near GMAC where the Spot-tailed Quoll has been recorded. Note that 1,500.1 ha of potential habitat for the Spot-tail Quoll has been mapped within this reserve
- The Gulguer Reserve investigation area which occurs on the western side of the Strategic Assessment Area and is connected to areas of habitat where the Spot-tailed Quoll has been recorded. Note that 911.9 ha of potential habitat for the Spot-tail Quoll has been mapped within this reserve
- The Confluence Reserve investigation area, where a smaller area of potential habitat has been mapped to occur (11.4 ha)

INDIRECT IMPACTS ASSOCIATED WITH INTRODUCED PREDATORS, ROAD MORTALITY AND BUSHFIRES

The potential indirect impacts associated with the identified threats will be managed and mitigated through generic management strategies and species-specific controls.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

Development under the Plan will lead to the loss of a small proportion of areas mapped as potential habitat for the Spot-tailed Quoll. Implementation of the Plan is not expected to adversely influence the long-term viability of the species due to the:

- Level of avoidance and minimisation of impacts to habitat corridors achieved through design of the urban capable lands within the nominated areas
- Marginal value of habitat within the Strategic Assessment Area which is generally fragmented and more degraded compared to the vast, surrounding areas of intact habitat

- The specific commitment (Commitment 3) in the Plan to address potential impacts to dispersal ability from infrastructure design (namely the OSO) and road mortality

30.10.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan Prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These questions are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan is to reduce the rate of decline of the Spot-tailed Quoll, and ensure that viable populations remain throughout its current range in eastern Australia (DELWP, 2016). Specific objectives have been identified to support the overall objective. These fit broadly into three groups:

- Investigate and acquire information on distribution, status, and key aspects of the biology and ecology of the species to aid recovery
- Identify key threats and implement threat abatement management practices, those most relevant to the Plan include:
  - Reduce the rate of habitat loss and fragmentation on private land
  - Determine and manage the risk posed by introduced predators (in particular, cats)
  - Reduce the frequency of road mortality
- Increase community awareness of and involvement in the Recovery Plan

The outcome for the Spot-tailed Quoll under the Plan will not make it impossible to the achieve any of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan identifies a set of actions to be implemented in order to deliver on the objectives. The Plan may support these actions, including:

- Target landholders in areas where Spotted-tailed Quolls are known to occur to protect and manage their land in a manner that is compatible with maintenance of Spotted-tailed Quoll habitat through voluntary conservation agreements
- Maintain and restore habitat corridors on unprotected freehold land

The Plan will not prevent implementation of any of the actions.

30.10.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-42 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan has been developed to ensure that it is not inconsistent with any relevant TAPs. This analysis around consistency is presented in Chapter 15.

Table 30-42: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Spot-tailed Quoll

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Predation by European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008n)
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-43: Occurrence of the Spot-tailed Quoll in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	7	2
(IMPORTANT POPULATIONS)	(7)	(2)
HABITAT MAPPING (Ha)	32,445.4	5,422.3

Table 30-44: Avoidance of Spot-tailed Quoll habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	1,602.4	2,373.0	235.9	2,406.8	6,618.1
HABITAT WITHIN EXCLUDED LANDS (ha)	262.9	592.3	9.9	2,051.3	2,916.4
HABITAT WITHOUT EXCLUDED LANDS (ha)	**1,339.5**	**1,780.6**	**226.0**	**355.5**	**3,701.7**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	947.7	1,249.3	54.7	78.8	2,330.5
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	70.8	70.2	24.2	22.2	63.0
AVOIDANCE FOR OTHER REASONS (ha)	290.2	388.7	44.9	36.1	759.9
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	21.7	21.8	19.9	10.2	20.5
TOTAL AVOIDANCE (ha)	**1,237.9**	**1,638.0**	**99.6**	**115.0**	**3,090.4**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**92.4**	**92.0**	**44.1**	**32.3**	**83.5**

Table 30-45: Direct impacts to the Spot-tailed Quoll within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	101.6	142.7	126.3	240.6	28.7	**639.9**

30.11 *PTEROPUS POLIOCEPHALUS* (GREY-HEADED FLYING-FOX)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Pteropus poliocephalus* (Grey-headed Flying-fox [GHFF]) is the largest Australian bat with dark grey fur on the body and an orange/brown collar around the neck. The head is covered with light grey fur. It weighs 600-1,000 g and can grow up to 289 mm in length (DoEE, 2018f).
ECOLOGY	Mating occurs in early autumn, the larger roosting camps then break up and reform in late spring/early summer when food resources start to increase (DoEE, 2018f). Males and females separate in October when females usually give birth to a single young (DoEE, 2018f). The young are carried on their mothers' backs to foraging sites until they are around five weeks old, then left in maternal camps while their mothers forage until they become independent at around 12 weeks old. Following this, the males return to the camps for courting and to form bonds for the next breeding season (DoEE, 2018f). Blossom from *Eucalyptus* and related genera form a large part of the species diet (DoEE, 2018f). It also feeds on commercial fruit crops and on introduced tree species in urban areas (DoEE, 2018f). The species is highly mobile and migrates in response to food shortages (OEH, 2019b).
DISTRIBUTION AND HABITAT	The Grey-headed Flying-fox is usually found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Melbourne in Victoria. It requires suitable habitat for both roosting and foraging. **Roosting habitat** The species roosts in groups of various sizes on exposed branches. Roost sites (known as camps) are generally located close to water, such as lakes, rivers, or the coast (DoEE, 2018f). Roost vegetation includes rainforest patches, stands of *Melaleuca*, mangroves and riparian vegetation (DoEE, 2018f). Roosting camps may contain tens of thousands of animals and are used for mating, and for giving birth and rearing young. Site fidelity to roosting camps is high; some have been used for over a century. The species can travel up to 50 km a night from roosting camps to forage but more often the distances are less than 20 km (DoEE, 2018f). **Foraging habitat** Grey-headed Flying-foxes feed on fruit and nectar from the canopy and use a range of vegetation communities, including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps, and *Banksia* woodlands (DoEE, 2018f).

	Winter and spring foraging resources are critical for the species. One of the recovery objectives for the species (DAWE, 2021f) is to "identify, protect and increase native foraging habitat that is critical to the survival of the Grey-headed Flying-fox'. A particular focus of this objective is protecting and increasing winter and spring foraging habitat. Important vegetation communities that provide winter and spring foraging resources are those that contain *Eucalyptus tereticornis, E. albens, E. crebra, E. fibrosa, E. melliodora, E. paniculata, E. pilularis, E. robusta, E. seeana, E. sideroxylon, E. siderophloia, Banksia integrifolia, Castanospermum australe, Corymbia citriodora citriodora, C. eximia, C. maculata, Grevillea robusta, Melaleuca quinquenervia* or *Syncarpia glomulifera* (DAWE, 2021e). **Habitat critical to the survival of the species** The recovery plan (DAWE, 2021e) defines habitat critical to the survival of the species. It encompasses the important winter and spring flowering vegetation communities (as identified above). It may also include: • Native species that are known to be productive as foraging habitat during the final weeks of gestation, and during the weeks of birth, lactation and conception (August to May) • Native species used for foraging within 20 km of a nationally important camp • Native and or exotic species used for roosting at the site of a nationally important camp Habitat critical to the survival of the species does not include back yard fruit trees, orchards or non-native trees that may be used for foraging.
POPULATIONS	There are no separate or distinct populations as there is constant genetic exchange and movement across the species' range. The most recent population estimate suggested that the population may have comprised 680,000 individuals (+/- 158,500; 95% CI) in 2014 (Westcott, Heersink et al., 2015) In 2008, thirty-nine camps used by Grey-headed Flying-foxes were known in the south-east region of NSW occurring mostly along the coastal lowlands and ranges (Eby & Law, 2008). A small number of the camps found in the Sydney Metropolitan area were occupied continuously. These were thought to have been established due to the increasing volumes of food in the gardens and streetscapes of Sydney. All camps associated with native vegetation were inhabited less consistently and were only occupied occasionally or rarely (Eby & Law, 2008).
SOS SITES	The species has been assigned to the landscape species management stream because it is distributed across large areas and is subject to threatening processes that generally act at the landscape scale rather than at distinct, definable locations (OEH, 2018g). The following priority management sites have been identified for this species: • Coffs Creek • Barcoo Court, Toormina • State-wide
RELEVANT PLANS AND POLICIES	National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus* (DAWE, 2021e) The SPRAT profile (DoEE, 2018f) for Grey-headed Flying-fox states that: • There is no approved Conservation Advice for the species • No Threat Abatement Plans have been identified as being relevant
SPECIES-SPECIFIC GUIDELINES	Referral guideline for management actions in grey-headed and spectacled flying-fox camps (DoE, 2015f)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*

- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">Yes</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report for this species.</td></tr>
<tr><td>HABITAT MAPPING</td><td colspan="5">Two forms of habitat mapping are used in this analysis:
• A species distribution model developed for the Cumberland subregion for this project
• Foraging habitat mapping developed by Eby and Law (Eby & Law, 2008)
SPECIES DISTRIBUTION MODEL
Species distribution model (SDM). Potential habitat was mapped using an SDM (see Supporting Document F). The SDM was developed using species records associated with camps. This condition was imposed because this species is known to forage widely, and therefore there was a risk that potential habitat would have been over-predicted by the model if all records had been included.
Consistent with the approach taken for other EPBC Category 1 species, impacts are calculated using the SDM.
During surveys for this assessment the species was recorded twice in GMAC and once in GPEC.
FORAGING HABITAT
Foraging habitat. Eby and Law (2008) mapped foraging habitat for the species across its range. As part of this work, they ranked native vegetation according to the nectar resources it provides. Habitat is ranked using a score of 1-4 where 1 is the highest nectar rank, and 4 is the lowest.
The mapping by Eby and Law is recognised in the recovery plan (DAWE, 2021e) as mapping of habitat critical to the survival of the species across most of its range, although it is acknowledged that the mapping was not ground-truthed.
The mapping is used in the analysis for context and to enable a consideration of foraging resources outside the Cumberland Plain (which were not mapped by the SDM).</td></tr>
<tr><td>CAMP MAPPING</td><td colspan="5">The National Flying Fox Monitoring Program provides monitoring data for camps across the range of the Grey-headed Flying-fox. Data is available about the number of individuals at camps from 2012 to 2019.
The importance of camps is categorised as follows:
CAMP CATEGORY | DESCRIPTION
Nationally important | Camps that have contained ≥ 10,000 GHFF in more than one year in the last 10 years, or have been occupied by more than 2,500 GHFF permanently or seasonally every year for the last 10 years (DoE, 2015f)
High priority | > 2,500 in at least 4 of last 8 surveys
Medium priority | Any records in the last 2 years
No GHFF in last 2 years | No records in the last 2 years
No GHFF since 2011 | No records since 2011</td></tr>
</table>

POPULATION MAPPING	**RECORD SELECTION** Based on other bat species, the life expectancy is likely to be between two and ten years. BioNet records have been taken from 2008 onwards. **BIONET RECORD DOWNLOAD DATE** The initial assessment of Grey-headed Flying-fox was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available within the Strategic Assessment Area. However, upon review, the new records do not alter the initial assessment's understanding of the species' distribution and abundance in the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of Grey-headed Flying-fox were downloaded in September 2019. **POPULATION DEFINITION** The records of Grey-headed Flying-fox are considered to be part of a single population across their range (DAWE, 2021e) **IMPORTANT POPULATION CRITERIA** The population of Grey-headed Flying-foxes was considered important within the Strategic Assessment Area because it met the following criteria: a population identified or inferred in a Commonwealth conservation advice, recovery plan, final determination, or other relevant policy document as being important.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAPS	See Map 30-8 for a map of records and habitat across the Strategic Assessment Area. See Map 30-9 for a map of Grey-headed Flying-fox camp sites and Eby and Law (2008) foraging habitat See Map 30-10 for a map of the Macquarie Fields flying fox camp site See Map 30-11 for a map of the Campbelltown flying fox camp site See Map 30-12 for a map of the Emu Plains flying fox camp site See Map 30-13 for a map of the Ropes Creek flying fox camp site
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-48 and Table 30-49 at the end of this species assessment for a breakdown of the occurrence of Grey-headed Flying-fox records, habitat, and camps in the Strategic Assessment Area. The Strategic Assessment Area supports foraging and roosting habitat for the species. **Foraging habitat** As outlined above, two types of mapping for foraging habitat are used in this assessment: • Baseline mapping for this assessment which was done through an SDM process • Eby and Law (2008) foraging habitat mapping The baseline mapping for the assessment mapped approximately 26,868.8 ha of potential and known foraging habitat within the Strategic Assessment Area (Map 30-8). Habitat is mapped in association with a range of woodland communities and generally occurs where native remnants are present. Foraging habitat within 20 km of camps is considered important due to the common distance the species can travel to feed. All potential habitat in the Strategic Assessment Area is within 20 km of a

camp. Map 30-9 shows Grey-headed Flying-fox camps with a 20 km buffer in relation to the Eby and Law (2008) foraging habitat. This mapping extends beyond the boundary of the Strategic Assessment Area to provide context about the amount of habitat within the surrounding region.

Roosting habitat

The Strategic Assessment Area supports 12 Grey-headed Flying-fox camps. Categorisation of camps is discussed above in the approach to baseline data section. Of the 12 camps:

- Two are nationally important. Of these:
  - The Macquarie Fields camp occurs at Bingara Reserve in Macquarie Fields and is located within the northern part of GMAC largely surrounded by existing development (see Map 30-10). It is approximately 1.4 km from the nearest urban capable land. Campbelltown City Council has prepared a Management Plan for the camp (Campbelltown City Council, 2021b)
  - The Windsor camp occurs to the north of GPEC, within the riparian zone of South Creek near the township of Windsor. This camp is on the outskirts of existing urban development and is close to agricultural land. It is approximately 13 km from the nearest transport corridor under the Plan and 15.5 km from the nearest urban capable land. This flying fox camp does not appear to have a Management Plan in place
- One is high priority. This is the Picton camp, which occurs to the north-west of Wilton and is located approximately 2.2 km from the nearest urban capable land. This camp is located within the township of Picton in a primarily rural area. Wollondilly Council has prepared a Management Plan for this camp (Wollondilly Shire Council, 2018)
- Six are medium priority. Of these:
  - The Campbelltown camp occurs within GMAC but outside of the urban capable lands. It is largely surrounded by existing development (see Map 30-11) and is approximately 3.4 km from the nearest urban capable land. The Campbelltown camp has a Management Plan that was prepared by the Campbelltown City Council (Campbelltown City Council, 2021a)
  - The Ropes Creek camp occurs within GPEC but outside of the urban capable lands. It is largely surrounded by existing development (see Map 30-13) and is approximately 2 km from the nearest urban capable land
  - The Emu Plains camp is close to the western boundary of GPEC (see Map 30-12) and is approximately 1.1 km from the nearest urban capable land
  - Three occur outside of the nominated areas, each over 5 km from the nearest nominated area. They are the Cabramatta camp; the Camden, Brownlow Hill camp; and the Yarramundi camp
- Three have had no records of GHFF since 2011 and all occur outside of the nominated areas. They are the Emu Plains (2007), Menangle, and Penrith camps

The two nationally important camps and high priority camp have significant mapped foraging resources (highest nectar rank) within 20 km. Much of this occurs outside the Strategic Assessment Area and is unlikely to be impacted (e.g. defence land, protected land).

In addition to these camps, there are 16 camps that occur within 20 km of the Strategic Assessment Area. Three of these are nationally important.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.11.1 NOMINATED AREAS

The sections below outline the avoidance that has occurred for:

- Roosting habitat

- Foraging habitat (as mapped by the SDM)
- Foraging habitat within 20 km of nationally important camps within the Strategic Assessment Area (as prepared by Eby and Law (2008))

The following section then outlines specific measures in the Plan which support avoidance of impacts to this species.

AVOIDANCE OF ROOSTING HABITAT

All of the three camps with recent records that occur within the nominated areas are located within excluded lands, and subsequently none will be directly impacted. They include the Macquarie fields and Campbelltown camps in GMAC, and the Ropes Creek camp in GPEC.

AVOIDANCE OF FORAGING HABITAT (AS MAPPED BY THE SDM)

The baseline mapping for this assessment mapped 1,744.4 ha of potential habitat for the species within the nominated areas (not including excluded lands). Approximately 1,142.7 (65.5 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 698.5 ha was avoided for biodiversity purposes
- 444.2 ha was avoided for other purposes

Avoidance in WSA, GMAC and Wilton ranges between 53 per cent and 86 per cent. Avoidance is lower in GPEC, with 34 per cent of potential habitat avoided (110 ha avoided of 322.4 ha of potential habitat).

A breakdown of avoidance across each nominated area is provided in Table 30-50. It is important to note that the avoidance calculations in Table 30-50, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-50 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

AVOIDANCE OF FORAGING HABITAT WITHIN 20 KM OF NATIONALLY IMPORTANT CAMPS (AS PREPARED BY EBY AND LAW 2008)

Within 20 km of the nationally important Macquarie Fields camp, there is 48,048.7 ha of foraging habitat for this species. Of this, 827.50 ha (not including excluded land) is located within nominated areas (411.70 ha in GMAC and 415.80 ha in WSA). Of the total habitat in nominated areas, 500.9 ha was avoided, including:

- 335.1 ha for biodiversity purposes
- 165.8 ha for other purposes

Within 20 km of the nationally important Windsor camp, there is 48,324.4 ha of foraging habitat for this species. Of this, 76.49 ha (not including excluded land) is located within GPEC. Of this total, 11.1 ha was avoided, including:

- 9.9 ha for biodiversity purposes
- 1.2 ha for other purposes

MEASURES UNDER THE PLAN TO SUPPORT FURTHER AVOIDANCE OF THE SPECIES

Appendix E of the Plan includes a species-specific mitigation measure to retain large trees (≥50cm DBH, including dead trees but excluding noxious weeds) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction. This measure applies to development within urban capable land, in addition to development of essential infrastructure within avoided lands. This measure may provide additional avoidance of significant foraging trees for the Grey-headed Flying-fox within the nominated areas.

Further, Appendix E of the Plan includes a precautionary requirement to establish a 100 m minimum setback for development around flying fox camps and maintained around roosting habitat to provide a buffer to adjacent development for any Grey-headed Flying-Fox camps. This measure applies across all four nominated areas and relates to development within urban capable land in addition to essential infrastructure development within avoided land. If this becomes relevant because new camps are established close to urban capable lands, the requirement will help to ensure that any future camp disturbance is avoided.

30.11.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred. It is important to note that there are no camps within the transport corridors.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

There will be no direct impacts to Grey-headed Flying-fox camps. Further, the Plan does not pose a risk of habitat fragmentation to the species.

However, implementation of the Plan will lead to the loss of potential foraging habitat. A breakdown of impacts across the Strategic Assessment Area is given in Table 30-51.

30.11.3 LOSS OF POTENTIAL HABITAT

LOSS OF POTENTIAL FORAGING HABITAT (AS MAPPED BY THE SDM)

Approximately 751 ha of potential foraging habitat will be lost as a result of implementation of the Plan, or 2.8 per cent of potential foraging habitat mapped across the Strategic Assessment Area.

While it is impossible to know the rate that habitat will be lost, it is clear that development will proceed in a staged way over the life of the Plan. If clearing was to occur progressively at an even rate over the life of the Plan, approximately 21 ha of potential foraging habitat would be lost each year. This rate and scale of clearing are considered unlikely to lead to dispersal from existing camp sites. Particularly within the context of the Plan's conservation program (see Section 30.10.4 below).

LOSS OF FORAGING HABITAT WITHIN 20 KM OF NATIONALLY IMPORTANT CAMPS (AS PREPARED BY EBY AND LAW 2008)

Within 20 km of the nationally important Macquarie Fields camp, there is 48,048.7 ha of foraging habitat for this species. Implementation of the Plan will result in the loss of 414.2 ha of foraging habitat (326.6 ha within the nominated areas, and 87.6 ha due to transport corridors outside of the nominated areas). Total impacts account for 0.9 per cent of total habitat within 20 km of the camp.

Within 20 km of the nationally important Windsor camp, there is 48,324.4 ha of foraging habitat for this species. Implementation of the Plan will result in the loss of 68.5 ha of foraging habitat (65.4 ha within the nominated areas, and 3.1 ha due to transport corridors outside of the nominated areas). Total impacts account for 0.1 per cent of total habitat within 20 km of the camp.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk assessment approach described in Section 30.3.5 was applied using potential foraging habitat as prepared by the SDM mapping method. The risk of substantial impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be low. As outlined in Section 30.3.5 which describes the risk assessment for wide-ranging species, "substantial" in this case is defined as impacts that could materially affect the species' use of the Strategic Assessment Area.

The risk rating of low was determined because:

- The likelihood of actual impacts occurring to the species has been categorised as possible. This is because:

  - There will be no impacts to known camps
  - The scale of impacts to foraging habitat is considered to be moderate. The species is highly mobile, feeds on fruit and nectar from a variety of vegetation communities, and has access to large areas of intact vegetation surrounding the Strategic Assessment Area
- The consequence of any impacts to the species (if they did occur) has been categorised as minor as there will be loss of approximately 2.8 per cent of mapped potential foraging habitat in the Strategic Assessment Area

30.11.4 FRAGMENTATION OF HABITAT

Given the wide-ranging nature of the species and broad availability of potential habitat, it is considered unlikely that development within the nominated areas or transport corridors would lead to any fragmentation effects.

30.11.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the low risk of residual adverse impacts to the species, specific offsets were not considered necessary for the Grey-headed Flying-fox.

However, it is worth noting that the Plan's conservation program will provide substantial offsets for native vegetation. Much of which will provide potential foraging habitat for the species. Key components of the conservation program that will benefit Grey-headed Flying-fox include:

- Commitment 8 which will lead to the protection of at least 5,325 ha of native vegetation in the Cumberland subregion. At least 75 per cent of this target will be achieved by protecting existing native vegetation, and up to 25 per cent (or approximately 1,331 ha) will relate to ecological restoration
- A range of commitments that will help manage landscape threats across the Strategic Assessment Area. These will help maintain and improve the condition of foraging habitat for the species across the landscape over the life of the Plan and include commitments to manage weeds (Commitment 15), pest animals (Commitment 16), fire (Commitment 17), disease (Commitment 18), and support adaptation to climate change (Commitment 19)

Ecological restoration will be particularly beneficial to the species given the loss of potential foraging habitat. Ecological restoration is being prioritised early in implementation of the Plan which will help counteract the predicted progressive loss of potential foraging habitat over the life of the Plan. The NSW Government has already committed over $100 million in the first five years to implement the Plan's commitments and actions, which includes funding to restore 80 ha of habitat with a focus on Koala habitat. It is noted that foraging habitat for the Grey-headed Flying-fox overlaps substantially with Koala habitat.

Further, it is noted that the SCA contain 5,546.5 ha of potential foraging habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 997.4 ha of potential foraging habitat for the Grey-headed Flying-fox is contained within the three conservation reserves proposed by the Plan, including:

- 916.4 ha within the Georges River Koala Reserve
- 63.8 ha within the Confluence Reserve investigation area
- 17.3 ha within the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.11.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Recovery Plan for the Grey-headed Flying-fox (DAWE, 2021e) identifies a range of threats to the species. There are two threats that are present in the Strategic Assessment Area that have the potential to be exacerbated under the Plan through indirect impacts. They are:

- Camp disturbance
- Electrocution on power lines

Climate change is also a relevant threat to the species. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

A range of other threats are identified in the Recovery Plan which are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risks across the Strategic Assessment Area. They include: mortality in commercial fruit crops; heat stress; public misunderstanding of disease risk; and entanglement in netting and barbed wire fencing.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Grey-headed Flying-fox are discussed below for each identified indirect impact.

It is noted that 997.4 ha of potential habitat for the Grey-headed Flying-fox is contained within the three conservation reserves proposed by the Plan. The protection of habitat for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

CAMP DISTURBANCE

The Recovery Plan notes that conflict between people and flying fox camps is an ongoing problem. People living near camps can (DAWE, 2021e):

- Find the camps annoying and unpleasant
- Be concerned about faecal droppings and the potential for disease transmission from flying foxes to people. Noting that the actual risk of transmission is very low

These issues typically occur where camps are surrounded by urban and rural residential development, and people request relocation of the camp. This section of the assessment:

- Outlines the overall framework for managing flying fox camps in NSW
- Outlines how the EPBC Act applies to the management of flying fox camps
- Considers the potential for development within the nominated areas to increase the risk of camp disturbance
- Analyses the Plan's requirements to manage the risks of increasing camp disturbance

Overall framework for managing flying fox camps in NSW

The Grey-headed Flying-fox is protected under the NSW BC Act and management of camps is a regulated activity. To assist land managers and the community, the Department has developed:

- The Flying-fox Camp Management Policy 2015 (OEH, 2018f)
- The Flying-fox Camp Management Code of Practice 2018 (OEH, 2018d)
- A Flying-fox Camp Management Template (DPIE, 2019b)

This suite of documents provides a robust framework for the protection and appropriate management of flying fox camps. The framework will continue to apply during implementation of the Plan.

The Flying-fox Camp Management Policy 2015

The camp management policy sets out how the NSW Government makes regulatory decisions about camp management actions. The policy encourages local councils and other land managers to prepare camp management plans for sites where the local community is affected and undertake proactive management.

The policy sets out a hierarchy of management options that is based on a principle of using the lowest form of intervention required. The hierarchy includes:

- Level 1 actions that involve routine activities that aim to maintain or improve the condition of a camp site
- Level 2 actions that involve creating buffers around camps to separate humans and flying foxes
- Level 3 actions that involve the disturbance or dispersal of flying-foxes from a camp

The Flying-fox Camp Management Code of Practice 2018

The code of practice is a regulatory instrument that was established under clause 2.9 of the *Biodiversity Conservation Regulations 2017*. It defines the standards required for effective and humane management of flying fox camps. Management actions that are consistent with the code of practice don't need a licence under the BC Act.

The code of practice is accompanied by guidance notes that provide further information to land managers.

Some high impact and high risk activities require the development of a camp management plan for the endorsement of the Environment Agency Head prior to being permitted under the code.

A Flying-fox Camp Management Template

To assist land managers, the Department has prepared a flying fox camp management template. The template meets the requirements of both the policy and code of practice. It sets out management options, flying fox ecology, case studies of camp management, and information about health issues.

How the EPBC Act applies to the management of flying fox camps

The EPBC Act also regulates management activities within nationally important camps for the two nationally listed flying fox species (including the Grey-headed Flying-fox). There is a referral guideline (DoE, 2015f) that assists proponents to determine if a management action is likely to have a significant impact and if a referral under the EPBC Act is required. In general, level 1 management actions (as set out in the NSW Flying-fox Camp Management Policy 2015) are considered lower risk and are less likely to require referral.

Flying fox camp management actions are not included within the classes of action for the Plan. As a result, management actions will not be subject to approval under Part 10 of the EPBC Act. Land managers will need to continue to consider the need for referral under Part 7 of the Act for management actions in nationally important flying fox camps.

Camps at risk of increased disturbance

Flying fox camps at risk of increased disturbance due to implementation of the Plan are those that:

- Are within or close to the nominated areas and have records since 2011
- Have the potential to be subjected to increasing disturbance due to development under the Plan because they:
    - Are not subject to existing pressures (i.e. not surrounded by nearby development) and where development under the Plan will increase the likelihood of negative interactions with people
    - Do not have appropriate buffers between the camp and nearby development
    - Do not have appropriate management

Camps within or close to the nominated areas

There are four camps that are within or close to the nominated areas that have had records since 2011 (see Table 30-46). Two are within GMAC, one is within GPEC, and one is close to GPEC. There are no camps within or close to Wilton or WSA.

Table 30-46: Grey-headed Flying-fox camps within or close to the nominated areas with records since 2011

CAMP	LOCATION	EXISTING CONTEXT	PROXIMITY TO DEVELOPMENT UNDER THE PLAN
Macquarie Fields	Within GMAC (see Map 30-10)	• Nationally important • Surrounded by existing development • Subject to an approved flying fox Management Plan that was prepared by Campbelltown City Council (Campbelltown City Council, 2021b)	~1.4 km to nearest urban capable land
Campbelltown	Within GMAC (see Map 30-11)	• Medium priority • Near the Campbelltown town centre and surrounded by existing development • Subject to an approved flying fox Management Plan that was prepared by Campbelltown City Council (Campbelltown City Council, 2021a)	~3.4 km to nearest urban capable land
Ropes Creek	Within GPEC (see Map 30-13)	• Medium priority • Surrounded by existing development	~2 km to nearest urban capable land
Emu Plains	Close to GPEC (see Map 30-12)	• Medium priority • Close to the Nepean River to the west of GPEC • Significant development and disturbed areas in the vicinity	~1.1 km to nearest urban capable land

Camps that have the potential to be subjected to increasing disturbance due to development under the Plan

Each of the four camps identified above are close to (or surrounded by) existing development and are not located adjacent to any of the proposed urban capable lands. The size of the buffers for each of the camps has already been established through previous planning decisions and will not be affected by implementation of the Plan. It is considered unlikely that additional development within the nominated areas will substantially increase the risk of disturbance beyond what is currently occurring.

In addition, the nationally important camp of Macquarie Fields and the medium priority Campbelltown camp are being actively managed by the Campbelltown City Council under approved management plans (Campbelltown City Council, 2021a, 2021b). These plans were prepared in accordance with the NSW Government template for camp management plans. Neither management plan recommends dispersal as an appropriate management action.

It is noted that the Ropes Creek and Emu Plains camps do not appear to have approved management plans.

The Plan's requirements to protect camps

While the likelihood of impacts to camps as a result of the Plan is low, Appendix E of the Plan includes a precautionary requirement to establish a 100 m minimum setback for development around flying fox camps and maintained around roosting habitat to provide a buffer to adjacent development for any Grey-headed Flying-Fox camps. This measure applies across all four nominated areas and relates to development within urban capable land in addition to essential infrastructure development within avoided land. If this becomes relevant because new camps are established close to urban capable lands, the requirement will help to ensure that any future camp disturbance is avoided.

Further, the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development contain a measure to ensure that above ground infrastructure maintains suitable setbacks to Grey-headed Flying-fox camps, and that operational management measures are implemented to minimise disturbance to the population.

The Plan further incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance. In relation to the Grey-headed Flying-fox these would be applicable to areas of potential foraging habitat in various locations. In summary, the measures include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 5,546.5 ha of foraging habitat for the Grey-headed Flying-fox is located within the SCA. As part of this, 997.4 ha of foraging habitat is contained within the three conservation reserves proposed by the Plan (the majority of which is within the Georges River Koala Reserve)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor habitat disturbance such as illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas. This commitment is consistent with the Recovery Plan which encourages increased education of the community about the Grey-headed Flying-fox

ELECTROCUTION ON POWER LINES

The Recovery Plan identifies electrocution on power lines in increasingly urbanised areas as an issue for the Grey-headed Flying-fox. Given that Western Sydney is already extensively urbanised it is considered unlikely that development under the Plan will substantially increase the risks to the species.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.11.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There are records of the Grey-headed Flying-fox on avoided land in Wilton and GMAC and potential habitat on avoided land in all nominated areas. The species may be subject to impacts from essential infrastructure. However, the species is mobile and wide-ranging, and the scale of impact is not expected to be significant.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development

- It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.11.8 POTENTIAL IMPACTS FROM TUNNELS

Foraging habitat (as mapped by the SDM) for the species occurs within the tunnel footprints for both the Metro Rail Future Extension (59.7 ha) and the Outer Sydney Orbital (79.3 ha). Further, the tunnel footprints contain 150.1 ha of foraging habitat (as mapped by Eby and Law (2008)) within 20 km of the nationally important Macquarie Fields camp. There are no Grey-headed Flying-fox camps in these areas.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

30.11.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Recovery Plan identifies the following key issues that are likely to have the greatest influence on the long-term viability of the Grey-headed Flying-fox in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts associated with camp disturbance and electrocution on power lines

In addition, this section provides a brief discussion about the implications to the species of the 2019-20 bushfires.

HABITAT LOSS

Implementation of the Plan will not lead to impacts to any of the known camp sites for the species across the Strategic Assessment Area. Appendix E of the Plan includes a measure to provide 100 m minimum buffers around any camps if it becomes relevant during future planning.

However, the Plan authorises the clearing of 751 ha of potential foraging habitat which will be minimised in some locations by a measure in Appendix E of the Plan to retain large trees (≥50cm DBH) during precinct planning. The overall risk of substantial impacts occurring to the species as a result of habitat loss is low.

Habitat loss is not expected to adversely influence the long-term viability of the species because:

- The scale of clearing within the context of the available habitat both within and near to the Strategic Assessment Area is relatively minor. For example, there is currently 26,868.8 ha of mapped habitat in the Strategic Assessment Area
- Clearing is likely to occur progressively over the life of the Plan
- The Plan includes a range of commitments to protect and manage vegetation which will provide benefits to the species. These include a commitment to restore up to 1,331 ha of vegetation. It is also noted that restoring vegetation early in the life of the Plan is prioritised as part of an initial funding commitment of over $100 million
- The SCA contain 5,546.5 ha of potential foraging habitat for the species. While the exact area of foraging habitat for the Grey-headed Flying-fox within the SCA which will be protected is uncertain, it is likely that large areas will be protected. For example, 997.4 ha of potential foraging habitat for the Grey-headed Flying-fox is contained within the three conservation reserves proposed by the Plan (the majority of which is in the Georges River Koala Reserve)
- The Plan includes a range of commitments to help manage landscape scale threats across the Strategic Assessment Area. These will provide a benefit to the species over the life of the Plan

The process of protecting land in the Strategic Assessment Area is likely to support actions from the Recovery Plan to increase the area of habitat for the species that is secured and managed for conservation.

INDIRECT IMPACTS

The potential indirect impacts associated with camp disturbance and electrocution on power lines are not expected to substantially change from the current situation and will not influence the long-term viability of the species.

IMPLICATIONS OF THE 2019-20 BUSHFIRES

As outlined in Part 1 of this report, the 2019-20 bushfires in NSW are unprecedented in their extent and intensity. As of 3rd February 2020, the fires had burnt 5.4 million hectares of land in the state (approximately 7 per cent of NSW), including 37 of the national parks estate and over 80 per cent of the Greater Blue Mountains World Heritage Area (DPIE, 2020b).

The Grey-headed Flying-fox has been identified by DAWE as one of 119 fauna species requiring urgent management intervention following the fires. While the area of the species' range affected by the fire is not as high as some other species (between 10-30 per cent of the species' national distribution occurs within fire-affected areas), the Grey-headed Flying-fox has a known sensitivity to extreme heat and reports of mass die-offs associated with heat waves in the summer of 2019-20 are also known (DAWE, 2020d).

The impacts of the 2019-20 fires on winter foraging resources of the Grey-headed Flying-fox have not yet been quantified. Early analysis has indicated minor impacts on camps in NSW, with a small number of fire-affected camps having been abandoned or recently vacated. It is predicted that movement of the species away from fire-affected camps into new areas may result in the species moving to new areas, increasing the potential for conflict with the public. Overall, it is expected that the total impact of the fires on the species will be significant, yet may take several years to detect (DAWE, 2021e).

Appendix E of the Plan includes a measure to ensure that development (including on urban capable land and essential infrastructure on avoided land) is set back from Grey-headed Flying-fox camps by a minimum of 100 m. This measure provides protection to any new camps which become established within urban capable lands or avoided lands in the future. This will minimise impacts to the species and help to ensure protection of individuals which may have been displaced by the fires.

Further, the Plan will increase protection of large areas of foraging habitat for the Grey-headed Flying-fox within the Strategic Assessment Area. This includes 916.4 ha within the Georges River Koala Reserve, which is a narrow reserve which follows the riparian zone of the Georges River. Riparian areas such as this help to provide refuge habitat to species during hot and dry times, including during bushfires. Given the Grey-headed Flying-fox is known to be susceptible to extreme heat, protection of refuge habitat is considered to be a substantial benefit to the species.

Overall, implementation of the Plan has been evaluated with regards to the species' recovery from the 2019-20 bushfires. The Plan will not adversely influence the long-term recovery of the species from the 2019-20 bushfires.

CONCLUSION

There will be no direct impacts to known camps. There are large areas of potential habitat (26,868.8 ha) and impacts to this are relatively minor (751 ha) given the larger areas of intact habitat surrounding the Strategic Assessment Area.

Potential indirect impacts are addressed through species-specific measures defined in the Plan and implementation of the conservation program which will protect large areas associated with potential habitat for the species.

Collectively these will ensure that the implementation of the Plan does not adversely influence the long-term viability of the Grey-headed Flying-fox.

30.11.10 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the draft Recovery Plan?
- Does the Plan prevent implementation of the draft Recovery Plan actions?

These are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE DRAFT RECOVERY PLAN?

The overall objectives of the Recovery Plan are to:

- Improve the Grey-headed Flying-foxes national population trend by reducing the impact of the threats outlined in this plan on Grey-headed Flying-foxes through habitat identification, protection, restoration and monitoring, and
- Assist communities and Grey-headed Flying-foxes to coexist through better education, stakeholder engagement, research, policy and continued support to fruit growers

In addition to the overall objectives, the Recovery Plan has a range of specific objectives, including:

- Identify, protect and increase native foraging habitat that is critical to the survival of the Grey-headed Flying-fox

- Identify, protect and increase roosting habitat of Grey-headed Flying-fox camps
- Determine trends in the Grey-headed Flying-fox population so as to monitor the species' national distribution, habitat use and conservation status
- Build community capacity to coexist with flying-foxes and minimise the impacts on urban settlements from new and existing camps while avoiding interventions to move on or relocate entire camps
- Increase public awareness and understanding of Grey-headed Flying-foxes and the recovery program, and involve the community in the recovery program where appropriate
- Improve the management of Grey-headed Flying-fox camps in areas where interaction with humans is likely
- Significantly reduce levels of licenced harm to Grey-headed Flying-foxes associated with commercial horticulture
- Support research activities that will improve the conservation status and management of Grey-headed Flying-foxes
- Reduce the impact on Grey-headed Flying-foxes of electrocution on power lines, and entanglement in netting and on barbed-wire

The outcome for the Grey-headed Flying-fox under the Plan will not make it impossible to the achieve any of the objectives of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE DRAFT RECOVERY PLAN ACTIONS?

The Recovery Plan includes a number of actions to help achieve its objectives. The Plan will not prevent implementation of any of the actions.

30.11.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-47 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For the Grey-headed Flying-fox there are no relevant Threat Abatement Plans.

Table 30-47: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Grey-headed Flying-fox

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-48: Occurrence of the Grey-headed Flying-fox in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	26,868.8	3,533.6

Table 30-49: Grey-headed Flying-fox Camps in the Strategic Assessment Area

CAMP NAME	CATEGORY	MAX RECORDS FOR A CAMP IN A SINGLE YEAR*							
		2012	2013	2014	2015	2016	2017	2018	2019
CABRAMATTA	Medium priority	3,000	3,500	6,740	14,130	7,500	5,000	5,000	-
CAMDEN, BROWNLOW HILL	Medium priority	-	2,600	5,800	6,300	6,000	800	-	3,300
CAMPBELLTOWN	Medium priority	500	1,554	1,533	3,299	3,276	3,039	669	7,915
EMU PLAINS	Medium priority	850	3,609	1,540	20,000	8,000	1,150	2,200	-
EMU PLAINS (2007)	No GHFF since 2011	-	-	-	-	-	-	-	-
MACQUARIE FIELDS	Nationally important	2,500	5,420	4,810	17,000	10,050	4,900	4,930	1,731
MENANGLE	No GHFF since 2011	-	-	-	-	-	-	-	-
PENRITH	No GHFF since 2011	-	-	-	-	-	-	-	-
PICTON	High priority	-	-	190	5,335	5,934	8,760	6,100	9,820
ROPES CREEK	Medium priority	-	900	1,500	6,780	3,620	600	1,248	2,500
WINDSOR	Nationally important								50,000
YARRAMUNDI	Medium priority	500	2,566	900	2,500	-	-	850	2,751

* From 2013 onwards four surveys per year have been conducted. The highest count for a year is shown

Table 30-50: Avoidance of Grey-headed Flying-fox habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	122.5	1,498.1	601.1	2,450.4	4,672.2
HABITAT WITHIN EXCLUDED LANDS (ha)	37.1	691.3	71.3	2,128.0	2,927.7
HABITAT WITHOUT EXCLUDED LANDS (ha)	**85.4**	**806.8**	**529.8**	**322.4**	**1,744.4**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	35.1	442.2	150.2	71.0	698.5
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	41.1	54.8	28.4	22.0	40.0
AVOIDANCE FOR OTHER REASONS (ha)	19.2	253.7	131.4	39.9	444.2
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	22.5	31.4	24.8	12.4	25.5
TOTAL AVOIDANCE (ha)	**54.4**	**695.8**	**281.6**	**110.9**	**1,142.7**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**63.7**	**86.2**	**53.2**	**34.4**	**65.5**

Table 30-51: Direct impacts to the Grey-headed Flying-fox within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	31.0	111.0	248.2	211.6	149.3	**751.0**

SPECIES AT VERY LOW RISK OF DIRECT IMPACTS

30.12 *HELEIOPORUS AUSTRALIACUS* (GIANT BURROWING FROG)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	This species is currently listed as Vulnerable. Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing upgraded to Endangered (DAWE, 2021d) A decision is due by 30 October 2022 (DAWE, 2021g)
DESCRIPTION	*Heleioporus australiacus* (Giant Burrowing Frog) is a large, rotund frog that ranges from steely blue-grey to dark brown and black in colour with white/yellowish spots on its sides. It grows to approximately 10 cm in length. Tadpoles are plump, slow-moving and can grow up to 7.5 cm long (DoE, 2014c).
ECOLOGY	Adults feeds primarily on ground-dwelling invertebrates (preferentially ants) yet has also been recorded to have occasional moths found in stomach contents. Tadpoles are likely to feed on algae and bacteria in the pond base (DAWE, 2020c). Most frogs do not breed every year (EES, 2017). Adults move to breeding sites immediately before or during heavy rain events and remain at breeding sites for up to ten days. Most breeding occurs in autumn, although breeding may occur throughout the year. Egg masses are foamy and can contain 700-1,200 eggs. They are laid in burrows or under vegetation in small pools. Tadpoles take 3-12 months to develop into frogs (DAWE, 2020c). Male frogs are strongly territorial at breeding sites (EES, 2017). The species spends most of their time (more than 95 per cent) in non-breeding habitats where they burrow below the soil surface or leaf litter (DoE, 2014c). Individual frogs use multiple burrow sites, and some burrows are used repeatedly (EES, 2017). Non-breeding frogs have been found up to 500 m from streams (DAWE, 2020c). Frogs appear to occupy exclusive non-breeding ranges of approximately 0.04 ha (EES, 2017). The species is slow growing, and may live up to 10 years of age (or possibly longer) (EES, 2017). Age to sexual maturity is three years. Generational length is thought to be approximately six to seven years (DAWE, 2020c).
DISTRIBUTION AND HABITAT	The Giant Burrowing Frog occurs in NSW and Victoria, along the coast and nearby ranges. It has been found up to 100 km inland and up to 1,000 m above sea level (DAWE, 2020c). Genetic disparities and a gap in records between Ulladulla and Narooma suggest that *H. australiacus* comprises two separate species, with one species occurring in the north (in the Central Coast and

	Sydney region) and one in the south (south of Kiama). However, taxonomic revision of the species is still underway and has not yet been accepted. If the taxonomic review is accepted, this would influence understanding of the species' habitat use, as there are recognised differences in habitat use between the northern and southern populations (DAWE, 2020c). In the north, the Giant Burrowing Frog is largely confined to areas of sandstone geology associated with the Sydney Basin. It has been found in ephemeral and semi-permanent streams, beside perennial creeks, in hanging swamps on sandstone shelves, and infrequently in semi-permanent to permanent artificial dams, ditches and culverts. It is associated with sandy soil on sandstone which supports heath vegetation (DAWE, 2020c). In the south, the frog has been recorded in a wide range of vegetation communities including montane sclerophyll forest, montane riparian woodland, wet sclerophyll forest and dry sclerophyll forest (DAWE, 2020c). Breeding habitat includes ponds and slow-moving streams in heaths or forest. Breeding habitat is generally located at soaks or pools within first or second order streams, but has also been recorded in small permanent creeks (DAWE, 2020c).
POPULATIONS	The Giant Burrowing Frog occurs as two distinct metapopulations (one in the north and one in the south), although it is recognised that the species is currently undergoing taxonomic revision to determine whether the current listing comprises two separate species (DAWE, 2020c). The majority of records of the species are located within the northern metapopulation (DAWE, 2020c). There are no robust estimates of population size. It is considered likely that the species has a small population size of less than 10,000 mature individuals, but more than 1,000 mature individuals (DAWE, 2020c). Historically, the species was locally common in the Sydney region, yet the species is now considered to be rare in this area. Recent reports of the species primarily consist of single or small numbers of individuals (DAWE, 2020c).
SOS SITES	This species has been assigned to the landscape species management stream because it is distributed across large areas and is subject to threatening processes that generally act at the landscape scale rather than at distinct, definable locations The following priority management sites have been identified: • Watagans, Blue Mountains and Kangara-Boyd National Parks • Blue Mountains, Newnes Plateau and Shoalhaven (proposed) (EES, 2021)
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Heleioporus australiacus* (giant burrowing frog) (DoE, 2014c) Draft Conservation Advice available within: Consultation Document on Listing Eligibility and Conservation Actions, *Heleioporus australiacus* (Giant Burrowing Frog) (DAWE, 2020c)
SPECIES-SPECIFIC GUIDELINES	There are no species-specific guidelines for the Giant Burrowing Frog
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1973

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	Yes	Yes	No	Yes
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps within the nominated areas for the Giant Burrowing Frog were generated using: • BioNet PCT associations of intact vegetation • Patch sizes of larger than 5 ha were to exclude small isolated patches of vegetation from the model • Areas within 300 m of 1st and 2nd order watercourses, excluding overlapping areas within 300 m from a 3rd (or higher) order watercourse • Rock units in 'Hawkesbury Sandstone' and 'Minchinbury Sandstone' and excluded soils in 'Blacktown', 'Glenorie', 'Luddenham', 'Picton', 'West Pennant Hills' Targeted habitat assessments were undertaken for this species, the species was not recorded however suitable habitat was found to occur.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). As above. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	BioNet records were used from 2008 onwards based on the approximate 10 year life-span of the species (noting that this only excluded two records from the assessment – both with limited accuracy from 1974 and 1913).				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *Heleioporus australiacus* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *Heleioporus australiacus* were downloaded in September 2019.				
	POPULATION DEFINITION				
	Records within 300 m were considered to be a population.				
	IMPORTANT POPULATION CRITERIA				
	The populations of Giant Burrowing Frog were considered important within the Strategic Assessment Area because they met the following criteria: a population within a conservation reserve				

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-5 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-53 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Giant Burrowing Frog in the Strategic Assessment Area. **Records** There are limited records for the Giant Burrowing Frog within the Strategic Assessment Area. This reflects the lack of suitable habitat across the Cumberland subregion generally and the relative extent of clearing compared with surrounding areas. The species occurs more commonly to the south-east of the Strategic Assessment Area between Campbelltown and Helensburgh, as well as to the north-west, north, and north-east of the Strategic Assessment Area. Two populations from five records have been mapped within the Strategic Assessment Area – one in the Castlereagh area in the north, and a second in the Gulguer Nature Reserve in Greendale towards the western boundary of the Strategic Assessment Area. The population from the Castlereagh area is considered not important. It comprises a single record located within a largely cleared landscape containing large housing lots. The second population (comprising four records) is considered to be important on the basis of its occurrence within a protected area; the premise being that populations within protected areas have a greater chance of persistence, and therefore make a significant contribution to the conservation and recovery of the species. **Potential habitat** The baseline mapping for this assessment has mapped 4,064.2 ha of potential habitat within the Strategic Assessment Area. This primarily occurs in the south of the Strategic Assessment Area, with scattered patches in the west and along parts of the eastern boundary of the Strategic Assessment Area. Potential habitat within the Strategic Assessment Area occurs along the interface between broad areas of intact vegetation surrounding the Cumberland subregion and land that has been cleared for farming or houses within the Strategic Assessment Area. It is likely to be marginal when compared to available habitat in the region.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.12.1 NOMINATED AREAS

The baseline mapping for the assessment mapped 317.9 ha of potential habitat for the Giant Burrowing Frog within the nominated areas (not including excluded lands). Nearly all of this habitat has been avoided as part of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 223.6 ha was avoided for biodiversity purposes
- 93.6 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 30-54.

It is important to note that the avoidance calculations in Table 30-54, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-54 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.12.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.12.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will result in very small impacts to potential habitat.

LOSS OF POTENTIAL HABITAT

Approximately 0.6 ha of potential Giant Burrowing Frog habitat will be lost as a result of the implementation of the Plan (within Wilton and GMAC). This habitat represents <0.1 per cent of potential habitat within the Strategic Assessment Area. No direct impacts will occur to locations where the species has been recorded.

A summary of these impacts is provided in Table 30-55.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be very low. This is because:

- The likelihood of substantial impacts occurring to the species has been categorised as unlikely. There will be no direct impacts to known populations and small impacts to potential habitat. The species has not been recorded within the region associated with direct impacts and is unlikely to be found there. Impacts are to small and fragmented areas and avoid direct impacts to first and second order streams within the distribution of mapped potential habitat
- The consequence of any impacts to the species has been categorised as negligible. There will be loss of approximately <0.1 per cent of mapped potential foraging habitat in the Strategic Assessment Area

30.12.4 FRAGMENTATION OF HABITAT

Development within the nominated areas or transport corridors will not lead to fragmentation of potential habitat for the species.

30.12.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for the Giant Burrowing Frog.

Further, it is noted that the SCA contain 2,065.6 ha of potential habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 561.5 ha of potential habitat for the Giant Burrowing Frog is contained within two conservation reserves proposed by the Plan, including:

- 281.9 ha within the Georges River Koala Reserve
- 279.7 ha within the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.12.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for the Giant Burrowing Frog identifies a range of threats to the species. Where these threats are relevant to the implementation of the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Changes to hydrology and water quality
- Inappropriate fire regimes
- Predation by foxes and cats
- Vehicle strike
- Infection with amphibian chytrid fungus

The Conservation Advice identifies a number of other key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Giant Burrowing Frog are discussed below for each identified indirect impact.

It is noted that 561.5 ha of potential habitat for the Giant Burrowing Frog is contained within two conservation reserves proposed by the Plan. The protection of habitat for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

HYDROLOGICAL CHANGES

Hydrological changes caused by stormwater run-off, water extraction and sedimentation has been identified as a threat to the species (DoE, 2014d).

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:

    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the species from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to habitat for the species
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to habitat for the species

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes are identified as a threat to the Giant Burrowing Frog (DoE, 2014d).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for Giant Burrowing Frog being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for Giant Burrowing Frog. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat

- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

PREDATION BY CATS

Predation by cats and other pest animals is recognised as a threat to the Giant Burrowing Frog, although the conservation advice states that the level of impact is unknown (DoE, 2014d). New urban development under the Plan is likely to increase the number of domestic cats in the local area, which in turn, may lead to an increase in feral cat populations.

The Plan incorporates a range of measures to manage the risks associated with cats. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

VEHICLE STRIKE

Vehicle strike as a result of increased traffic frequency is an identified potential threat to the species (DoE, 2014d).

Expanding urban development within the nominated areas and development of transport corridors will increase the traffic within and surrounding these areas. However, the Giant Burrowing Frog is unlikely to be affected by this increase given the lack of historical records within proximity to development and the location of the known populations in areas that are unlikely to see any change in vehicle movements due to development under the Plan.

INFECTION WITH AMPHIBIAN CHYTRID FUNGUS

Amphibian chytrid fungus, which causes the infection known as chytridiomycosis, is identified as a key threat to the Giant Burrowing Frog (DoE, 2014d).

Chytrid fungus is already present in the Cumberland subregion, although there may be pockets of disease free areas that are inhospitable to the growth of the disease (for example, due to salinity levels or elevated concentrations of trace metals). The potential for dispersing chytridiomycosis in wild frog populations increases with urbanisation around streams. This comes from growing potential for human interaction, more water flow (urban run-off) and reduced optimal habitat.

The Plan incorporates a range of general measures to manage the risks associated with amphibian chytrid fungus. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs

- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of Amphibian chytrid fungus

The package of measures in the Plan is expected to adequately manage the risk associated with chytrid fungus because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

It is noted that there is no mapped potential habitat, and no known records of the species, within either the OSO tunnel footprint or the Metro Rail Future Extension tunnel footprint. It is therefore considered unlikely that development within the tunnel footprints will negatively impact the Giant Burrowing Frog.

30.12.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There are no known records of the Giant Burrowing Frog within avoided lands in any of the nominated areas. However, there is 317.3 ha of potential habitat mapped for the species within avoided lands within Wilton and GMAC, and therefore it is considered to be possible that the species may occur within avoided lands in these nominated areas.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design

- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.12.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014d) identifies the following key issues relevant to implementation of the Plan that are likely to have the greatest influence on the long-term viability of the Giant Burrowing Frog:

- Habitat loss
- Indirect impacts such as:
    - Hydrological changes
    - Inappropriate fire regimes
    - Predation by cats
    - Vehicle strike
    - Infection with amphibian chytrid fungus

However, it is unlikely that any of these issues will be a problem within the Strategic Assessment Area. The key reasons for this are as follows:

- There are only two identified populations within the Strategic Assessment Area, one of which is important. The important population and associated habitat are separated by almost 6 km from the nearest urban capable land and is within an area already managed for conservation. The non-important population is based on one record located within a largely cleared landscape containing large housing lots
- While potential habitat in the south of the Strategic Assessment Area within Wilton and GMAC may be subject to indirect impacts, the species has not been recorded in this area and it is unlikely to be important to the viability of the populations in the region given the extent of adjacent wilderness known to support the species
- While there is a possibility that indirect impacts may affect the nearest records for the species to the east of the Strategic Assessment Area, potential impacts are likely to be minor and incremental given the distance from the nearest urban capable land (approximately 4 km) and the extent of existing development within the Campbelltown area

In addition, the Plan is very likely to lead to the protection and management of important areas for the species within the SCA. Two of the reserves currently proposed by the Plan are with known or have the potential to support the species. They are:

- The Gulguer Reserve investigation area which occurs on the western side of the Strategic Assessment Area. 279.7 ha of potential habitat for the species has been mapped in this area
- The Georges River Koala Reserve is on the eastern side of the Strategic Assessment Area near GMAC. 281.9 ha of potential habitat for the species has been mapped in this area

CONCLUSION

There is a very low risk of residual adverse impacts from habitat loss under the Plan and potential indirect impacts are managed and unlikely to affect the species.

Implementation of the Plan will not adversely influence the long-term viability of the Giant Burrowing Frog.

30.12.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.12.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in (DoE, 2014d) where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan has been developed to ensure that it is not inconsistent with any relevant TAPs. This analysis around consistency is presented in Chapter 15.

Table 30-52: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Giant Burrowing Frog

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoEE, 2016b)
Land clearance	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008n)
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-53: Occurrence of the Giant Burrowing Frog in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	2	1
(IMPORTANT POPULATIONS)	(1)	(1)
HABITAT MAPPING (Ha)	4,064.2	689.8

Table 30-54: Avoidance of Giant Burrowing Frog habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	292.4	108.0	0.0	0.0	400.4
HABITAT WITHIN EXCLUDED LANDS (ha)	49.1	33.3	0.0	0.0	82.5
HABITAT WITHOUT EXCLUDED LANDS (ha)	**243.2**	**74.7**	**0.0**	**0.0**	**317.9**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	182.2	41.4	0.0	0.0	223.6
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	74.9	55.5	0.0	0.0	70.3
AVOIDANCE FOR OTHER REASONS (ha)	60.7	32.9	0.0	0.0	93.6
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	25.0	44.1	0.0	0.0	29.5
TOTAL AVOIDANCE (ha)	**242.9**	**74.4**	**0.0**	**0.0**	**317.3**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**99.9**	**99.6**	**0.0**	**0.0**	**99.8**

Table 30-55: Direct impacts to the Giant Burrowing Frog within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.3	0.3	0.0	0.0	0.0	**0.6**

30.13 *LITORIA AUREA* (GREEN AND GOLDEN BELL FROG)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Litoria aurea* (Green and Golden Bell Frog) is a large dull olive to bright emerald-green frog with large irregular golden-bronze blotches on its back.
ECOLOGY	The Green and Golden Bell Frog has a diverse diet which includes invertebrates such as insect larvae, crickets, cockroaches, dragonflies, earthworms, flies, grasshoppers, mosquito wrigglers, isopods, freshwater crayfish and slugs (DEWHA, 2009b). Tadpoles feed on algal or bacterial scum growing on submerged rocks (DEWHA, 2009b). The species is active by day, although males call mostly at night. While they retain a close association with water bodies and appear to generally be faithful to a single water body for their general activities, records suggest that the species is highly mobile and can move some distance as part of migrations to and from breeding sites (Lemckert, 2019). Movements of up to 5 km may be common and the frog may disperse up to 10 km (DoEE, 2018f). Breeding occurs generally between September and February after heavy rains or storms and spawn is laid among aquatic vegetation (DEWHA, 2009b). The species has high fecundity and clutch sizes have been known to contain 2463-11,682 eggs (DEWHA, 2009b).
DISTRIBUTION AND HABITAT	Records of the Green and Golden Bell Frog are widely separated and isolated, occurring along coastal lowland areas of eastern NSW and Victoria ranging from Yuraygir National Park in the north to Lake Wellington in the south. In NSW, several records occur around Sydney and the species is known to occur in the Cumberland subregion. Nearly all current known populations of the Green and Golden Bell Frog are located with 10 km of the coast. This is most likely due to the fact that the species is susceptible to the amphibian chytrid fungus and the fungus is intolerant of salt. These locations therefore provide some refuge from the impacts of chytrid (Lemckert, 2019). Habitat comprises one or more water bodies, and associated terrestrial habitats with grassy areas and low vegetation (DEWHA, 2009b). The species uses water bodies that are still, shallow, temporary, unshaded, with aquatic plants and free of mosquito fish for breeding (DEWHA, 2009b). A range of water bodies are suitable for the species, as long as they are not fast flowing, including ponds, wetlands, farm dams, creek lines and irrigation channels (DEWHA, 2009b). Ephemeral water bodies are important habitat for the species as: • Flooding of these water bodies can trigger breeding • They can provide habitat stepping stones between otherwise disconnected areas

	• They are less likely to contain mosquito fish. In NSW, the species is known to occupy disturbed habitats such as abandoned mines and quarries (DEWHA, 2009b). Non-breeding habitat is usually closely associated with water bodies (often within 50 m) (Lemckert, 2019). These terrestrial habitats immediately adjacent to water bodies are used for foraging and shelter and preferably contain grassy areas and vegetation including a range of shelter sites such as logs, rocks or dense vegetation (DEWHA, 2009b). Shelter sites are used when the species is inactive and therefore vulnerable to predation. The species is more likely to be present, and habitat more likely to be important, where: • Multiple suitable breeding sites are within a close enough proximity for individuals to migrate between them • Multiple non-breeding water bodies are present in an area and within close enough proximity to allow migration between them (and breeding sites) with relative ease • The connectivity of breeding and non- breeding habitat contains vegetation and shelter that facilitates migration • There are other individuals occupying waterbodies in close proximity (Lemckert, 2019)
POPULATIONS	In 2008, 30 populations were known in NSW and records are clustered around the following areas: • Yuraygir National Park • Gosford • Greater Sydney • Kempsey-Port Macquarie • Hexham-Newcastle-Ravensworth-Mungo Brush • Illawarra-Batemans Bay • Eden-East Gippsland (DoE, 2014f) Most populations have fewer than 20 adults, however, a population in Captains Flat has around 100 adults and over 1,000 were recorded at Kooragang Island, Broughton Island and Homebush (DoEE, 2018f). A population is considered a separate population if it is located more than 10 km from a known or nearby population (DEWHA, 2009b).
SOS SITES	Eight SOS sites for the species have been identified: • Yuraygir National Park • Crescent Head • Broughton Island • Kooragang Island • Homebush/Sydney Olympic Park • Crookhaven • Molonglo Floodplain • Meroo The closest site to the Strategic Assessment Area is the Homebush/Sydney Olympic Park site.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Litoria aurea* (Green and Golden Bell Frog) (DoE, 2014f) EPBC Act Policy Statement 3.19. Significant impact guidelines for the vulnerable green and golden bell frog (*Litoria aurea*) (DEWHA, 2009c) Threat abatement plan for predation by feral cats (DoE, 2015g) Threat abatement plan for predation by the European red fox (DEWHA, 2008n) Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoEE, 2016b)

SPECIES-SPECIFIC GUIDELINES	The EPBC Act Policy Statement 3.19 - Significant Impact Guidelines for the Vulnerable Green and Golden Bell Frog (*Litoria aurea*) (DEWHA, 2009c) provides guidance about how to determine whether a proposed action is likely to have a significant impact on the Green and Golden Bell Frog. The guidelines describe an action as having a significant impact on the Green and Golden Bell Frog if it directly or indirectly alters or interferes with the breeding or dispersal of the species. Specifically, a referral under the EPBC Act should be considered if the action results in: 1. The removal or degradation of aquatic or ephemeral habitat either where the Green and Golden Bell Frog has been recorded since 1995 or habitat that has been assessed as being suitable according to these guidelines. This can include impacts from chytrid and *Gambusia* originating off-site 2. The removal or degradation of terrestrial habitat within 200 m of habitat identified in threshold 1 3. Breaking the continuity of vegetation fringing ephemeral or permanent waterways or other vegetated corridors linking habitats meeting the criteria in threshold 1 Only one threshold needs to be met to be considered a significant impact.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1870

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
		WILTON	**GMAC**	**WSA**	**GPEC**
	No	Yes	Yes	Yes	Yes
EXPERT REPORT (BCAR PROCESS)	Yes (Lemckert, 2019). Available at Supporting Document C.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS** **Expert report polygons**. Predicted polygons for the Green and Golden Bell Frog were provided for GMAC and GPEC only, as these are the only two nominated areas supporting extant populations of the species. The species polygons cover the locations of known records, the riparian corridor joining those records and a buffer of 1,000 m around the riparian corridor and records. This is the area deemed likely to be used for foraging, shelter, breeding and as migratory habitat as they move between water bodies and riparian corridors (Lemckert, 2019). Targeted surveys were undertaken at Ropes Creek within GPEC in December 2020 and January 2021 to determine whether a population of the species is present at this site. The species was not identified during the survey. Further information on this survey is available in Supporting Document I. Further, a recent 2019 record of the species within WSA near The Northern Road, Luddenham, became available on BioNet following completion of the expert report. This record was reviewed by the species expert. It was determined that this new record does not warrant updates to the species' habitat polygon. The record is considered to relate to a single and transient individual dispersing from a non-natural population of the species in Riverston (with habitats created by a				

	'backyard breeder'), and does not equate to a natural or self-sustaining population of the species (Dr Frank Lemckert pers. comm.)
	OUTSIDE THE NOMINATED AREAS
	Species distribution model (SDM). Potential habitat outside the nominated areas was mapped using an SDM. The report for this process notes that there are important factors driving the species' distribution for which appropriate predictors were not available. For example, Chytridiomycosis is known to impact where the species occurs. In addition, the Green and Golden Bell Frog is known not to be restricted to areas surrounded by native vegetation and has been found in quarries, constructed ponds, and small bodies of the water on the ground. Therefore, the resulting predictions should be used with some caution. No targeted surveys as part of this project were undertaken outside the nominated areas.
POPULATION MAPPING	**RECORD SELECTION**
	All available BioNet records from 1995 onwards were included in the assessment, based on the guidance in the EPBC Act Policy Statement 3.19 (DEWHA, 2009c).
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *Litoria aurea* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *Litoria aurea* were downloaded in October 2020.
	POPULATION DEFINITION
	Populations were considered separate if records were more than 10 km apart OR where landscape features interrupted connectivity, based on the guidance in the EPBC Act Policy Statement 3.19 (DEWHA, 2009c).
	IMPORTANT POPULATION CRITERIA
	The populations of Green and Golden Bell Frog were considered important within the Strategic Assessment Area because they met the following criteria: a population identified or inferred in a Commonwealth conservation advice, plan, final determination, or other relevant policy document as being important

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-7 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-57 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Green and Golden Bell Frog in the Strategic Assessment Area. **Records** The Green and Golden Bell Frog has been recorded within the Strategic Assessment Area, although current records (from 1995 onwards) are limited. Four populations have been identified: • One population (population 190) within GPEC associated with Ropes Creek • One population (population 193) restricted to a small area around Blair Athol in GMAC. Initially, no records after 2014 were known to occur at this location, and records were originally considered to be of frogs that escaped a captive colony (Lemckert, 2019). However, subsequent record database searches discovered new records recorded in 2015 and 2018. The new records

indicate that this is likely to be a persistent population and therefore will be assessed accordingly

- One population (population 194) identified at Gow Park in Mulgoa, approximately 2.4 km south of the nearest urban capable land within GPEC. This population was recorded in 1999 in a non-permanent creek. It is noted that the new record within WSA has been assigned to population 194, based on its proximity to Mulgoa and because the new record is located in the same sub-catchment. However, the new record is considered to relate to a single and transient individual dispersing from a non-natural population of the species in Riverston (with habitats created by a 'backyard breeder'), and does not equate to a natural or self-sustaining population of the species (Dr Frank Lemckert pers. comm.). Therefore, population 194 is considered to comprise of one reliable record of the species only (the record at Gow Park)
- One population (population 192) along the eastern boundary of the Strategic Assessment Area

There are a relatively large number of BioNet records for the Cumberland subregion. However, these are dominated by records from Sydney Olympic Park (outside of the Strategic Assessment Area) with over 95 per cent of the records located within the eastern third of the Cumberland subregion; again, primarily outside of the Strategic Assessment Area (Lemckert, 2019).

The expert report for this species notes that the Green and Golden Bell Frog is unlikely to have been common across the majority of the Cumberland subregion, reflecting the fact that the region is over 10 km from the coast so chytrid fungus is more likely to be present (Lemckert, 2019).

Potential habitat

The baseline mapping for this assessment has mapped 5,500.3 ha of potential habitat within the Strategic Assessment Area. This habitat is concentrated towards the eastern most boundary of the Strategic Assessment Area, with some large areas identified north of GPEC and small, scattered areas along the western edge. Potential habitat within GPEC and GMAC is associated with the location of known records in these nominated areas.

There is no potential habitat within Wilton and WSA. It is expected that survey effort has been sufficient to reasonably indicate likely presence across all four nominated areas (Lemckert, 2019).

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.13.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 24.6 ha of potential habitat for the Green and Golden Bell Frog within the nominated areas (not including excluded lands). Approximately 11.3 ha (45.8 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors. All of the avoidance occurred in GPEC and almost all for biodiversity purposes.

A breakdown of avoidance across each nominated area is provided in Table 30-58.

It is important to note that the avoidance calculations in Table 30-58, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-58 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.13.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

The Plan includes a species-specific commitment (Commitment 3) to avoid and minimise impacts to the Green and Golden Bell Frog and its habitat within certified major transport corridors through detailed planning and design. This includes avoiding areas of potential habitat connectivity within riparian corridors where possible.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.13.3 LOSS OF KNOWN AND POTENTIAL HABITAT

Implementation of the Plan will lead to impacts to potential habitat. The majority of these impacts relate to habitat within GPEC where the species has previously been recorded. A very small area of mapped potential habitat will be affected within transport corridors outside the nominated areas.

A breakdown of impacts across the Strategic Assessment Area is given in Table 30-59.

IMPACTS TO HABITAT WITHIN GPEC

The urban capable lands and transport corridors within GPEC intersect approximately 14 ha of habitat within and adjacent to the Ropes Creek corridor. This habitat is known to have supported a population of the Green and Golden Bell Frog, with 6 BioNet records made between 1998 and 2012.

At the time of public exhibition, it was considered likely that the population at this locality could still be present, and targeted surveys of the site had not been completed. The draft Plan at this stage contained a species-specific measure to undertake surveys within potential habitat along Ropes Creek to determine if the species was still present, and if confirmed to be present, to avoid, protect and enhance key habitat features of the site.

Targeted surveys of Ropes Creek have since been completed. The surveys were carried out in December 2020 and January 2021. The surveys did not find any individuals of the species present at the site. Potential shelter and dispersal habitat for the species was identified, yet the habitat of the locality was considered unlikely to be suitable for breeding. Further information regarding the species' survey is available in Supporting Document I.

Given that the riparian habitat available for the species at this site is suitable for shelter and dispersal only, and that the species was not found to be present during survey, the risk posed to the species of impacts to this habitat is considered to be very low. It is recognised that the Plan includes a species-specific commitment (Commitment 3) to avoid and minimise impacts to the Green and Golden Bell Frog and its habitat within certified major transport corridors through detailed planning and design. This includes avoiding areas of potential habitat connectivity within riparian corridors where possible. This measure will help to minimise potential impacts to riparian habitat for the Green and Golden Bell Frog within GPEC.

The standard risk assessment method described in Section 30.3 was not seen as applicable to the Green and Golden Bell Frog, as targeted surveys have been undertaken to identify occupancy status of impacted potential habitat of the species.

IMPACTS TO HABITAT OUTSIDE THE NOMINATED AREAS

Two very small areas of mapped potential habitat (totalling 0.7 ha) will be intersected by transport corridors outside the nominated areas. There are no records associated with these areas. The risk to the species from these impacts is considered to be very low as the lack of historical records within the two impacted areas and connected habitats provides a good indication that they are unlikely to support the species given the reasonable level of survey effort in the region.

30.13.4 FRAGMENTATION OF HABITAT

Development under the Plan will not lead to any further fragmentation of Green and Golden Bell Frog populations.

30.13.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for the Green and Golden Bell Frog.

Further, it is noted that the SCA contain 462.3 ha of potential habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 91.4 ha of potential habitat for the Green and Golden Bell Frog is contained within the three conservation reserves proposed by the Plan, including:

- 16.1 ha within the Georges River Koala Reserve
- 2,2 ha within the Confluence Reserve investigation area
- 73.1 ha within the Gulguer Reserve investigation area

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.13.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for the Green and Golden Bell Frog identifies a range of threats to the species. Where these threats are relevant to the implementation of the Plan, the Plan includes management strategies to mitigate their impacts. They include:

- Changes to the structure and diversity of aquatic vegetation
- Changes to hydrology and water quality
- Intensification of public access to habitat
- Predation by foxes, cats, dogs, and rats
- Inappropriate fire regimes
- Infection with amphibian chytrid fungus
- Road mortality

Predation of eggs and tadpoles, interaction with cane toads and grazing are also identified as potential threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for Green and Golden Bell Frog are discussed below for each identified indirect impact.

It is noted that 91.4 ha of potential habitat for the Green and Golden Bell Frog is contained within the three conservation reserves proposed by the Plan. The protection of habitat for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

CHANGES TO THE STRUCTURE AND DIVERSITY OF AQUATIC VEGETATION

Changes to the structure and diversity of aquatic vegetation from weed invasion is a key threat to the Green and Golden Bell Frog. Weeds are already present within the Strategic Assessment Area. However, urban, transport and agricultural development has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or inadvertently changing conditions to favour weeds.

The species is most susceptible to the threat of weeds from development under the Plan where new urban growth or transport occurs adjacent to known populations or habitat, in particular adjacent to the OSO and close to North St Marys along Ropes Creek in GPEC.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for Green and Golden Bell Frog:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk posed to the Green and Golden Bell Frog from invasive weeds. This is because:

- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

CHANGES TO HYDROLOGY AND WATER QUALITY

A reduction in water quality and changes to hydrology are recognised as a principal threat to the species (DEWHA, 2009c). Key issues relate to changes to drainage patterns and stormwater runoff, soil erosion and sedimentation and increased pollutants.

Development under the Plan has the potential to alter water quality and hydrology in areas of known and potential habitat for the Green and Golden Bell Frog. The areas at risk include:

- The population associated with Ropes Creek where development of the Western Sydney Freight Line (transport corridor to the east of WSA) intersects an upstream section of the creek
- The population at Gow Park in Mulgoa, which is located downstream of development within WSA

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:

        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the species from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to habitat for the species
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to habitat for the species

INTENSIFICATION OF PUBLIC ACCESS TO HABITAT

Intensification of public access to habitat is identified as a threat to the species. However, populations of the Green and Golden Bell Frog adjacent to or within proximity of proposed development are already subject to this threat as they are located within highly urbanised areas. Implementation of the Plan is unlikely to change the current level of disturbance.

The Plan also incorporates a range of measures to mitigate the risks associated with inappropriate habitat disturbance for the species. In summary, these include:

- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations. It is noted that 91.4 ha of potential habitat for the Green and Golden Bell Frog is contained within the three conservation reserves proposed by the Plan
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased public access to habitat areas as a result of development. This is because:

- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

PREDATION BY CATS AND OTHER PEST ANIMALS

Predation by cats and other pest animals is recognised as a threat to the Green and Golden Bell Frog. New urban development under the Plan is likely to increase the number of domestic cats in the local area. However, areas of habitat

within proximity of proposed development already occur within highly urbanised areas. Any increase in the risk of predation from cats on populations of the Green and Golden Bell Frog as a result of the Plan is expected to be minimal.

The Plan also incorporates a range of measures to manage this issue across throughout the nominated areas. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes are identified as a potential threat to the Green and Golden Bell Frog (DoE, 2014f).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for Green and Golden Bell Frog being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for Green and Golden Bell Frog. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

INFECTION WITH AMPHIBIAN CHYTRID FUNGUS

Amphibian chytrid fungus, which causes the infection known as chytridiomycosis, is likely to impact on populations of the Green and Golden Bell Frog. The threat to the species from chytrid fungus is not well understood, with the risk of extinction from the disease categorised as low to moderate (DEWHA, 2009b; DoEE, 2016b). However, the suitability of habitat is influenced by the presence of chytrid fungus.

Chytrid fungus is already present in the Cumberland subregion, although there may be pockets of disease free areas that are inhospitable to the growth of the disease (for example, due to salinity levels or elevated concentrations of trace metals). The potential for dispersing chytridiomycosis in wild frog populations increases with urbanisation around streams. This comes from growing potential for human interaction, more water flow (urban run-off) and reduced optimal habitat. Increased risks associated with development under the Plan are minimal, however, as habitat areas are already highly urbanised.

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development contain the following species-specific measure: "For areas where the Green and Golden Bell Frog is confirmed, incorporate best practice site hygiene protocols to manage the potential spread of chytrid fungus". This measure will address the potential impacts of chytrid fungus to the species from development of essential infrastructure on avoided land.

Further, Appendix E of the Plan contains a range of measures to incorporate best practice site hygiene protocols for development on urban capable land and development within the transport corridors across all nominated areas. While the Green and Golden Bell Frog is not specifically identified as a target species for these measures, the species will nonetheless benefit from these controls which will minimise the risk of spread of chytrid fungus.

The Plan further incorporates a range of general measures to manage the risks associated with chytrid fungus. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of chytrid fungus

The package of measures in the Plan is expected to adequately manage the risk associated with chytrid fungus because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

ROAD MORTALITY

Road mortality is identified as a potential threat to the Green and Golden Bell Frog (DoE, 2014f). This is not a novel threat to the species within the Strategic Assessment Area as roads have already been developed in proximity to habitat areas. However, implementation of the Plan will lead to new roads and an increase in the volume of cars on existing roads within and surrounding the nominated areas. The main areas of concern relate to:

- The development of the Outer Sydney Orbital downstream of habitat associated with the Ropes Creek corridor

- Development of the Western Sydney Freight Line (transport corridor to the east of WSA) which intersects a creek line upstream of Ropes Creek

The Plan includes a species-specific measure to avoid and minimise impacts to the Green and Golden Bell Frog and its habitat within certified major transport corridors through detailed planning and design. This includes avoiding areas of potential habitat connectivity within riparian corridors where possible. This measure will minimise the risk of road mortality to the species.

Further, Commitment 6 of the Plan contains the following action (Action 1 d): "identify potential design options for major watercourse crossings to reduce disruption to connectivity and the risk of fauna vehicle strikes".

These measures are considered to adequately address any potential increased threat from road mortality due to implementation of the Plan.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

There is no habitat for the Green and Golden Bell Frog within tunnel footprints and the species will not be impacted in these locations.

30.13.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The species may be subject to impacts to potential habitat from essential infrastructure on avoided land within GPEC associated with the Ropes Creek corridor. Surveys of this site have been conducted, which found that the site contained likely shelter and dispersal habitat for the species yet did not contain breeding habitat. No individuals of the species were identified during the surveys. The potential risks to the species associated with impacts to this site are subsequently considered to be very low.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.13.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014f) identifies the following key issues relevant to implementation of the Plan that are likely to have the greatest influence on the long-term viability of the Green and Golden Bell Frog:

- Habitat loss
- Indirect impacts including:
    - Changes to the structure and diversity of aquatic vegetation
    - Changes to hydrology and water quality
    - Intensification of public access to habitat
    - Predation by cats and other pest animals
    - Inappropriate fire regimes
    - Infection with amphibian chytrid fungus
    - Road mortality

HABITAT LOSS

At the time of public exhibition, the biggest potential threat posed by habitat loss to the Green and Golden Bell Frog was identified as impacts to habitat at Ropes Creek within GPEC. Since that time, surveys of the site have been completed which did not identify any individuals of the species at the site and determined that the site contained suitable shelter and dispersal habitat only (and not breeding habitat). There is a species-specific commitment (Commitment 3) for certified major transport corridors to avoid and minimise impacts to habitat for the Green and Golden Bell Frog, which will assist in reducing the total impacts to the species within GPEC. Overall, impacts to this site are therefore considered to pose a very low risk to the species.

Other potential impacts to the species relate to two very small areas of mapped potential habitat (totalling 0.7 ha) which will be intersected by transport corridors outside the nominated areas. The risk to the species from these impacts is considered to be very low as these localities are considered unlikely to support the species.

Any loss of potential habitat as a result of development is not expected to adversely affect the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with development under the Plan will all be adequately managed and mitigated through a combination of species-specific and generic management strategies.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

There is a very low risk of residual adverse impacts from habitat loss under the Plan and potential indirect impacts are managed and unlikely to affect the species.

30.13.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.13.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-56 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan has been developed to ensure that it is not inconsistent with any relevant TAPs. This analysis around consistency is presented in Chapter 15.

Table 30-56: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Green and Golden Bell Frog

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoEE, 2016b)
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008n)
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-57: Occurrence of the Green and Golden Bell Frog in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	4	0
(IMPORTANT POPULATIONS)	(4)	(0)
HABITAT MAPPING (Ha)	5,500.3	340.6

Table 30-58: Avoidance of Green and Golden Bell Frog habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	0.0	232.9	0.0	1,421.6	1,654.5
HABITAT WITHIN EXCLUDED LANDS (ha)	0.0	232.9	0.0	1,397.0	1,629.9
HABITAT WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**0.0**	**24.6**	**24.6**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	0.0	11.2	11.2
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.0	45.7	45.7
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	0.0	0.0	0.1	0.1
TOTAL AVOIDANCE (ha)	**0.0**	**0.0**	**0.0**	**11.3**	**11.3**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**0.0**	**0.0**	**0.0**	**45.8**	**45.8**

Table 30-59: Direct impacts to the Green and Golden Bell Frog within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	0.0	13.3	0.7	**14.0**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	1*	1	0	**2**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(1*)	(1)	(0)	**(2)**

*This record has been reviewed by the species expert and has been determined to relate to a single and transient individual dispersing from a non-natural population of the species in Riverston (with habitats created by a 'backyard breeder'), and does not equate to a natural or self-sustaining population of the species (Dr Frank Lemckert pers. comm.). Therefore, impacts to this record are not considered to constitute genuine impacts to the species

30.14 *PETAUROIDES VOLANS* (GREATER GLIDER)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing upgraded to Endangered (DAWE, 2021a). A decision is due by 30 October 2021 (DAWE, 2021h).
DESCRIPTION	*Petauroides volans* (Greater Glider) is the largest gliding possum in Australia. It has thick fur which is dusky brown or dark to mottled grey on top and white or cream underneath. It can have a head and body length of 35-46 cm and 45-60 cm long tail (TSSC, 2016f). At the time of the species' original listing, it was thought that *P. volans* was the only species of the genus. However, *P. volans* is recognised to comprise of two species: *P. volans* in the south, and *P. minor* in the north (DAWE, 2021a). The following information presented in this assessment relates to *P. volans* (southern).
ECOLOGY	An arboreal nocturnal marsupial. Its diet consists of eucalypt leaves and sometimes flowers (TSSC, 2016f). The species favours habitats with a diversity of eucalypt species (DAWE, 2021a). It relies on trees with large hollows to shelter in during the day, and has been found in higher densities in habitats with abundant hollows, and is absent from habitats without sufficient density of hollows (TSSC, 2016f). The home range is larger for males than for females, and male home ranges don't tend to overlap. Home range size varies depending upon habitat quality, from 1-4 ha (in taller, montane, moist eucalypt forest) up to 16 ha (in drier, more open habitat). Male home ranges don't tend to overlap. Modelling suggests that the species requires at least 160 km^2 of native forest patches to maintain viable populations (TSSC, 2016f). Females reach sexual maturity in their second year and give birth to one offspring from March to June. They are estimated to live for 15 years, and generation length is likely to be 7-8 years (TSSC, 2016f). The species is sensitive to disturbance including forest clearing and wildfire and is slow to recover from major disturbance. The species may be susceptible to fragmentation as it has poor persistence in small areas of vegetation, and exhibits poor dispersal in areas which are not native forest (TSSC, 2016f).
DISTRIBUTION AND HABITAT	Restricted to eastern Australia, from south of Townsville in Queensland through to central Victoria (DAWE, 2021a).

	The species' EOO is thought to have largely remained the same following European settlement, although its AOO is thought to have substantially reduced. The species' EOO is estimated to be 1,066,146 km^2 and its AOO 15,532 km^2 (DAWE, 2021a). The species occurs between sea level to 1,200 m ASL, with higher densities recorded at higher elevations. Lives in habitats with high eucalypt diversity, ranging from tall forest to woodland. Large trees with large trunk diameter are required, as such trees provide hollows required by the species. The species is absent from pine forests and cleared areas (DAWE, 2021a).
POPULATIONS	While there is no reliable estimate of population size, it is thought that the total number of mature individuals is likely to be over 100,000 (DAWE, 2021a). The draft Conservation Advice for the species notes that all populations are important for conservation, due to the species' low reproductive capacity and limited dispersal capabilities (DAWE, 2021a).
SOS SITES	The species is not listed as threatened in NSW, and as such is not included within the SOS program.
RELEVANT PLANS AND POLICIES	Conservation Advice for *Petauroides volans* (Greater Glider) (TSSC, 2016f) Draft Conservation Advice available within: Consultation on Species Listing Eligibility and Conservation Actions *Petauroides volans* (Greater Glider (southern)) (DAWE, 2021a)
SPECIES-SPECIFIC GUIDELINES	There are no species-specific guidelines for the Greater Glider.
SPRAT LINK	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=254

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps for the Greater Glider were generated using BioNet PCT associations of intact vegetation in areas with a patch size of greater than 25 ha. This patch size was chosen because smaller patch sizes were returning many areas of unsuitable habitat in the modelling.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). As above.				
POPULATION MAPPING	**RECORD SELECTION**				
	BioNet records were restricted to post 2003 to account for the average 15 year lifespan of the species				

	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *Petauroides volans* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *Petauroides volans* were downloaded in May 2021.
	POPULATION DEFINITION
	The species occupies a relatively small home range with an average size of 1 to 3 ha and they have a low dispersal ability. Records separated by several kilometres and/or cleared developed areas were identified as separate populations.
	IMPORTANT POPULATION CRITERIA
	The populations of Greater Glider were considered important within the Strategic Assessment Area because they met the following criteria: a population within a conservation reserve

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-6 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-61 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Greater Glider in the Strategic Assessment Area. **Records** Records for the Greater Glider are limited within the Strategic Assessment Area. There are eight known populations, of which three are considered important due to their location within a conservation reserve, including: • In the west of the Strategic Assessment Area, in Gulguer Nature Reserve. Approximately 5 km from the nearest transport corridor and WSA (important population 209) • In the south of the Strategic Assessment Area, between GMAC and Wilton. Records occur between 500 m and 2 km from urban capable lands (important population 207) • South west of Wilton towards the boundary of the Strategic Assessment Area. Near Couridjah, in the Thirlmere Lakes National Park (important population 210) **Potential habitat** The baseline mapping for this assessment has mapped 25,609.8 ha of potential habitat within the Strategic Assessment Area. Due to the level of historical land clearing, potential habitat within the Strategic Assessment Area is more fragmented compared to surrounding areas of vegetation. The species is considered to be particularly sensitive to fragmentation, with a low dispersal ability and a requirement for large native patches of vegetation containing a high enough density of tree hollows. Potential habitat within the Strategic Assessment Area is therefore likely to be marginal compared to the much broader and intact areas of habitat to the north and west of the Strategic Assessment Area and to the south of Sydney.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.14.1 NOMINATED AREAS

The baseline mapping for the assessment mapped 2,332.4 ha of potential habitat for the Greater Glider within the nominated areas (not including excluded lands). Approximately 2,231.1 ha (95.7 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 1,588.3 ha was avoided for biodiversity purposes
- 642.8 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 30-62.

It is important to note that the avoidance calculations in Table 30-62, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-62 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.14.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.14.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will lead to loss and fragmentation of potential habitat. A breakdown of impacts across the Strategic Assessment Area is given in Table 30-63.

LOSS OF POTENTIAL HABITAT

Approximately 127.2 ha of potential Greater Glider habitat will be lost as a result of the implementation of the Plan (101.3 ha within the nominated areas and 25.8 ha within transport corridors outside the nominated areas). This habitat represents 0.5 per cent of potential habitat within the Strategic Assessment Area. There are no records of the species in these areas to be impacted.

The main impact areas include:

- GMAC: Loss of 48 ha of potential habitat on the edges of riparian corridors adjacent to the urban capable land
- GPEC: Loss of 31.4 ha where the OSO intersects Wianamatta Regional Park
- Wilton: Loss of 12.1 ha of potential habitat on the edges of riparian corridors adjacent to the urban capable land

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be very low. This is because:

- The likelihood of actual impacts occurring to the species has been categorised as possible. There will be impacts to potential habitat with a moderate confidence that the species occurs in the impact area. For example, in Wilton there will be some impacts to the edges of vegetation patches that are connected to an area with a known population (population 207). It is possible, although not certain that the species is present in some of the impact areas
- The consequence of any impacts to the species (if they did occur) has been categorised as negligible. There will be loss of approximately 0.5 per cent of mapped potential habitat in the Strategic Assessment Area

30.14.4 FRAGMENTATION OF HABITAT

FRAGMENTATION IMPACTS

The Plan will lead to fragmentation of potential habitat due to the development of the OSO within Wianamatta Regional Park.

RISK OF RESIDUAL ADVERSE IMPACTS

The risk of residual adverse impacts occurring to the species as a result of the loss of fragmentation is considered to be very low. This is because:

- The likelihood of fragmentation has been categorised as possible. This is because:
  - The likelihood that development presents a barrier to dispersal of the species is likely. The OSO transport corridor fragments habitat that could be used by the Greater Glider for dispersal
  - The type of fragmentation is impact to mapped habitat only. There are no records in the vicinity of the fragmentation
- The consequence of fragmentation has been categorised as negligible. This is because the area to be fragmented consists of a small area of potential habitat with no associated records

30.14.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for the Greater Glider.

It is noted that the SCA contain 9,661 ha of potential habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 2,188.2 ha of potential habitat for the Greater Glider is contained within the three conservation reserves proposed by the Plan, including:

- 1,320.1 ha within the Georges River Koala Reserve
- 4.4 ha within the Confluence Reserve investigation area
- 863.7 ha within the Gulguer Reserve investigation area

Further, one important population of the species is known to occur within the Gulguer Reserve investigation area.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.14.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (and other key documents) for the Greater Glider identify a range of threats to the species (TSSC, 2016f). Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Too intense or frequent fires
- Habitat loss or degradation from *Phytophthora* root fungus

Timber production, entanglement in barbed wire fencing, hyper-predation by owls and competition from Sulphur-crested Cockatoos are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Greater Glider are discussed below for each identified indirect impact.

It is noted that 2,188.2 ha of potential habitat for the Greater Glider is contained within the three conservation reserves proposed by the Plan. Further, an important population of the species is known to occur within the Gulguer Reserve investigation area. The protection of habitat and a known population for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

TOO INTENSE OR FREQUENT FIRES

Bushfires and prescribed burning are identified as key threats to the Greater Glider (TSSC, 2016f).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species or result in direct mortality. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Greater Glider being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Greater Glider. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities

within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- A landscape scale approach to fire management (including in reserves) will be applied with a focus on biodiversity values
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

HABITAT LOSS OR DEGRADATION FROM PHYTOPHTHORA ROOT FUNGUS

Potential habitat for the Greater Glider is threatened by exposure to *Phytophthora cinnamomi,* a soil-borne water mould which is fatal to many flora species.

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

Appendix E of the Plan includes two species-specific mitigation measures to incorporate best practice site hygiene protocols to manage the potential spread of pathogens such as *Phythophthora* within or adjacent to potential habitat for the Greater Glider. The first measure relates to all major transport corridors within and outside the nominated areas and will be implemented by the State Significant Infrastructure assessment and approval process. The second measure relates to development of urban capable land and essential infrastructure, and will be implemented by the DCP template, Mitigation Measures Guideline, and *Cumberland Plain Conservation Plan Guidelines for Infrastructure*. These measures will minimise the risk of disease to the Greater Glider.

The Plan further incorporates a range of general measures to manage the risks associated with *Phytophthora cinnamomi*. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to potential habitat from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.14.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There is potential habitat on avoided land within all nominated areas. Therefore, the species may be subject to impacts from essential infrastructure. However, the species is mobile, and the scale of impact is not expected to be significant.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.14.8 POTENTIAL IMPACTS FROM TUNNELS

Potential habitat for the Greater Glider occurs within the tunnel footprints for the Metro Rail Future Extension (30.6 ha) and the Outer Sydney Orbital (45.2 ha). These habitat areas are not associated with records.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)

- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

30.14.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2015d) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the Greater Glider in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts such as:
    - Too intense or frequent fires
    - Habitat loss or degradation from *Phytophthora* root fungus

HABITAT LOSS AND FRAGMENTATION

The risk of residual adverse impacts to the species from habitat loss and fragmentation is very low. While the Plan authorises the clearing of 127.2 ha of potential habitat (0.5 per cent of potential habitat within the Strategic Assessment Area), this is considered unlikely to have a significant effect on the species because:

- There are no direct impacts to areas with known records of the species or important populations
- The majority of direct impacts occur on the edges of habitat corridors and to areas that are already highly fragmented
- The areas of foraging habitat within the Strategic Assessment Area are connected to a much larger network of intact habitat to the north, west and south. In this regional context, implementation of the Plan impacts a very small proportion of the habitat available to the species

In addition, the conservation program is likely to provide significant benefits to the species within the Strategic Assessment Area.

Habitat loss and fragmentation are not expected to adversely influence the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with too intense or frequent fires, and habitat loss or degradation from *Phytophthora* root rot fungus will be managed and mitigated through the generic and species-specific management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

There are large areas of potential habitat (25,609.8 ha) and impacts to this are relatively minor (127.2 ha) given the larger areas of intact habitat surrounding the Strategic Assessment Area.

Potential indirect impacts are addressed through general management strategies and species-specific controls defined in the Plan and implementation of the conservation program will protect large areas associated with potential habitat for the species.

Collectively these will ensure that the implementation of the Plan does not adversely influence the long-term viability of the Greater Glider.

30.14.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.14.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-60 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan has been developed to ensure that it is not inconsistent with any relevant TAPs. This analysis around consistency is presented in Chapter 15.

Table 30-60: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Greater Glider

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant TAP
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gasses	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-61: Occurrence of the Greater Glider in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	8	3
(IMPORTANT POPULATIONS)	(3)	(3)
HABITAT MAPPING (Ha)	25,609.8	4,638.5

Table 30-62: Avoidance of Greater Glider habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	990.1	1,846.9	33.2	867.7	3,737.9
HABITAT WITHIN EXCLUDED LANDS (ha)	168.7	405.9	0.9	830.0	1,405.5
HABITAT WITHOUT EXCLUDED LANDS (ha)	**821.4**	**1,441.1**	**32.3**	**37.7**	**2,332.4**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	535.5	1,031.5	15.1	6.2	1,588.3
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	65.2	71.6	46.7	16.5	68.1
AVOIDANCE FOR OTHER REASONS (ha)	273.9	361.6	7.4	0.0	642.8
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	33.3	25.1	22.8	0.0	27.6
TOTAL AVOIDANCE (ha)	**809.4**	**1,393.1**	**22.4**	**6.2**	**2,231.1**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**98.5**	**96.7**	**69.5**	**16.5**	**95.7**

Table 30-63: Direct impacts to the Greater Glider within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	12.1	48.0	9.8	31.4	25.8	**127.2**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

30.15 *POMMERHELIX DURALENSIS* (DURAL LAND SNAIL)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Pommerhelix duralensis* (Dural Land Snail) is a medium sized snail with a dark brown to black semi-translucent, almost spherical shaped, shell. Adults grow approximately 10-23 mm in height and 14-23 mm in width. (DoE, 2015d)
ECOLOGY	Individuals are solitary. The species is nocturnal and typically active approximately one hour after dusk until dawn. Migration and dispersal are limited, overnight straight-line distances are less than one metre. Reproduction rates are low with about 32 eggs per season. Offspring mortality is high at 90 per cent in the first year. Life expectancy is approximately five years. Main food source is native fungi. The ranges of individuals are adjacent to each other but do not overlap significantly (DoE, 2015d).
DISTRIBUTION AND HABITAT	Endemic to NSW. Until recently, known records occurred predominantly along the north-east fringes of the Cumberland subregion on shale-sandstone transitional landscape, where the distribution is dependent on the shale availability (DoE, 2015d). Within the last year, new records for the species have been found near Silverdale and St Helens Park, which significantly increase the known southern range of the species. Inhabits forested areas with good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark (OEH, 2019b). It is thought to be intolerant of highly disturbed and weedy habitats (DoE, 2015d). The species is found within the following EPBC listed TECs: • Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • Turpentine-Ironbark Forest in the Sydney Basin Bioregion • Shale Sandstone Transition Forest of the Sydney Basin Bioregion The species' habitat is severely fragmented, almost all links between the species' shale transition habitat and adjoining Cumberland Plain have been lost through land clearance. (DoE, 2015d) Shale-influenced habitats along the north west fringes of the Cumberland Plain are considered important for the species (DoE, 2015d).
POPULATIONS	Long term population trends are unknown. A number of populations are now isolated into remnants under five hectares in size (DoE, 2015d).
SOS SITES	No SOS sites for the species have been identified due to data deficiencies.

RELEVANT PLANS AND POLICIES	Conservation advice for *Pommerhelix duralensis* (Dural Land Snail) (DoE, 2015d)
SPECIES-SPECIFIC GUIDELINES	There are no species-specific guidelines.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85268

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**ACROSS THE STRATEGIC ASSESSMENT AREA**				
	Species distribution model (SDM). An SDM for the species was prepared across the Cumberland subregion. Given the species was determined not to be a candidate species credit species in the nominated areas, any mapped habitat within the nominated areas was removed. The report for this process, published in 2018 (Supporting Document F), used known information and records about the species to model the distribution of habitat for the Dural Land Snail. However (as outlined in the following section), additional records of the Dural Land Snail have recently been discovered which significantly extend the known southern range of the species. It is therefore recognised that the SDM was produced without knowledge of the full current extent of the species' records. The report for this process mapped some areas of habitat in the locality of the new southern records of the species. Based on available records at the time, analysis within the report suggests that the model for the species overestimated the available habitat for the species, due to an absence of known records in those localities. However, the recent discovery of new records now suggests that the habitat mapped in these areas is likely to constitute real habitat. It is further recognised that additional habitat may be present for this species within the southern portion of the Strategic Assessment Area, and that future research may provide greater clarity regarding the extent of occurrence and habitat preferences for the Dural Land Snail.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. It is noted that there are recent records of the species in BioNet which significantly expand the known range of the species beyond what is identified in official advice for the species. The Conservation Advice notes that the Dural Land Snail is morphologically similar to, and can be mistaken for, other species within the *Pommerhelix* and *Meridolum* genera which occur adjacent to the range of the Dural Land Snail. Expert review may therefore be required to confirm the authenticity of recent southern records. However, for the purposes of this report, it is assumed on a				

	precautionary basis that the new species records have been correctly identified as the Dural Land Snail, and the records have been assessed accordingly.
	BIONET RECORD DOWNLOAD DATE
	The initial assessment of *P. duralensis* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, further records have become available. These records provide important additional understanding of the species' distribution and abundance in the Strategic Assessment Area. The assessment has therefore been updated to incorporate these new records. The BioNet records used for this assessment of *P. duralensis* were downloaded in October 2020.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. Records have been grouped into populations based on geographic restrictions and connectivity between patches of suitable vegetation.
	IMPORTANT POPULATION CRITERIA
	Populations of the Dural Land Snail were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. All populations were considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-4 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-65 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Dural Land Snail in the Strategic Assessment Area. **Records** The majority of known records of the Dural Land Snail occur in the north and north east of the Cumberland subregion, ranging between Parramatta and Macquarie Park in the south, through to South Maroota and Sackville in the north. Of these northern records, all except one is outside the Strategic Assessment Area. The record is located along the northern boundary of the Strategic Assessment Area, near Tennyson (population 205). There are four additional records to the south, which significantly expand the known range of the species. These are as follows: • Two records to the north of GPEC, one at Agnes Banks (population 605) and one to the east of Wianamatta Nature Reserve (population 606) • One record between Silverdale township and the Gulguer Nature Reserve (population 603) • One record directly adjacent to the boundary of GMAC, near the Georges River at St Helens Park (population 604). It is noted that this record occurs within the footprint of the proposed Georges River Koala Reserve The new records at Silverdale and St Helens Park are the southernmost known records of the Dural Land Snail.

	Potential habitat The baseline mapping for this assessment has mapped 25,498.5 ha of potential habitat within the Strategic Assessment Area. The majority of mapped potential habitat occurs in the north of the Strategic Assessment Area, with scattered patches along the Western fringes and across the centre.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.15.1 NOMINATED AREAS

There is no mapped habitat for the species within the nominated areas.

30.15.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.15.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will not lead to direct impacts to records or populations. However, it will lead to the loss of some potential habitat within the transport corridors. A breakdown of impacts across the Strategic Assessment Area is given in Table 30-66.

LOSS OF POTENTIAL HABITAT

Approximately 45.7 ha of potential habitat will be directly impacted. This loss is associated with the transport corridors outside the nominated areas, including development of the M7/Ropes Crossing Link Road at the north-east corner of GPEC, and development of the OSO to the west and south of WSA. It is noted that there are no known records of the species in the vicinity of impacted habitat.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be very low. This is because:

- The likelihood of actual impacts occurring to the species has been categorised as possible. There will be moderate impacts to potential foraging habitat
- The consequence of any impacts to the species (if they did occur) has been categorised as minor. There will be loss of approximately 0.2 per cent of mapped potential foraging habitat in the Strategic Assessment Area, however, there are very few records close to and within areas that will be impacted

30.15.4 FRAGMENTATION OF HABITAT

Placement of development under the Plan is not predicted to result in fragmentation of habitat for this species.

30.15.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for the Dural Land Snail.

Further, it is noted that the SCA contain 3,337.3 ha of potential habitat for the species, and that land secured for conservation within the SCA is likely to include habitat for the species. For example, 1,301.8 ha of potential habitat for the Dural Land Snail is contained within the three conservation reserves proposed by the Plan, including:

- 200.5 ha within the Georges River Koala Reserve
- 245.5 ha within the Confluence Reserve investigation area
- 585.5 ha within the Gulguer Reserve investigation area

Further, one important population of the species is known to occur within the Georges River Koala Reserve, and one important population is known to occur within the Gulguer Reserve investigation area.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.15.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DoE, 2015d) for the Dural Land Snail (and other key documents) identifies a range of threats to the species. Where these threats are relevant to the implementation of the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes and habitat modification for bushfire asset protection
- Disturbance due to weed control activities, including slashing and burning activities

Predation, habitat modification, low fecundity, and high mortality, use of garden pesticides to control snails and slugs, and competition with the common garden snail are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Dural Land Snail are discussed below for each identified indirect impact.

It is noted that 1,301.8 ha of potential habitat for the Dural Land Snail is contained within the three conservation reserves proposed by the Plan. Further, an important population of the species is known to occur within the Georges River Koala Reserve, and a second important population is known to occur within the Gulguer Reserve investigation area. The

protection of habitat and known populations for this species will contribute to the protection of the species from indirect impacts, as these sites will be managed for conservation purposes.

INAPPROPRIATE FIRE REGIMES AND HABITAT MODIFICATION FOR BUSHFIRE ASSET PROTECTION

Inappropriate fire regimes and habitat modification for bushfire asset protection are identified as key threats to the Dural Land Snail (DoE, 2015d).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Dural Land Snail being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Dural Land Snail. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

It is further noted that a record for the Dural Land Snail occurs within the footprint of the proposed Georges River Koala Reserve (Commitment 10). The establishment of the Koala Reserve is a major focus of the Plan and will be managed for conservation purposes, which will include fire management measures to protect the biodiversity values of the reserve.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- A known record at the southernmost extent of the species will be protected through establishment and management of the Georges River Koala Reserve (Commitment 10) which will undertake fire management practices to protect biodiversity values
- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

DISTURBANCE DUE TO WEED CONTROL ACTIVITIES INCLUDING SLASHING AND BURNING ACTIVITIES

Disturbance due to weed control activities is identified as a key threat to the Dural Land Snail (DoE, 2015d). In particular, the species is threatened by weed control which involves mechanical damage to the understorey, and by the burning of composted weed materials (as the snail is attracted to the compost piles which subsequently are burnt).

There is no potential habitat for the Dural Land Snail within the nominated areas. Therefore, the main risk areas for this species include known populations and mapped potential habitat outside of the nominated areas. The majority of habitat for the species occurs within the northern portion of the Strategic Assessment Area.

The Plan includes a commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes an action to prepare a Weed Control Strategy, which will:

- Identify the training, extension and resource needs to address threats
- Provide guidance on weed control methods

Through the Weed Control Strategy, it is considered that the Plan will enable implementation of appropriate weed control measures which will not result in damage to biodiversity values. This measure is considered to provide protection to the Dural Land Snail from inappropriate weed control methods.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts associated with transport corridors, there is the potential for impacts to the species to occur due to tunnels associated with transport projects.

As the species does not have potential habitat mapped within nominated areas, the species is not considered to be at risk of impacts from essential infrastructure.

30.15.7 POTENTIAL IMPACTS FROM TUNNELS

Potential habitat for the Dural Land Snail occurs within the tunnel footprints for the Metro Rail Future Extension (19.4 ha) and the Outer Sydney Orbital (60.3 ha). However, whilst habitat has been mapped for this species in this locality, it is noted that there are no known records of the species in the vicinity of the tunnel footprints.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.15.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice for the Dural Land Snail (DoE, 2015d) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the species in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts such as:
    - Inappropriate fire regimes and habitat modification for bushfire asset protection
    - Disturbance due to weed control activities, including slashing and burning activities

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan will lead to loss of potential habitat within transport corridors. While the Plan facilitates the clearing of 45.7 ha of potential habitat, this is only a small proportion (0.2 per cent) of potential habitat within the Strategic Assessment Area. It is noted that the Plan will not impact shale-influenced habitats along the northwest fringes of the Cumberland subregion which are considered to be important for the species' survival (DoE, 2015d).

Based on the application of the risk assessment method, the overall risk of residual adverse impacts associated with these direct impacts is very low. Impacts will only occur within foraging habitat, and no known records of the species will be impacted.

The Plan includes a broader set of commitments and actions which are likely to benefit the species, which includes commitments to protect land within the SCA which contain approximately 3,337.3 ha of potential habitat for the Dural Land Snail. It is also noted that the southernmost known record of the Dural Land Snail occurs within the footprint of the proposed Georges River Koala Reserve, which will be protected and managed for conservation under Commitment 10 of the Plan.

On balance, direct impacts associated with implementation of the Plan are not expected to threaten the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes and habitat modification for bushfire asset protection and disturbance due to weed control activities, including slashing and burning activities have been analysed and determined to be adequately managed and mitigated through the generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

The limited scale of direct impacts to the species habitat and the management measures in the Plan to address potential indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

30.15.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.15.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in (DoE, 2015d) where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For the Dural Land Snail, there are no relevant Threat Abatement Plans.

Table 30-64: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Dural Land Snail

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-65: Occurrence of the Dural Land Snail in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	5	0
(IMPORTANT POPULATIONS)	(5)	(0)
HABITAT MAPPING (Ha)	25,498.5	2,804.0

Table 30-66: Direct impacts to the Dural Land Snail within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	0.0	0.0	0.0	0.0	45.7	**45.7**
DIRECT IMPACTS TO POPULATIONS (Number)	0	0	0	0	0	**0**
DIRECT IMPACTS TO IMPORTANT POPULATIONS (Number)	(0)	(0)	(0)	(0)	(0)	**(0)**

30.16 *ROSTRATULA AUSTRALIS* (AUSTRALIAN PAINTED SNIPE)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered, marine
DESCRIPTION	*Rostratula australis* (Australian Painted Snipe) is a medium sized stocky wading bird with blue-green legs and a long orange-pink bill. It has a brown head, nape and chest with comma shaped white markings around the eyes, white belly and a white harness shape marking from its breast to back. Its plumage is barred olive green and black (DSEWPC, 2013).
ECOLOGY	Relatively little is known about the ecology of this species, as it has few records, unpredictable movements, cryptic habits, and often occurs in reasonably inaccessible areas (DoEE, 2019). The species breeds all year round depending on available suitable wetland conditions. It has been known to lay up to four clutches of 2 to 6 eggs per year. Females mostly breed every two years. (DoEE, 2018f). The species feeds on vegetation, seeds, and invertebrates such as insects, worms, molluscs, and crustaceans. It is mostly active at dawn, dusk and throughout the night (DoEE, 2018f; S Garnett, Szabo et al., 2011) It is generally seen singly or in pairs. Movement patterns are not well understood, the species may be dispersive or migratory (DoEE, 2018f).
DISTRIBUTION AND HABITAT	The species is only found in Australia and mainly occurs in the Murray Darling Basin. It is widespread across Australia (DoEE, 2018f; DSEWPC, 2013) Important areas for the species include the Murray Darling Basin, Queensland Channel Country, Fitzroy Basin of Central Queensland, south-eastern South Australia, and adjacent parts of Victoria (DSEWPC, 2013). It is associated with the following EPBC Act listed TECs (DSEWPC, 2013): • Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains • Upland Wetlands of the New England Tablelands The species inhabits ephemeral and permanent shallow freshwater wetlands, occasionally brackish wetlands. It favours a dense cover of grass and reeds (DSEWPC, 2013). Breeding habitat requirements may be quite specific (DoEE, 2019). Due to limited understanding of the species' ecology and habitat requirements, it is not possible to generate a detailed description or definition of habitat critical to the survival of the species (DoEE, 2019).

POPULATIONS	There are a number of population estimates for the species, ranging between 1,500 and 5,000 mature individuals. Population estimates are considered unreliable due to the species' cryptic nature, inaccessible habitat and limited numbers of surveys (DoEE, 2019). The species occurs as a single homogenous breeding population across the country (DoEE, 2019).
SOS SITES	One SOS site has been identified for the species: • Gayini
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (DSEWPC, 2013) Threat abatement plan for predation by feral cats (DoE, 2015g) Threat abatement plan for predation by the European red fox (DEWHA, 2008n) It is noted that the species has a draft Recovery Plan which has been released for public consultation: Draft National Recovery Plan for the Australian Painted Snipe *Rostratula australis* (DoEE, 2019).
SPECIES-SPECIFIC GUIDELINES	There are no species-specific guidelines for the Australian Painted Snipe.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=77037

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	Yes	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps were generated using vegetation classes derived from BioNet PCT associations, vegetation condition parameters (intact), 40 m buffer to waterways (based on preferred habitat comprising freshwater wetlands). No targeted surveys were undertaken as part of this project.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). As above. No targeted surveys as part of this project were undertaken outside the nominated areas.				
POPULATION MAPPING	**RECORD SELECTION**				
	Records restricted to post 2002 to account for estimated 16 year lifespan of the species.				
	BIONET RECORD DOWNLOAD DATE				

	The initial assessment of *Rostratula australis* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset. The BioNet records used for the assessment of *Rostratula australis* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations of were defined using the records dataset and available information about the nature of the species. All records within the Cumberland subregion are representative of a portion of the east coast population and therefore records in the Strategic Assessment Area have been grouped as one single population.
	IMPORTANT POPULATION CRITERIA
	Populations of the Australian Painted Snipe were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. All populations were considered to be important as the species is endangered.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-2 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-68 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Australian Painted Snipe in the Strategic Assessment Area. **Records** There are two records for the Australian Painted Snipe within the Strategic Assessment Area in the last sixteen years: • One is within GPEC from an unnamed water body outside of the urban capable land near to Wianamatta (South Creek) • The other is from the north of the Strategic Assessment Area in the floodplain of the Hawkesbury River While two records occur in the Strategic Assessment Area, the area is not recognised as a key location for the species and the nominated areas include only one record (within GPEC). The only other recent record in the Cumberland subregion (outside the Strategic Assessment Area) is from the former wastewater ponds associated with the old Riverstone Meatworks in the Marsden Park North Precinct of the North West Growth Centre (approximately 5.6 km from the nearest development area). **Potential habitat** The baseline mapping for this assessment has mapped 2,230.7 ha of potential habitat within the Strategic Assessment Area. This mapping is considered to be highly precautionary as it is based on all mapped waterways with the appropriate PCTs.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.16.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 112.1 ha of potential habitat for the Australian Painted Snipe within the nominated areas (not including excluded lands). Approximately 66.7 ha (59.5 per cent) of this has been avoided as part of the design of the urban capable lands and transport corridors (not including excluded lands). Of this:

- 13.7 ha was avoided for biodiversity purposes
- 53 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 30-69.

It is important to note that the avoidance calculations in Table 30-69, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-69 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.16.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

30.16.3 LOSS OF POTENTIAL HABITAT

Implementation of the Plan will lead to impacts to some potential habitat. Given the wide-ranging nature of the species, it is considered unlikely that development within the nominated areas or transport corridors would lead to any fragmentation effects.

LOSS OF POTENTIAL HABITAT

Approximately 50.5 ha of potential habitat will be lost as a result of the implementation of the Plan. This habitat represents 2.3 per cent of mapped potential habitat across the Strategic Assessment Area. The majority of impacts to potential habitat occur in WSA (22.4 ha) and GPEC (12.6 ha), consisting of multiple small potential habitat areas.

A summary of these impacts is provided in Table 30-70.

RISK OF RESIDUAL ADVERSE IMPACTS TO THE SPECIES

The risk of residual adverse impacts occurring to the species as a result of the loss of potential foraging habitat is considered to be very low. This is because:

- The likelihood of actual impacts occurring to the species has been categorised as unlikely. There will be minor impacts to potential foraging habitat, and it is considered unlikely for the species to be present in these areas. The

Strategic Assessment Area is not recognised as a key location for the species and the mapping is considered to be highly precautionary

- The consequence of any impacts to the species (if they did occur) has been categorised as minor. There will be loss of approximately 2.3 per cent of mapped potential habitat in the Strategic Assessment Area and very few records close to or within impacted areas

30.16.4 FRAGMENTATION OF HABITAT

Given the wide-ranging nature of the species, it is considered unlikely that development within the nominated areas or transport corridors would lead to any fragmentation effects.

30.16.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given the very low risk of residual adverse impacts to the species, offsets were not considered necessary for the Australian Painted Snipe.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.16.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for the Australian Painted Snipe identifies a range of threats to the species. Where these threats are relevant to the implementation of the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Loss or degradation of wetlands
- Predation by feral animals
- Vegetation changes caused by introduced plants
- Inappropriate fire regimes

Grazing, coastal port and infrastructure development, and shale oil mining are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Australian Painted Snipe are discussed below for each identified indirect impact.

LOSS OR DEGRADATION OF WETLANDS

Loss and degradation of wetlands through drainage and diversion of water is identified as a threat to the Australian Painted Snipe (DSEWPC, 2013). This is a particular threat where important habitat areas are in the proximity of development and well connected hydrologically. The majority of habitat in the Strategic Assessment Area within the vicinity of development lacks records and is not considered to be critical for the species.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the species from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to habitat for the species
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to habitat for the species

The commitments and actions under the Plan are consistent with the following regional priority action in the conservation advice (DSEWPC, 2013): "manage any changes to hydrology that may result in changes to water table levels, run-off, salinity, algal blooms, sedimentation or pollution".

PREDATION BY FERAL ANIMALS

Predation by feral animals such as foxes and cats is identified as a potential threat to the Australian Painted Snipe, however, the Conservation Advice states that there is no evidence for this (DSEWPC, 2013).

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the species.

However, the extent of proposed new urban development under the Plan means that the threat associated with cats is likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats in the local area, which, in turn, may lead to an increase in feral cat numbers. The main areas of concern relate to new urban development in Wilton and the southern section of GMAC, where the current density of houses is low.

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
  - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
  - Preparation of a Pest Animal Control Implementation Strategy

  - A process to enter into written agreements with delivery partners to implement the pest animal control program
  - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
  - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
  - Require appropriate management and control of pest animals relevant to development sites

VEGETATION CHANGES CAUSED BY INTRODUCED PLANTS

Vegetation changes caused by introduced plants is identified as a threat to the Australian Painted Snipe (DSEWPC, 2013).

Many weeds are already present within the Strategic Assessment Area and pose a threat to habitat for the Australian Painted Snipe. However, urban development and transport have the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The species is most susceptible to the threat of weeds from development under the Plan where new urban development occurs adjacent to habitat areas and introduces edge effects.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area (SCA). This includes a number of actions, of which the following are the most relevant to the outcome for the Australian Painted Snipe:
  - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a new SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk posed to the species from weed invasion. This is because:

- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

INAPPROPRIATE FIRE REGIMES

Altered fire regimes are identified as a potential threat to the Australian Painted Snipe, however, the conservation advice states that the impacts are unknown (DSEWPC, 2013).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Australian Painted Snipe being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Australian Painted Snipe. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

The commitments and actions under the Plan are consistent with the following regional priority action in the conservation advice (DSEWPC, 2013) to: "develop and implement a suitable fire management strategy for the habitat of the Australian Painted Snipe".

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable lands
- Tunnels associated with transport projects

30.16.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There are no records and limited potential habitat for the Australian Painted Snipe on avoided land in the nominated areas.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

Overall, the package of mitigation measures under the Plan is expected to adequately minimise the risk of impacts to Australian Painted Snipe from essential infrastructure. It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

30.16.8 POTENTIAL IMPACTS FROM TUNNELS

Foraging habitat for the Australian Painted Snipe occurs within the tunnel footprints for the Metro Rail Future Extension (6.2 ha) and the Outer Sydney Orbital (5.6 ha). These areas are not associated with records and the habitat mapping for the species is considered to be highly precautionary

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

These commitments are expected to adequately address threats to the species from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

30.16.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DSEWPC, 2013) identifies the following key issues that are likely to have the greatest influence on the long-term viability of Australian Painted Snipe in relation to implementation of the Plan:

- Habitat loss
- Indirect impacts such as:
  - Loss or degradation of wetlands
  - Predation by introduced vertebrates
  - Vegetation changes caused by introduced plants
  - Inappropriate fire regimes

HABITAT LOSS AND FRAGMENTATION

The risk of residual adverse impacts to the species from habitat loss is very low. Although the Plan authorises the clearing of 50.5 ha of potential habitat, this is only a small proportion (2.3 per cent) of potential habitat within the Strategic Assessment Area.

There are no specific commitments for the Australian Painted Snipe included in the Plan. This reflects the low level of risk to the species.

However, the Plan includes broader commitments and actions that are likely to benefit the species. In particular, the SCA contain approximately 174.4 ha of mapped potential habitat for the species. Although the final extent of potential habitat that will be secured in these areas is unclear, the opportunity to secure large, well-connected, and high-quality vegetation that provides potential habitat makes it likely that the conservation program will deliver benefits for this specie. It is noted that 15.7 ha of potential habitat for the Australian Painted Snipe is located within the three conservation reserves proposed by the Plan (the Georges River Koala Reserve, the Gulguer Reserve investigation area and the Confluence Reserve investigation area).

The process of protecting land in the Strategic Assessment Area is likely to support a management priority from the conservation advice to increase the area of habitat for the species that is secured and managed for conservation.

As a result, habitat loss under the Plan is not expected to influence the long-term viability of the species.

INDIRECT IMPACTS

The potential indirect impacts associated with the identified threats will be managed and mitigated through the generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

There will be no direct impacts to known populations. There are large areas of potential habitat (2,230.7 ha) and impacts to this are relatively minor (50.5 ha).

Potential indirect impacts are addressed through management measures in the Plan.

Collectively these will ensure that the implementation of the Plan does not adversely influence the long-term viability of the Australian Painted Snipe.

30.16.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.16.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-67 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15. The Plan is not inconsistent with any of the Threat Abatement Plans.

Table 30-67: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Australian Painted Snipe

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by European red fox	Threat abatement plan for predation by the European red fox (DEWHA, 2008n)
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-68: Occurrence of the Australian Painted Snipe in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	0
(IMPORTANT POPULATIONS)	(1)	(0)
HABITAT MAPPING (Ha)	2,230.7	81.9

Table 30-69: Avoidance of Australian Painted Snipe habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	17.8	27.3	77.7	211.0	333.9
HABITAT WITHIN EXCLUDED LANDS (ha)	0.5	15.8	7.9	197.7	221.9
HABITAT WITHOUT EXCLUDED LANDS (ha)	**17.4**	**11.6**	**69.8**	**13.3**	**112.1**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.1	13.6	0.0	13.7
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	0.0	1.0	19.4	0.0	12.2
AVOIDANCE FOR OTHER REASONS (ha)	16.1	2.4	33.8	0.7	53.0
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	92.6	20.6	48.5	5.3	47.3
TOTAL AVOIDANCE (ha)	**16.1**	**2.5**	**47.4**	**0.7**	**66.7**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**92.6**	**21.6**	**67.9**	**5.3**	**59.5**

Table 30-70: Direct impacts to the Australian Painted Snipe within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO HABITAT (ha)	1.3	9.1	22.4	12.6	5.1	**50.5**

SPECIES AT NO RISK OF DIRECT IMPACTS

30.17 *HIRUNDAPUS CAUDACUTUS* (WHITE-THROATED NEEDLETAIL)

This species assessment provides an impact assessment for the White-throated Needletail. The species is also a listed migratory species and assessed in Chapter 32 which should be read in conjunction with the assessment in this section.

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable, migratory ***NB:*** *An assessment of this species as a migratory species is provided in Chapter 32*
DESCRIPTION	*Hirundapus caudacutus* (White-throated Needletail) is a large swift, weighing up to 120 g. It has a thickset body up to around 20cm in length and long pointed wings. Plumage is generally olive green on the head and neck, grey and brown on the wings and body, with a white patch under the tail. (TSSC, 2019b)
ECOLOGY	There is limited information about the ecology of the White-throated Needletail. The species has two subspecies of which only one (*Hirundapus caudacutus caudacutus*) occurs in Australia. This subspecies is migratory. It breeds in northeast Asia (from central Siberia through to Northern China, Sakhalin and Japan) and migrates to Australia for the non-breeding season. The species typically arrives in northern Australia between September and early November before dispersing south along both sides of the Great Dividing Range. The species typically departs Australia between mid-March and April. (TSSC, 2019b) In Australia, the species has been recorded eating a wide range of insects. It is mostly aerial but has been recorded roosting. The species is typically gregarious and has been recorded in large flocks of hundreds or thousands of birds, including mixed flocks with Fork-tailed Swift (*Apus pacificus*) and Fairy Martins (*Hirundo ariel*). (DoEE, 2018f)
DISTRIBUTION AND HABITAT	In Australia, the species is widespread across eastern and south-eastern Australia. It has been recorded between Queensland and the south-east of South Australia in coastal regions and inland as far as the western side of the Great Dividing Range (DoEE, 2018f). The species is almost always observed in flight and has been recorded over a wide range of habitats at altitudes between 1 m above ground up to below cloud level (TSSC, 2019b). It is most commonly recorded above wooded areas and less commonly above treeless areas, but has been recorded above urban areas, farmland, coastal areas, and islands well out to sea (DoEE, 2018f). There are limited records of the species roosting in Australia, but it seems to prefer trees in forests and woodlands with dense foliage or hollows (TSSC, 2019b).

POPULATIONS	The White-throated Needletail occurs as a single, mobile population. The total population that migrates to Australia is unknown, but is estimated at 10,000 individuals (DoE, 2015e).
SOS SITES	No SOS Sites have been identified.
RELEVANT PLANS AND POLICIES	Conservation Advice *Hirundapus caudacutus* (White-throated Needletail) (TSSC, 2019b)
SPECIES-SPECIFIC GUIDELINES	Referral guideline for 14 birds listed as migratory species under the EPBC Act (DoE, 2015e)
SPRAT LINK	https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=682

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	No	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	Due to the aerial nature of the species and the limited information about its ecology, it was not possible to produce meaningful habitat mapping. The species appears to prefer certain geographic and meteorological conditions, rather than relying on particular kinds of vegetation or habitat features.				
POPULATION MAPPING	**RECORD SELECTION**				
	Records of the species were collated from Birdlife Australia, the Atlas of Living Australia, and BioNet Atlas. These records reflect observations as well as organised surveys. The analysis used a conservative estimate of individuals based on the total recorded sightings of the species per year across the Cumberland subregion.				
	POPULATION DEFINITION				
	As outlined above, there is a single population of the species. All records within the Strategic Assessment Area are therefore considered part of the same population.				
	IMPORTANT POPULATION CRITERIA				
	The population is an important population.				

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	There are numerous records of the White-throated Needletail within the Strategic Assessment Area. See the record data below which shows the ten years with the highest records of the species since 1980. Records occur from spring to early autumn and the species has been recorded in ecologically significant numbers (based on the definition in the *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE, 2015e) with over 2,000 records in 2016-17 and 2012-13, and at least 350 records every year since the 2009-10 austral summer. Records are more frequent over urban areas in the north and east of the Strategic Assessment Area. This may reflect the increased population of birdwatchers in this area, rather than any preference for this area by the species. It is likely that the species is also regularly present above less disturbed areas but is not recorded.

Ranked year of highest number of records (number of individuals/year)									
First	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**	**Seventh**	**Eighth**	**Ninth**	**Tenth**
2,576 (2016-17)	2,208 (2012-13)	1,472 (2017-18)	884 (2015-16)	739 (2014-15)	676 (2011-12)	644 (2013-14)	593 (2010-11)	356 (2009-10)	233 (1986-87)

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

Avoidance of habitat has not been calculated for this species as it was not possible prepare meaningful habitat mapping.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. Due to the nature of the data for this species, a risk assessment using the methodology set out in Section 30.3 was not undertaken.

30.17.1 LOSS OF POTENTIAL HABITAT

Potential impacts associated with implementation of the Plan are discussed in relation to foraging and roosting habitat.

LOSS OF POTENTIAL FORAGING HABITAT

The species has been observed foraging over a wide range of habitats. The Atlas of Living Australia, Birdlife Australia and BioNet Atlas contain numerous records in or above heavily modified and urban environments. The species is aerial while foraging and is often observed in areas of updraughts (e.g. above cliffs, ridges, and dunes, in the smoke of bushfires, in whirlwinds, or along the edges of low pressure systems) (DoEE, 2018f).

It is unlikely that modification of habitat from implementation of the Plan will substantially alter the species' use of the Strategic Assessment Area. There are no anticipated impacts to foraging habitat from the Plan.

LOSS OF POTENTIAL ROOSTING HABITAT

There are limited records of the White-throated Needletail roosting and it was previously thought that the species was exclusively aerial in Australia. Records now suggest that the species can roost in tall trees and may prefer roosting sites on ridgelines. There is some evidence that the species uses traditional roosting sites although there are no records of these sites in the Cumberland subregion.

The risk to the species from the impact of the Plan on roosting habitat is low. The species is wide-ranging and not known to roost within the Strategic Assessment Area. The Plan will conserve large areas of high-quality woodland, which will ensure species has continued access to potential roosting sites within the Cumberland subregion.

30.17.2 FRAGMENTATION OF HABITAT

Given the wide-ranging nature of the species, it is considered unlikely that development within the nominated areas or transport corridors would lead to any fragmentation effects.

30.17.3 OFFSETS FOR RESIDUAL DIRECT IMPACTS

Given there is no risk of residual adverse impacts to the species, offsets were not considered necessary for the White-throated Needletail.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.17.4 RELEVANT POTENTIAL INDIRECT IMPACTS

Direct mortality (wind turbines and overhead wires) and poisoning (organochlorides) are identified as key threats to the White-throated Needletail in the Conservation Advice. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to substantially exacerbate the risks across the Strategic Assessment Area.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

30.17.5 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (TSSC, 2019b) identifies threats to the White-throated Needletail within Australia. However, these threats in the context of the Strategic Assessment Area are unlikely to influence the long-term viability of the species.

30.17.6 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.17.7 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Given the lack of direct and indirect impacts, there are no relevant Key Threatening Processes (KTPs) or associated Threat Abatement Plans (TAPs).

30.18 *HOPLOCEPHALUS BUNGAROIDES* (BROAD-HEADED SNAKE)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*
- *Data tables*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable
DESCRIPTION	*Hoplocephalus bungaroides* (Broad-headed Snake) is black with yellow spots forming narrow irregular cross-bands on its back, and a grey-black belly. It has a flattened head and can grow to 60-150 cm long. (DoE, 2014e)
ECOLOGY	The species is active at dusk and is an ambush predator, spending long periods of time (up to four weeks) in the same place, preying on small reptiles and mammals. Female snakes mature at six years old and males at five years old. Females reproduce every other year. Mating occurs from autumn to spring and females give birth to 4-12 live young between January and April. The average home range of the species in woodland is 3.43 ha. Male home ranges do not overlap, and individuals show a preference for sites they have previously used. (DoEE, 2018f)
DISTRIBUTION AND HABITAT	Records are restricted to the sandstone ranges in the Sydney Basin, within a 200 km radius of Sydney. There are four main areas of occurrence: • Blue Mountains • Southern Sydney • An area outside of the Cumberland Plain, to the north-west • The Nowra hinterland (DoE, 2014e) Adults shelter in rocky outcrops during autumn, winter, and early spring, then move to adjacent sclerophyll woodland during late spring and summer. In woodland areas, the species can be found in large trees, with multiple hollows and in dead trees. Individual snakes use between one and nine trees. Pregnant females and juveniles remain in rocky habitat, using cooler, shaded rocks and crevices (DoEE, 2018f). They can spend long periods of inactivity (up to 48 days) in a single hollow (DoEE, 2018f).
POPULATIONS	There are no current population estimates.
SOS SITES	The following SOS sites for the species have been identified: • Woronora Plateau • Morton National Park

	• Royal National Park None of these sites occur within the Cumberland IBRA subregion.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Hoplocephalus bungaroides* (Broad-headed Snake) (DoE, 2014e) Threat abatement plan for competition and land degradation by unmanaged goats (DEWHA, 2008m) Threat abatement plan for predation by feral cats (DoE, 2015g) Threat abatement plan for predation by the European red fox (DEWHA, 2008n)
SPECIES-SPECIFIC GUIDELINES	There are no species-specific guidelines for the Broad-headed Snake.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1182

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)	**ECOSYSTEM CREDIT SPECIES**	**CANDIDATE SPECIES CREDIT SPECIES**			
	Yes	**WILTON**	**GMAC**	**WSA**	**GPEC**
		No	No	No	No
EXPERT REPORT (BCAR PROCESS)	There is no expert report for this species.				
HABITAT MAPPING	**WITHIN THE NOMINATED AREAS**				
	Knowledge based map (KBM). Habitat maps for the Broad-headed Snake were generated using BioNet PCT associations of intact vegetation. Patch sizes of larger than 5 ha were used to exclude small isolated patches of vegetation from the model.				
	OUTSIDE THE NOMINATED AREAS				
	Knowledge based map (KBM). As above.				
POPULATION MAPPING	**RECORD SELECTION**				
	Species records were compiled from BioNet and surveys undertaken for the project. The BioNet records were cleaned using a process that interrogated the likelihood of persistence based on the historical removal of, or disturbance to, habitat. Where it was considered unlikely that a record still existed, it was removed from the dataset.				
	BIONET RECORD DOWNLOAD DATE				
	The initial assessment of *Hoplocephalus bungaroides* was based on BioNet records which were downloaded in September 2019. This initial assessment was exhibited for public comment along with the Plan in mid-2020. Since that time, the BioNet database has been reviewed to check for updates to the database. No new records for this species have been identified within the Strategic Assessment Area. Therefore, the species' assessment is based on the original dataset.				

	The BioNet records used for the assessment of *Hoplocephalus bungaroides* were downloaded in September 2019.
	POPULATION DEFINITION
	Biological populations were defined using the records dataset and available information about the nature of the species. There is only one record of this species within the Strategic Assessment Area, which has been identified as a single population.
	IMPORTANT POPULATION CRITERIA
	Populations of the Broad-headed Snake were then categorised as important or not-important based on the methodology set out in Section 11.5.3 of Chapter 11. No important populations have been identified for this species (all non-important).

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-3 for a map of records and habitat across the Strategic Assessment Area. It is important to note that the records for this species are sensitive and have been denatured for representation on the map.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	See Table 30-72 at the end of this species assessment for a breakdown of the occurrence of records and habitat for the Broad-headed Snake in the Strategic Assessment Area. **Records** There is a single current record of the Broad-headed Snake within the Strategic Assessment Area, reflecting the largely unsuitable habitat across most of the area. The record is dated from 2014 located in the southern section of the Strategic Assessment Area, near Buxton. The species is known from surrounding areas, with numerous records located in the broad areas of intact vegetation: • To the south of Sydney, south-east of the Strategic Assessment Area • In the Blue Mountains to the north-west of the Strategic Assessment Area **Potential habitat** The baseline mapping for this assessment has mapped 6,695.2 ha of potential Broad-headed Snake habitat within the Strategic Assessment Area. This is primarily associated with the vegetation along riparian corridors that occur over sandstone geology in the very south of the Strategic Assessment Area and along the eastern boundary. Some potential habitat has been mapped within Wilton and the southern parts of GMAC. Mapped potential habitat may support the species. However, it is likely to be less important than surrounding areas given the small number of records within the Strategic Assessment Area. There are large areas of more suitable, intact habitat adjacent to the Strategic Assessment Area, while potential habitat within the Strategic Assessment Area is limited and at the interface between bushland and cleared farmland or urban areas.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

30.18.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 694.3 ha of potential habitat for the Broad-headed Snake within the nominated areas (not including excluded lands). All of this habitat has been avoided as part of the urban capable lands and transport corridors (not including excluded land). Of this:

- 297.3 ha was avoided for biodiversity purposes
- 397 ha was avoided for other purposes

A breakdown of avoidance across each nominated area is provided in Table 30-73.

It is important to note that the avoidance calculations in Table 30-73, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 30-73 shows the amounts of habitat within excluded lands for context only, and Chapter 14 defines the land types that are excluded.

30.18.2 TRANSPORT

Results are only reported for the nominated areas, as detailed planning within the transport corridors outside the nominated areas has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

Direct impacts are assessed in relation to known populations, loss of potential habitat, or fragmentation of habitat. The risk of residual adverse impacts to the species occurring as a result of any direct impacts is characterised as per the methodology set out in Section 30.3.

Offsets are provided for species that are considered to be at medium or high risk of residual adverse impacts. Offsets are not provided for species that are considered to be at low or very low risk of residual adverse impacts. The rationale and process for setting offset targets for species is set out in Section 8.5.2 of Chapter 8.

There will be no direct impacts to the species as a result of implementation of the Plan and offsets are not considered necessary.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.18.3 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice for the Broad-headed Snake identifies a range of threats to the species (DoE, 2014e). Where these threats are relevant to the implementation of the Plan, the Plan includes management strategies to mitigate their impacts. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated

under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Bush rock removal
- Inappropriate fire regimes
- Predation by cats
- Road mortality

Development of ridgetops, pine plantation development, illegal collection, vehicle strike and disturbance by feral goats are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

Potential indirect impacts are considered relevant to populations of the Broad-headed Snake to the south of Sydney, south-east of the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Broad-headed Snake are discussed below for each identified indirect impact.

BUSH ROCK REMOVAL

Bush rock removal has been identified as a threat to the Broad-headed Snake as rocks are used as retreat sites by the species (DoEE, 2018f). Bush rock 'collectors' are known to favour the same type and size of rocks as the Broad-Headed Snake, their gecko prey and the spiders preyed on by geckos (DoEE, 2018f).

Development in GMAC and Wilton may lead to an increase in human activity and landscaping of gardens which could increase this threat in accessible areas of the surrounding bushland where the species is known to occur. The risk areas primarily relate to the Dharawal National Park (noting that large areas of bushland near to Wilton and the southern half of GMAC are designated as 'Special Areas' within Sydney's drinking water catchment and access is restricted).

The Dharawal National Park Plan of Management acknowledges the threat of bush rock removal to the Broad-headed Snake and undertakes to protect exfoliating rock from all avoidance disturbance (DEC, 2006).

These measures are considered to adequately mitigate the level of risk to the Broad-headed Snake.

INAPPROPRIATE FIRE REGIMES

Bushfires are identified as a threat to the Broad-headed Snake as they can reduce the availability of hollows or prey, and may endanger snakes sheltering in hollows (DoEE, 2018f).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact habitat for the species. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Broad-headed Snake being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans

- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Broad-headed Snake. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

The package of measures in the Plan is expected to adequately manage the risk to the species from increased fire frequency as a result of development. This is because:

- APZs for fire management are required to be located within urban capable lands which will reduce the risk of fire mitigation activities impacting habitat
- Fire management authorities will be engaged to ensure they understand the values relevant to the species and incorporate these values into their fire management practices. This will include specific fire management approaches for conservation areas

PREDATION BY CATS

Cats are a potential predator of Broad-headed Snakes (DoEE, 2018f).

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the species.

However, the extent of proposed new urban development under the Plan means that the threat associated with cats is likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats in the local area, which, in turn, may lead to an increase in feral cat numbers. The main areas of concern relate to new urban development in Wilton and the southern section of GMAC, where the current density of houses is low.

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the SCA. This includes a number of actions with the most relevant to the outcome for the species being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

Further, existing pest management within the Dharawal, Heathcote, and Royal National Parks will contribute to management of cats within these areas.

The package of measures in the Plan is expected to adequately mitigate the level of risk to the Broad-headed Snake

ROAD MORTALITY

The Broad-headed Snake is susceptible to vehicle strike, and mortality on roads has been identified as a potential threat to the species (DoE, 2014e). Implementation of the Plan will lead to new roads and an increase in the volume of cars on existing roads within and surrounding Wilton and GMAC.

The development of new roads will not intersect any potential habitat for the Broad-headed Snake and is unlikely to increase the level of threat to the species. Increased traffic on existing roads outside of the Strategic Assessment Area may present more of a risk to the species. For instance, along the Hume Highway, Picton Road and Appin Road. It is noted that this will represent an incremental change to an existing threat rather than a novel one, and while it is difficult to predict, any potential increase in road mortality along these existing roads as a direct result of development under the Plan is expected to minor in this context.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

In addition to predicted impacts within the urban capable lands and transport corridors, there is the potential for impacts to the species to occur due to the development of essential infrastructure within nominated areas but outside the urban capable lands.

It is noted that there is no mapped potential habitat, and no known records of the species, within either the OSO tunnel footprint or the Metro Rail Future Extension tunnel footprint. It is therefore considered unlikely that development within the tunnel footprints will negatively impact the Broad-headed Snake.

30.18.4 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

There are no known records of the Broad-headed Snake within avoided lands in any of the nominated areas. However, there is 694.3 ha of potential habitat mapped for the species within avoided lands within Wilton and GMAC, and therefore it is considered to be possible that the species may occur within avoided lands in these nominated areas.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including prioritising avoidance of impacts for certain species

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15

30.18.5 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014e) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the Broad-headed Snake in relation to implementation of the Plan:

- Indirect impacts, such as:
  - Bush rock removal
  - Inappropriate fire regimes
  - Predation by cats
  - Road mortality

INDIRECT IMPACTS

The potential indirect impacts associated with bush rock removal, inappropriate fire regimes, predation by cats and road mortality will be managed and mitigated through generic management strategies in the Plan.

Indirect impacts are not expected to influence the long-term viability of the species.

CONCLUSION

There will be no direct impacts to the species as a result of implementation of the Plan.

Potential indirect impacts are addressed through general management strategies

Collectively these will ensure that the implementation of the Plan does not adversely influence the long-term viability of the Broad-headed Snake.

30.18.6 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the species.

30.18.7 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-71 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The consistency of the Plan with relevant Threat Abatement Plans is discussed in detail in Chapter 15. The Plan is not inconsistent with any of the Threat Abatement Plans.

Table 30-71: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Broad-headed Snake

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance and direct impacts. Cross references to the tables are provided throughout the text above.

Table 30-72: Occurrence of the Broad-headed Snake in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL POPULATIONS	1	0
(IMPORTANT POPULATIONS)	(0)	(0)
HABITAT MAPPING (Ha)	6,695.2	738.4

Table 30-73: Avoidance of Broad-headed Snake habitat within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL HABITAT ACROSS NOMINATED AREA (ha)	444.5	425.7	0.0	0.0	870.2
HABITAT WITHIN EXCLUDED LANDS (ha)	98.8	77.1	0.0	0.0	175.9
HABITAT WITHOUT EXCLUDED LANDS (ha)	**345.7**	**348.6**	**0.0**	**0.0**	**694.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	130.1	167.2	0.0	0.0	297.3
AVOIDANCE FOR BIODIVERSITY PURPOSE (% HABITAT WITHOUT EXCLUDED LANDS)	37.6	48.0	0.0	0.0	42.8
AVOIDANCE FOR OTHER REASONS (ha)	215.6	181.4	0.0	0.0	397.0
AVOIDANCE FOR OTHER REASONS (% HABITAT WITHOUT EXCLUDED LANDS)	62.4	52.0	0.0	0.0	57.2
TOTAL AVOIDANCE (ha)	**345.7**	**348.6**	**0.0**	**0.0**	**694.3**
TOTAL AVOIDANCE (% HABITAT WITHOUT EXCLUDED LANDS)	**100.0**	**100.0**	**0.0**	**0.0**	**100.0**

30.19 *MACQUARIA AUSTRALASICA* (MACQUARIE PERCH)

This species assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- *Species background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the species*

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	*Macquaria australasica* (Macquarie Perch) is a moderately sized, elongated oval shaped, freshwater fish. Mature adults are either black-grey, blue-grey, or olive-brown on the dorsal side and off-white on the ventral side (DoE, 2013b).
ECOLOGY	The Macquarie Perch is a nocturnal species. Males reach maturity at two years of age and females at three years of age. Spawning occurs immediately upstream of stretches of shallow running water over gravel beds from the middle of spring to early summer (DoE, 2013b). Feeds on insects and larvae. Some fish use the same river each year for spawning (DoEE, 2018f).
DISTRIBUTION AND HABITAT	Distribution extends from southern NSW, through the ACT, to northern Victoria (DoE, 2013b). Current NSW populations exist in catchments of the Hawkesbury-Nepean river system and the Georges River, the upper reaches of the Lachlan and Murrumbidgee Rivers, Mongarlowe River, and Queanbeyan River. In Victoria populations occur in the upper reaches of the Mitta Mitta River, Ovens River, Broken River, Campaspe River, Goulburn River, Yarra River, and in Lake Eildon. (DoEE, 2018f) A riverine schooling species typically found in the cool upper reaches of rivers. It has a preference for clear water and deep, rocky holes with vegetation, overhanging banks and debris providing coverage (DoE, 2013b; DoEE, 2018f).
POPULATIONS	Populations are often small and geographically separated (DoE, 2013b). There is currently no estimate of total population.
SOS SITES	Not applicable. This species is listed under the NSW *Fisheries Management Act 1994* and is not addressed under the SOS program.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for *Macquaria australasica* (Macquarie Perch) (DoE, 2013b) National Recovery Plan for the Macquarie Perch (*Macquaria australasica*) (DoEE & DPI, 2018)
SPECIES-SPECIFIC GUIDELINES	There are no species-specific guidelines for the Macquarie Perch.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66632

APPROACH TO BASELINE DATA

This section provides a summary of the baseline information used in the assessment. It sets out:

- *If the species is a candidate species under the BCAR process*
- *If an expert report was prepared for the species under the BCAR process*
- *An overview of the habitat mapping for the species within and outside the nominated areas*
- *An overview of the population mapping for the species*

Please refer to Section 11.5 in Chapter 11 for further details about the threatened species baseline data, including the various approaches to habitat and population mapping.

<table>
<tr><td rowspan="3">NOMINATED AREA CANDIDATE SPECIES (BCAR PROCESS)</td><td>ECOSYSTEM CREDIT SPECIES</td><td colspan="4">CANDIDATE SPECIES CREDIT SPECIES</td></tr>
<tr><td rowspan="2">No</td><td>WILTON</td><td>GMAC</td><td>WSA</td><td>GPEC</td></tr>
<tr><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>EXPERT REPORT (BCAR PROCESS)</td><td colspan="5">There is no expert report for this species.</td></tr>
<tr><td rowspan="2">HABITAT MAPPING</td><td colspan="5">WITHIN AND OUTSIDE THE NOMINATED AREAS</td></tr>
<tr><td colspan="5">Knowledge based map (KBM). Habitat mapping for the Macquarie Perch was generated by mapping:
• The waterways identified in the recovery plan (DoEE & DPI, 2018) that occur within and close to the Strategic Assessment Area that support:
  ○ Self-sustaining native populations, or
  ○ Translocated and stocked populations
• Any additional waterways within the Strategic Assessment Area that support records of the species since 2000</td></tr>
<tr><td rowspan="6">POPULATION MAPPING</td><td colspan="5">RECORD SELECTION</td></tr>
<tr><td colspan="5">All BioNet records since 2000 have been included in the assessment.</td></tr>
<tr><td colspan="5">POPULATION DEFINITION</td></tr>
<tr><td colspan="5">Populations in distinct rivers and streams are considered separate populations.</td></tr>
<tr><td colspan="5">IMPORTANT POPULATION CRITERIA</td></tr>
<tr><td colspan="5">All populations were considered to be important as the species is endangered.</td></tr>
</table>

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area. It includes reference to a map of records and habitat which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where records and habitat occur.

MAP	See Map 30-23 for a map of records and habitat across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The species' recovery plan identifies a number of self-sustaining native populations of the Macquarie Perch in stretches of river within and near to the Strategic Assessment Area as follows: • The Grose River, north-west of the Strategic Assessment Area boundary, in the Blue Mountains National Park, near Yarramundi. It is approximately 11 km from the northern boundary of GPEC

- Erskine Creek, west of the Strategic Assessment Area boundary, in the Blue Mountains National Park, near Warragamba. It is approximately 9.7 km from GPEC in the Hawkesbury-Nepean catchment
- The Warragamba dam to the west of the Strategic Assessment Area boundary
- The upper reaches of the Nepean River to the south of the Strategic Assessment Area
- Cordeaux River, where there is a single BioNet record approximately 600 m south of Wilton
- Cataract River (below Cataract Dam) which flows from the south-east to the north west in between Wilton and GMAC up to the Nepean river
- The Georges River, which follows the eastern boundary of GMAC from Gilead to Appin. it is between 130 m and 1.6 km from the GMAC urban capable land in the Georges/Cooks catchment

There are also a number of waterways that have BioNet records that are not identified in the recovery plan. They are:

- Little Wheeny Creek, near kurrajong in the north-west. This record is located approximately 20 km from the closest urban capable land in GPEC
- Glenbrook Creek, where there is a single BioNet record approximately 7.6 km west of GPEC
- Nattai and Little Rivers which occur to the south-west of the Strategic Assessment Area

AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

All riparian corridors and waterways that are potential habitat for the species were avoided as part of the planning process within the nominated areas. No potential habitat occurs within proposed transport corridors.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. Direct impacts are assessed in relation to impacts to mapped habitat.

Due to the nature of the data for this species, a risk assessment using the methodology set out in Section 30.3 was not undertaken.

There will be no direct impacts to known populations or areas of potential habitat for the Macquarie Perch as a result of the Plan and offsets are not considered necessary.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice, or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

30.19.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice and Recovery Plan for Macquarie Perch identify a range of threats to the species. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. The following potential indirect impacts (identified as threats) are considered relevant to implementation of the Plan:

- Hydrological changes
- Habitat degradation caused by bushfires
- Recreational fishing

Competition and predation from introduced fish species (including carp, gambusia, redfin perch and trout), barriers to fish movement, introduced diseases, and cold-water pollution are also identified as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for the Macquarie Perch are discussed below for each identified indirect impact.

HYDROLOGICAL CHANGES

Hydrological changes, including river siltation, as a result of the removal of riparian vegetation, land use changes and construction activities is identified as a key threat to the Macquarie Perch (DoEE, 2018f; DoEE & DPI, 2018). Increased sediment loads can fill in deep holes and cover gravel beds, which are important spawning habitats, and can affect the composition of the benthic fauna, which form the majority of the species' diet (DoEE, 2018f).

There is no possibility of hydrological changes in the majority of waterways that occur within and near to the Strategic Assessment Area as they are not hydrologically connected to areas of development. However, there are two areas that have some limited potential to be affected. They are:

- The population and habitat along the Georges River which is within the same catchment as a very small section of the urban capable land in GMAC. There is minimal risk of hydrological changes within this section of the River as a result of development. However, measures are included in the Plan to protect water ways and water quality (see below)
- The population/s and habitat along the Cordeaux River and upper reaches of the Nepean River which have the potential to be affected by hydrological changes as a result of development as they are within the same catchment as the majority of Wilton

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application

- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines (NSW RTA & NGH Environmental Consultancy, 2011). These include a range of provisions to mitigate and minimise changes to hydrology

These measures are considered to adequately mitigate the level of risk to the Macquarie Perch.

HABITAT DEGRADATION CAUSED BY BUSHFIRES

Bushfires are identified as a threat to the Macquarie Perch as they can increase water temperatures, increase pH, reduce the foliage cover of streams, and increase the sediment load of rivers (DoEE, 2018f; DoEE & DPI, 2018).

Increased human activity within the nominated areas increases the risk of fire within adjacent areas of potential Macquarie Perch habitat. Key risk areas are those that are easily accessible to the public and in close proximity to urban development. Bushfire management by authorities is also likely in areas close to new urban development.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the strategic assessment area. This includes a number of actions with the most relevant to the outcome for the Macquarie Perch being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a Fire Management Strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the Fire Management Strategy
    - Integration of the fire management actions for conservation land identified in the Fire Management Strategy in stewardship agreements and reserve management plans
- Introduction of a new SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from habitat for the Macquarie Perch. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

These measures are considered to adequately mitigate the level of risk to the Macquarie Perch.

RECREATIONAL FISHING

Recreational fishing is identified as a threat to the Macquarie Perch. Urban development may lead to increased recreational fishing within nearby areas known to support the species. Fishing Macquarie Perch is prohibited in Australia and comes with heavy penalties for harming, possessing, buying or selling them or for damaging their habitat (DoEE & DPI, 2018; NSW DPI, 2017). Despite this, a potential increase in the rate of recreational fishing presents a greater risk to the populations within proximity of the nominated areas.

Commitment 5, Action 8 of the Plan, and Appendix E of the Plan, both include the following measure:

- Consult with the relevant public land manager to minimise disturbance and impacts to threatened species in accordance with Appendix E, including:
    - Work with NSW Fisheries to address the risk of illegal and incidental recreational fishing capture along stretches of known habitat for Macquarie Perch in Erskine Creek, Glenbrook Creek, Georges River and Cordeaux River

- Installing signs and/or interpretive displays at appropriate sites in areas used for recreational fishing along Erskine Creek, Glenbrook Creek, Georges River and Cordeaux River to assist with identification of Macquarie Perch and awareness of threats

The measure in Appendix E applies to Erskine Creek. Glenbrook Creek, Georges River and Cordeaux River, and will be implemented via consultation with local councils and other public agencies.

These measures are expected to adequately mitigate the level of risk to the Macquarie Perch.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the species. The assessment of viability has regard for the guidance in the Conservation Advice and (if applicable) the Recovery Plan, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also discusses the consistency of the Plan with any Recovery Plans and relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

30.19.2 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2013b) and Recovery Plan (DoEE & DPI, 2018) identify the key issues that are likely to have the greatest influence on the long-term viability of the Macquarie Perch in relation to implementation of the Plan. They are indirect impacts associated with:

- Hydrological changes
- Habitat degradation caused by bushfires
- Recreational fishing

Direct impacts are not relevant to this species

INDIRECT IMPACTS

The potential indirect impacts associated with hydrological changes, habitat degradation caused by bushfires, and recreational fishing will be managed and mitigated through a number of commitments and actions in the Plan (see Chapter 15 for details). Indirect impacts will not adversely influence the long-term viability of the species.

IMPLICATIONS OF THE 2019-20 BUSHFIRES

As outlined in Part 1 of this report, the 2019-20 bushfires in NSW are unprecedented in their extent and intensity. As of 28 January 2020, the fires had burnt 5.3 million ha (6.7 per cent of NSW), including 2.7 million ha in national parks (37 per cent of the national park estate) and over 80 per cent of the Greater Blue Mountains World Heritage Area (EES, 2020b).

The full impact of the fires will not be understood for some time (EES, 2020b). This includes the potential impacts to the Macquarie Perch. However, it appears that fish populations in some waterways outside the Strategic Assessment Area may have been severely affected.

It should be noted that the initial analysis undertaken of the implications of the fires for this report (Supporting Document G) did not identify Macquarie Perch as a species that may need additional commitments in the Plan. This is because it did not meet all of the following criteria (see Supporting Document G for explanation):

- A high percentage (>10 per cent) of NSW records have been affected by fires of the 2019-2020 period, and
- The Cumberland subregion is already important for species persistence in NSW and/or has the potential to become more important for persistence because of the impacts of the fires to other areas of habitat, and
- The Plan has known or likely impacts to the species

CONCLUSION

The Plan will not lead to direct impacts to this species, while the management strategies for indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the species.

30.19.3 CONSISTENCY WITH RECOVERY PLAN

In accordance with Section 146K of the EPBC Act, this section considers whether the implementation of the Plan is not inconsistent with the species' Recovery Plan. It considers two questions:

- Does the Plan prevent achievement of the objectives of the Recovery Plan?
- Does the Plan prevent implementation of the Recovery Plan actions?

These are discussed below.

DOES THE PLAN PREVENT ACHIEVEMENT OF THE OBJECTIVES OF THE RECOVERY PLAN?

The overall objective of the Recovery Plan is to: ensure the recovery and ongoing viability of Macquarie perch populations throughout the species' range (including historically translocated populations in Cataract Reservoir and the Mongarlowe and Yarra rivers).

The Recovery Plan also includes a range of strategies to achieve the objective. These are:

- Conserve existing Macquarie perch (including historically translocated populations in Cataract Reservoir and the Mongarlowe and Yarra rivers);
- Protect and restore Macquarie perch habitat;
- Understand and address threats to Macquarie perch populations and habitats;
- Establish additional Macquarie perch populations within the species' natural range;
- Improve understanding of the biology and ecology of the Macquarie perch and its distribution and abundance; and
- Increase participation by community groups in Macquarie perch conservation.

The outcome for the Macquarie Perch under the Plan will not make it impossible to the achieve the objective or implement the strategies of the Recovery Plan.

DOES THE PLAN PREVENT IMPLEMENTATION OF THE RECOVERY PLAN ACTIONS?

The Recovery Plan includes a number of actions to help achieve its objective. The Plan will not prevent implementation of any of the actions.

30.19.4 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 30-74 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

For Macquarie Perch, there are no relevant Threat Abatement Plans.

Table 30-74: Relevant Key Threatening Processes and associated Threat Abatement Plans for the Macquarie Perch

RELEVANT KEY THREATENING PROCESS	ASSOCIATED THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP

30.20 THREATENED MIGRATORY SHOREBIRDS

This section provides an impact analysis for the five migratory shorebirds that are also listed as threatened. It draws on the detailed analysis in Section 32.2 of Chapter 32 which addresses the 21 listed migratory shorebirds that have been recorded in the Cumberland subregion. Chapter 32 should be read in conjunction with the assessments in this section.

The five species are:

- *Calidris canutus* (Red Knot)
- *Calidris ferruginea* (Curlew Sandpiper)
- *Charadrius leschenaultii* (Greater Sand Plover)
- *Limosa lapponica bauera* (Bar-tailed Godwit)
- *Numenius madagascariensis* (Eastern Curlew)

They are addressed in the same section because they:

- Share similar habitat requirements
- Are assessed using the same baseline data
- Are very similar in terms of potential impacts

The assessment of the five species in this section analyses the implications of implementation of the Cumberland Plain Conservation Plan in accordance with the EPBC Terms of Reference. It sets out:

- The approach to baseline data for migratory shorebirds
- A background to each species including its occurrence in the Strategic Assessment Area
- Avoidance of impacts
- Direct impacts and offsets
- Potential indirect impacts and mitigation
- Potential additional impacts from essential infrastructure and tunnels
- Likely effects of implementation of the Plan on the long-term viability for each species

30.20.1 THE APPROACH TO BASELINE DATA FOR MIGRATORY SHOREBIRDS

The approach to developing baseline data for migratory shorebirds is described in detail in Section 32.2.2 of Chapter 32. It is summarised here.

The baseline data includes:

- Compilation of available records for shorebird species
- Habitat mapping (including the identification of important habitat) across the Cumberland subregion

None of the species were candidate species under the BCAR process.

COMPILATION OF RECORDS

Records were compiled from the Birdlife Australia Database and the OEH BioNet Database. This is considered to be the most complete data for shorebirds in the Cumberland subregion.

APPROACH TO HABITAT MAPPING WITHIN THE CUMBERLAND SUBREGION

Given the similarity in habitat requirements between migratory shorebirds, habitat was mapped for all species through a single process which identified habitat sites across the Cumberland subregion.

The habitat mapping was undertaken broadly in accordance with the approach outlined in the *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoEE, 2017a) (referred to as the Guidelines from this point). However, the method applied was more precautionary than required under the Guidelines to ensure that no important habitat sites were missed (see 'limitations in the baseline data' below).

See Section 32.2.1 for an explanation of the Guidelines and how they treat habitat for migratory shorebirds.

The process involved the following steps:

Step 1: Analysis of records across the Cumberland subregion

Records were compiled and examined across the whole of the Cumberland subregion. The initial step considered the subregion as a single habitat unit to determine which species exceeded the thresholds outlined in the Guidelines for important habitat across the whole area (i.e. which species occur in numbers greater than the threshold when records are summed across the whole subregion).

Step 2: Identification of important migratory shorebird habitat sites

The spatial distribution of records was then assessed to identify the individual wetland and waterbody (or wetland mosaic) where the thresholds were exceeded at a site level. Each wetland that was identified as important for migratory shorebirds had its boundary marked and a 250 m buffer applied. This buffer distance is consistent with the Guidelines which suggest buffer distances ranging from 165 to 255 m to mitigate against disturbance (DoEE, 2017a).

For ephemeral wetlands the threshold was considered across every year where records were held.

For permanent wetlands, the guidelines suggest considering the last five years. The approach taken for this assessment was to look at records for the last 20 years for sites that were thought to be permanent. This acknowledges the uncertainty in determining if habitat sites are permanent or ephemeral across the Strategic Assessment Area.

Step 3: Identification of potential migratory shorebird habitat

The remaining potential migratory shorebird habitat in the subregion was determined based on the presence of suitable wetlands throughout the landscape that exceed 1.5 ha in area. This 1.5 ha threshold was used as a proxy for the minimum disturbance distance for shorebirds of 150 m.

Wetland mapping layers were interrogated from the Directory of Important Wetlands (DoEE, 2018e) and the LPI topographical data Hydro Area layer (LPI, 2016) to identify areas of potential habitat.

LIMITATIONS IN THE BASELINE DATA

The data used in the habitat mapping is the best available across the Cumberland subregion. It incorporates:

- Historical records from both BioNet and Birdlife Australia
- Wetland and waterbody mapping from DAWE and LPI

However, there has not been a systematic survey for migratory shorebirds across the subregion and it is likely that shorebirds visit a number of sites where there are no records.

To address uncertainty in the data a precautionary approach was taken. This involved:

- Considering the whole of the Cumberland subregion to determine what species occurred in numbers greater than the important habitat thresholds when their records were summed for all sites
- Mapping potential habitat using wetland and waterway mapping

OVERVIEW OF SHOREBIRD HABITAT

A total of 11 important sites occur for migratory shorebirds across the subregion (see Table 30-75 and Map 30-28). None of these sites will be directly impacted by development under the Plan.

Table 30-75: Summary of migratory shorebird habitat sites

Habitat type	Number of sites	Total area of habitat (ha)
Important habitat within the Strategic Assessment Area	5	182.3
Important habitat within the broader Cumberland subregion	6	54.5

The important habitat sites can be broadly placed into five groups based on their location:

- Sites in the Strategic Assessment Area:
  - Sites 7, 9, 17 and 21 all occur near to the Hawkesbury River in the north of the Strategic Assessment Area
  - Site 19 occurs in the Mt Annan Botanic Gardens to the west of GMAC
- Sites outside the Strategic Assessment Area in the broader Cumberland subregion:
  - Sites 1 and 11 occur in the Marsden Park North Precinct of the existing North West Growth Area
  - Sites 3, 13 and 15 all occur within the vicinity of Sydney Olympic Park
  - Site 5 occurs outside in the suburb of Panania

It is important to note that important migratory shorebird habitat has been mapped for use in BAM assessments. No important migratory shorebird habitat has been identified within the Strategic Assessment Area.

A number of sites are subject to existing management (e.g. as a nature reserve). A profile for each site is provided in Section 32.2.3 of Chapter 32.

30.20.2 BACKGROUND TO EACH SPECIES INCLUDING ITS OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

CALIDRIS CANUTUS (RED KNOT)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Endangered, marine, migratory Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing downgraded to Vulnerable (DAWE, 2021d) ***NB:*** *An assessment of this species as a migratory species is provided in Chapter 32*
DESCRIPTION	*Calidris canutus* (Red Knot) is a small to medium migratory shorebird. It has a length of 23-25 cm, a wingspan of 45-54 cm, a short neck, a short straight bill, short legs, and wings that extend beyond its tail (TSSC, 2016b).
ECOLOGY	There are six recognised subspecies of the Red Knot, of which three have been recorded in Australia: • *Calidris canutus piersmai* regularly occurs in Australia, almost exclusively in the north west • *C. c. rogersi* regularly occurs in Australia, mostly in the east • *C. c. canutus* occurs as a vagrant The species breeds at a range of locations around the Arctic. It is thought that the vast majority of the population migrates to Australia in the non-breeding season. Individuals typically arrive in Australia from late August. The species returns to the northern hemisphere between February and May. (TSSC, 2016b)
DISTRIBUTION AND HABITAT	In Australia, the species mainly inhabits coastal environments and saline wetlands near the coast. The Red Knot is rarely observed in or around freshwater swamps or inland aquatic habitats. The species:

	• Forages in soft substrate near the edge of intertidal mudflats or sandflats exposed by low time, or in nearby lakes, sewage ponds and floodwaters • Roosts on sandy beaches, spits, and islets; mudflats; or shallow saline ponds. The species prefers roosting habitat in open areas away from potential cover for predators (TSSC, 2016b)
POPULATIONS	The species occurs as a single population in Australia. An estimated 135,000 individuals are present in Australia during the austral summer.
SOS SITES	No SOS Sites have been identified.
RELEVANT PLANS AND POLICIES	Conservation Advice. *Calidris canutus*. Red Knot (TSSC, 2016b)
SPECIES-SPECIFIC GUIDELINES	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017a) Wildlife Conservation Plan for Migratory Shorebirds (DoEE, 2015)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=855

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area and provides a qualitative description of where records and habitat occur.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The Red Knot has been recorded at one important habitat site, the Mason Park Wetlands (Site 3). This site is outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion, close to Sydney Olympic Park. The species has not been recorded in the Cumberland subregion in numbers above the 0.1 per cent threshold for important habitat (as defined in the migratory shorebird Guidelines) when the subregion is considered a single habitat unit.

CALIDRIS FERRUGINEA (CURLEW SANDPIPER)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Critically endangered, migratory Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing downgraded to Endangered (DAWE, 2021d) ***NB:*** *An assessment of this species as a migratory species is provided in Chapter 32*
DESCRIPTION	*Calidris ferruginea* (Curlew Sandpiper) is a small, slim migratory bird with long legs and a long black bill (TSSC, 2015a).
ECOLOGY	The species breeds in the Russian Arctic before migrating to the southern hemisphere. A relatively small proportion of the species (thought to be less than 13 per cent) migrates to Australia for the for the austral summer. Most immature birds do not return to the northern hemisphere for two years following their first arrival in Australia.
DISTRIBUTION AND HABITAT	In Australia, the species occurs along the coast but is also widespread inland (although in lower and variable numbers). The species uses a range of freshwater and brackish coastal and estuarine areas and inland waterbodies, where it: • Forages on mudflats and in nearby shallow water, and occasionally low, sparse vegetation

	• Roosts in open areas with damp substrates, especially on shingle, shell or sand beaches, spits and islets (TSSC, 2015a)
POPULATIONS	The species occurs as a single population in Australia.
SOS SITES	Five SOS Sites have been identified for the Curlew Sandpiper: • Clarence River Estuary • Hunter Estuary and Port Stephens • Manning River Estuary • Richmond River Estuary • Shoalhaven Estuary They are all outside the Strategic Assessment Area. The closest SOS Site is in the Shoalhaven Estuary, north of Jervis Bay.
RELEVANT PLANS AND POLICIES	Conservation Advice. *Calidris ferruginea*. Curlew Sandpiper (TSSC, 2015a)
SPECIES-SPECIFIC GUIDELINES	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017a) Wildlife Conservation Plan for Migratory Shorebirds (DoEE, 2015)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=856

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area and provides a qualitative description of where records and habitat occur.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The Curlew Sandpiper has been recorded in small numbers in a range of wetlands and waterbodies across the Strategic Assessment Area. These include:
	• Six sites which are identified as important habitat for migratory shorebirds:
	  ○ Site 1 – which is comprised of ponds at the old Riverstone Meatworks. It occurs outside the Strategic Assessment Area (in the Marsden Park North Precinct of the North West Growth Centre)
	  ○ Sites 3 and 13 – which both occur within the vicinity of Sydney Olympic Park outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion
	  ○ Site 7 – which is Bushell's Lagoon in the north of the Strategic Assessment Area (to the north of the Hawkesbury River)
	  ○ Site 9 – which is Pitt Town Lagoon in the north of the Strategic Assessment Area (to the east of the Hawkesbury River)
	  ○ Site 21 – which is McGraths Hill Wetland in the north of the Strategic Assessment Area (to the south of the Hawkesbury River)
	• A small number of other sites close to the Hawkesbury River and in proximity to Sites 7, 9 and 21
	• One record within GPEC outside urban capable land
	The number of records from these sites is low. Considered as a single habitat unit, the Cumberland subregion has not exceeded 0.1 per cent of the total flyway population for this species in a single year.

CHARADRIUS LESCHENAULTII (GREATER SAND PLOVER)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Vulnerable, migratory, marine Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing downgraded to Not Listed (DAWE, 2021d) ***NB:*** *An assessment of this species as a migratory species is provided in Chapter 32*
DESCRIPTION	*Charadrius leschenaultii* (Greater Sand Plover) is a medium sized brown and white plover. It is similar in appearance to the Lesser Sand-plover although distinctly bigger (TSSC, 2016c).
ECOLOGY	The Greater Sand Plover is a migratory shorebird. The species breeds in China, Mongolia and nearby parts of Russia. During the non-breeding season, the species migrates south, with records from Australia and the south Pacific across the coast of the Indian Ocean to the eastern and southern coasts of Africa and the south eastern shores of the Mediterranean. (TSSC, 2016c) Only the subspecies *C. l. leschenaultia* occurs in Australia. Almost three quarters of the subspecies is present in Australia during the austral summer. Birds typically arrive between mid-July and November and leave in late February. Most immature birds remain in Australia during the breeding season. (TSSC, 2016c)
DISTRIBUTION AND HABITAT	During the austral summer the species is widespread but more common in northern Australia. It is found in coastal areas in every Australian state. In NSW, the species is common north of the Northern Rivers region, with occasional records south to around Shoalhaven Heads. (TSSC, 2016c) While in Australia the species is almost entirely coastal. It inhabits sheltered beaches, intertidal mudflats, sandbanks, salt marshes, estuaries, coral reefs, rocky islands or platforms, tidal lagoons and dunes near the coast. They typically forage in wet sand or mud, and roost on sand-spits or high on banks near beaches. (TSSC, 2016c)
POPULATIONS	The species occurs as a single (important) population in Australia.
SOS SITES	Five SOS Sites have been identified for the Curlew Sandpiper. They are all outside the Strategic Assessment Area. The closest SOS Site is in the Shoalhaven Estuary, north of Jervis Bay.
RELEVANT PLANS AND POLICIES	Conservation Advice. *Charadrius leschenaultia*. Greater sand plover (TSSC, 2016c)
SPECIES-SPECIFIC GUIDELINES	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017a) Wildlife Conservation Plan for Migratory Shorebirds (DoEE, 2015)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=877

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area and provides a qualitative description of where records and habitat occur.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The Greater Sand Plover has been recorded at one important habitat site, the Mason Park Wetlands (Site 3). This site is outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion, close to Sydney Olympic Park. The species has not been recorded in the Cumberland subregion in numbers above the 0.1 per cent threshold for important habitat when the subregion is considered a single habitat unit.

LIMOSA LAPPONICA BAUERI (BAR-TAILED GODWIT)

SPECIES BACKGROUND

This section describes the occurrence of the species in the Strategic Assessment Area and provides a qualitative description of where records and habitat occur.

EPBC ACT LISTING	Vulnerable, migratory Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing upgraded to Endangered (DAWE, 2021d) ***NB:*** *An assessment of this species as a migratory species is provided in Chapter 32*
DESCRIPTION	*Limosa lapponica baueri* (Bar-tailed Godwit) is a large migratory bird with a long neck and very long upturned bill. It has dark barring on the lower white rump, upper tail and lining of the underwing (TSSC, 2016d).
ECOLOGY	Two subspecies of *L. lapponica* regularly occur in Australia: • In the non-breeding season, *L. l. baueri* (listed as migratory and vulnerable) occurs along the north and east coasts of Australia (TSSC, 2016d) • *L. l. menzbieri* (listed as migratory and critically endangered) occurs predominately in Western Australia (TSSC, 2016d) and is not considered likely to occur in the Cumberland subregion This assessment considers impacts to *L. lapponica baueri*. The subspecies breeds in northern Siberia and Alaska before migrating through the Yellow Sea to Australia and New Zealand. Immature birds often remain in Australia for one or two austral winters before returning to their breeding grounds in the Northern Hemisphere. The Bar-tailed Godwit has one of the longest non-stop migratory routes recorded for any bird. This makes the species sensitive to changes in intertidal habitats used for feeding to create fuel stores prior to migration.
DISTRIBUTION AND HABITAT	In Australia, the species: • Mainly occurs along the north and east coasts • Typically forages in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons, and bays • Typically roosts on sandy beaches, sandbars, spits and in near-coastal saltmarsh The Bar-tailed Godwit is thought to have high site fidelity in the non-breeding season (TSSC, 2016d).
POPULATIONS	The species occurs as a single (important) population in Australia.
SOS SITES	No SOS Sites have been identified.
RELEVANT PLANS AND POLICIES	Conservation Advice. *Limosa lapponica baueri*. Bar-tailed godwit (western Alaskan) (TSSC, 2016d)
SPECIES-SPECIFIC GUIDELINES	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017a) Wildlife Conservation Plan for Migratory Shorebirds (DoEE, 2015)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=86380

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area and provides a qualitative description of where records and habitat occur.

OCCURRENCE IN THE STRATEGIC	The species has been recorded in the Cumberland subregion in numbers above the 0.1 per cent threshold for important habitat when the subregion is considered a single habitat unit.

ASSESSMENT AREA	However, it does not exceed the threshold at any individual site. It has been recorded at three of the important habitat sites: • Site 9 – which is Pitt Town Lagoon in the north of the Strategic Assessment Area (to the east of the Hawkesbury River) • Sites 13 and 15 – which both occur in Sydney Olympic Park outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion There are no records within the nominated areas or transport corridors.

NUMENIUS MADAGASCARIENSIS (EASTERN CURLEW)

SPECIES BACKGROUND

This section sets out the basic information about the species. It provides an overview of the species' ecology, distribution, habitat, and populations. These provide context for the impact assessment. At the end of the section are links to key species' documents that provide additional background information.

EPBC ACT LISTING	Critically endangered, migratory Note that this species is currently on the Finalised Priority Assessment List (FPAL) and is proposed to have its listing downgraded to Endangered (DAWE, 2021d) ***NB:*** *An assessment of this species as a migratory species is provided in Chapter 32*
DESCRIPTION	*Numenius madagascariensis* (Eastern Curlew) is the largest migratory shorebird in the world. It has a long neck and legs, and a very long downcurved bill (TSSC, 2015b).
ECOLOGY	The species breeds in Russia, Mongolia, and north-eastern China. It is thought that approximately 73 per cent of the population migrates to Australia in the non-breeding season. Individuals arrive in Australia as early as July, with the majority of birds arriving in mid-to-late August. Migration north typically starts in late February and continues until March or April. Immature individuals may spend as many as three austral winters in Australia before returning to the Northern Hemisphere to breed. (TSSC, 2015b)
DISTRIBUTION AND HABITAT	In Australia, the species: • Is typically distributed across coastal areas and is rarely found inland • Typically forages in sheltered intertidal sandflats or mudflats that are either open or vegetated with seagrass, or near mangroves, salt flats, or saltmarshes • Typically roosts during high tide periods on sandy spits, sandbars, and islets, either on sand near the high-water mark or among coastal vegetation • Is rarely found on near-coastal lakes or in grassy areas (TSSC, 2015b)
POPULATIONS	The species occurs as a single population in Australia.
SOS SITES	No SOS Sites have been identified.
RELEVANT PLANS AND POLICIES	Conservation Advice. *Numenius madagascariensis*. Eastern Curlew (TSSC, 2015b)
SPECIES-SPECIFIC GUIDELINES	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017a) Wildlife Conservation Plan for Migratory Shorebirds (DoEE, 2015)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=847

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the species in the Strategic Assessment Area and provides a qualitative description of where records and habitat occur.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The Eastern Curlew has been recorded at one important habitat site, Wanngal Wetland (Site 13). This site is outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion. It is part of the Newington Nature Reserve within Sydney Olympic Park. The species has not been recorded in the Cumberland subregion in numbers above the 0.1 per cent threshold for important habitat when the subregion is considered a single habitat unit.

30.20.3 AVOIDANCE OF IMPACTS

This section provides an overview of the area of potential habitat that was avoided for the species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

No important habitat for any of the five species occurs within the nominated areas or transport corridors. Avoidance of impacts was therefore not necessary.

30.20.4 DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts.

There are no direct impacts to important habitat for any of the five species. Offsets were therefore not considered necessary.

30.20.5 POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the five species that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the species if:

- *The indirect impact is identified as a threat in a relevant profile or conservation advice, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

The Conservation Advices identify a common range of threats to each of the five species along their migratory pathways and in Australia. Threats along their migratory pathways (i.e. outside Australia) are not considered further.

Threats in Australia include:

- Ongoing human disturbance
- Habitat loss and degradation from pollution
- Changes to the water regime
- Invasive plants

Climate change is also a relevant threat to each species. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

Section 32.2.4 in Chapter 32 provides a detailed analysis of the potential for these threats to occur as indirect impacts to migratory shorebirds as a result of implementation of the Plan. This analysis (which should be read in conjunction with this assessment) concludes that the risks to important habitat from these threats are considered to be negligible across the Strategic Assessment Area. In summary, this is because none of the important habitat sites are:

- In close proximity to the nominated areas or transport corridors
- Hydrologically well connected (e.g. downstream) to development areas

It is relevant to note that even though implementation of the Plan is considered unlikely to indirectly impact migratory shorebird habitat, the Plan includes a range of measures that may provide a benefit to these areas. These measures include landscape scale approaches to:

- Conserving and managing land
- Managing fire
- Managing weeds
- Managing pest animals

30.20.6 POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to each species from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable lands (but still within the nominated areas)*

No important habitat for any of the five species occurs within the nominated areas or transport corridors. Potential additional impacts from essential infrastructure and tunnels are therefore not relevant.

30.20.7 LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY FOR EACH SPECIES

This section considers the likely effects of implementation of the Plan on the long-term viability of the five species. The analysis has regard for the guidance in the Conservation Advices (there are no Recovery Plan for the species), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

As outlined above, implementation of the Plan will not lead to any direct or indirect impacts to important habitat for any of the species. This will ensure that the implementation of the Plan does not adversely influence their long-term viability.

CONSISTENCY WITH RECOVERY PLANS

There are no recovery plans for the species.

KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Given the lack of direct and indirect impacts, there are no relevant Key Threatening Processes (KTPs) or associated Threat Abatement Plans (TAPs).

31 Threatened Ecological Communities impact assessment

31.1 INTRODUCTION

There are nine Category 1 Threatened Ecological Communities (TECs) that are assessed in this Chapter. These ecological communities were identified as needing detailed assessment (see Part 3 for the approach, and Chapter 28 for the results) as they are reliant on the Cumberland subregion and have some potential to be impacted directly, indirectly, or cumulatively.

The Chapter is structured around the level of direct impacts likely to occur to each TEC (see Table 31-1). TECs subject to the largest direct impacts are discussed first, with TECs at lower levels of direct impact discussed subsequently.

The overall assessment approach for TECs is presented below in Section 31.2. To support the TEC assessment three additional pieces of technical analysis were undertaken. These were:

- A patch size analysis to calculate the number and sizes of patches of each TEC across the Strategic Assessment Area. See Section 31.3 for a description of the approach with the results presented in each TEC assessment
- A viability analysis to identify the patches of each TEC within the Strategic Assessment Area that are more likely to be viable in the longer term. The methodology for the viability analysis is presented below in Section 31.4 with the results presented in each TEC assessment
- A trend analysis undertaken by RMIT University (A Gordon & Peterson, 2019) that examined the extent and condition of a component (PCT 849) of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. The trend analysis examined the potential impacts of development and offsetting under various scenarios on PCT 849 over the life of the Plan. A report for the trend analysis is provided at Supporting Document D. A summary of the approach and results is provided in Section 31.6 as part of the assessment of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

The analysis in this chapter concludes that the avoidance, mitigation, and offset measures in the Plan will ensure that the long-term viability of the TECs will not be adversely influenced.

Table 31-1: Ecological communities assessed in this chapter categorised according to the scale of direct impacts

Direct impacts to TECs	Number of TECs	TEC names
TECs subject to direct impacts	5	• Shale Sandstone Transition Forest of the Sydney Basin Bioregion • Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest • River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria • Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion • Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South-East Queensland ecological community
TECs not directly impacted	4	• Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion • Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion • Turpentine-Ironbark Forest of the Sydney Basin Bioregion • Western Sydney Dry Rainforest and Moist Woodland on Shale

31.2 TEC ASSESSMENT APPROACH

The assessments for TECs follow a standard format. However, the content is tailored for the specific context of each TEC.

There are nine sections to the assessments. They are described below and include:

- TEC background
- Approach to baseline data
- Occurrence in the Strategic Assessment Area
- Avoidance of impacts
- Direct impacts and offsets
- Potential indirect impacts and mitigation
- Potential additional impacts from essential infrastructure and tunnels
- Likely effects of implementation of the Plan on the long-term viability of the TEC
- Data tables

To assist the reader, standard explanatory text about the purpose and content of each section is provided throughout the assessments in *blue italics text*. The text is repeated for each TEC. It enables the reader to quickly understand the content of each section and where in the broader report more detailed information is available about a particular issue.

31.2.1 TEC BACKGROUND

Sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

31.2.2 APPROACH TO BASELINE DATA

Provides an overview of the approach to baseline data for the TEC. It:

- Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping
- Outlines the vegetation condition states used in the mapping
- Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC
- Summarises the approach to mapping the EPBC TEC at the scale of the Strategic Assessment Area
- Summarises the approach to the patch size analysis for the TEC
- Summarises the approach to identifying areas of likely higher long-term viability for the TEC in the Strategic Assessment Area

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

31.2.3 OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

Describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map of the TEC which can be viewed as a separate file (layered PDF). The map provides critical context for the assessment and should be viewed in conjunction with the text presented in the assessments. This section also provides a qualitative description of where the TEC occurs.

31.2.4 AVOIDANCE OF IMPACTS

Provides an overview of the area of potential habitat that was avoided for each species through the design of the urban capable lands within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan.

The definition of what constitutes avoidance has been adopted from the BCAR process. Under the BAM, avoidance refers to land that is suitable for development and included in the area proposed for development or biodiversity

certification, but has been avoided and not certified because of its biodiversity value. This is referred to as avoidance for 'biodiversity purposes' in this assessment.

Land not impacted because it is not suitable for development or biodiversity certification, or land that has been excluded from the area proposed for development is not considered to have been avoided under the BAM. This land is referred to as avoidance for 'other purposes' and includes:

- Land that is mapped as a riparian corridor associated with a Strahler order 3 stream or above (or Strahler order 2 streams with mapped vegetation, adjacent to avoided lands or that contribute to landscape connectivity). Riparian buffers applied are consistent with the *Water Management Act 2000*:
    - Strahler stream order 2 - buffer 20 m either side
    - Strahler stream order 3 - buffer 30 m either side
    - Strahler stream order 4 and above - buffer 40 m either side
- State protected land within avoided lands (>18 degrees slope, considered too steep for urban development)

Flood-prone land is not included in the list of land avoided for other purposes because significant development does occur within flood-prone land in the Plan Area. The use of fill and other flood-mitigation works means that flood-prone land does not necessarily constrain urban development.

Some land within the nominated areas was not considered for inclusion in the area proposed for development and has therefore been identified as 'excluded' land. These lands include:

- Existing protected land, including reserves and established offset sites
- Council owned land which is zoned for environmental conservation, environmental management or recreation
- Commonwealth land, such as Defence Establishment Orchard Hills
- Lands within the nominated areas already assessed as part of another development approval (Bingara Gorge), or lands progressing through an alternate assessment (Mount Gilead, Menangle Park, Sydney Metro Stage 1)
- Lands already developed (existing urban areas, urban land zones and roads)

A further, detailed explanation of the avoidance process and terminology is provided in Chapter 14.

31.2.5 DIRECT IMPACTS AND OFFSETS

Provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. Direct impacts are assessed in relation to the loss of the mapped TEC.

Direct impacts were determined based on an intersect of the urban capable land and transport corridors with the baseline mapping generated for each TEC. It has been assumed that total permanent clearing will occur within the urban capable land and transport corridors for the purposes of the assessment. However, it is important to note that in reality:

- Further avoidance will be undertaken within the transport corridors (see Chapter 7)
- Direct impacts will occur progressively over the life of the Plan, which reduces the severity of impacts

The analysis considers direct impacts within the context of the information provided through the patch size analysis and viability analysis (i.e. which patches are considered most likely to be viable in the long term).

The Plan provides offsets for TECs that are impacted directly. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8 and explained in detail in the Conservation Priorities Method that supports the Plan.

31.2.6 POTENTIAL INDIRECT IMPACTS AND MITIGATION

Identifies and discusses the potential indirect impacts to each TEC that may occur as a result of development under the Plan. They were identified as being relevant to the TEC if:

- The indirect impact is identified as a threat in a relevant profile or conservation advice or recovery plan, *and*
- The threat is present in the Cumberland subregion, *and/or*

- The Plan has the potential to introduce or exacerbate the threat in a way that may affect the known occurrence of a TEC

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 to understand the conclusions reached in this section.

Where relevant to each TEC, indirect impacts are discussed in relation to the following categories which encapsulate the various ways threats to TECs are discussed in Conservation and Listing Advices:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna

31.2.7 POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

Considers the potential additional impacts to TECs due to essential infrastructure projects that are needed to support development within the nominated areas. These might include projects such as water and electricity utilities, communications facilities, stormwater management systems, and waste or resource management systems. The assessment covers projects that may need to be located outside urban capable land and on areas that are identified as avoided lands within the nominated areas.

This section also assesses the likelihood of potential additional impacts to TECs due to the tunnel sections of the transport corridors. The impacts of tunnels were assessed separately to the rest of the transport corridors as only small areas of the footprints will be disturbed and it is not possible to determine at this stage the nature and extent of those impacts.

Please refer to the following chapters for details about these development types:

- Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels
- Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)

31.2.8 LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

Considers the likely effects of implementation of the Plan on the long-term viability of the TEC. This assessment has regard for the guidance in the Conservation Advice for each TEC (none of the TECs have EPBC Recovery Plans), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation.

Where applicable, this section also discusses the consistency of the Plan with any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.2.9 DATA TABLES

Sets out the data tables for occurrence, avoidance, and direct impacts for each TEC.

31.3 PATCH SIZE ANALYSIS

A patch size analysis was undertaken for each TEC. This process used the mapping undertaken for the strategic assessment to identify and calculate the size of each patch of the TEC. This information was then used to calculate:

- The total number of patches of each TEC
- The distribution of patch sizes across three categories:
    - 0.5-5 ha

- 5-20 ha
- >20 ha

31.4 ASSESSMENT OF VIABILITY FOR TECS

For TECs, the impact assessment was informed by an analysis (undertaken as part of the strategic assessment) to identify the areas of likely higher long-term viability for each TEC.

31.4.1 PURPOSE

The purpose of the analysis was to identify the patches of each TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches".

31.4.2 APPROACH

The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included:

- Larger patches are generally more viable than smaller patches
- Better condition patches are generally more viable than poorer condition patches
- Connected patches are generally more viable than poorer connected patches
- Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio

While the Conservation Advices identified several more factors as being important for viability or conservation significance, spatial data at the scale of the Strategic Assessment Area was not available on TECs to include these factors in the analysis.

A single rule set was developed for all TECs to identify patches more likely to be of higher viability. To meet this requirement, patches needed to:

- Have a minimum patch size of 20 ha
- Be in intact condition
- Be well connected to other patches of native vegetation (this was defined as having greater than 30 per cent native vegetation cover in surrounding 550 m and 1750 m buffers)
- Have a good edge to area ratio (this was defined as an edge to area ratio of the patch of native vegetation that is smaller than an equivalent 100 m wide patch of the same size)

It is important to note that patches of the TEC that do not meet this rule set are not necessarily of lower conservation value. Small patches are often of high conservation significance, particularly in over-cleared landscapes such as the Cumberland subregion, and if managed appropriately, can persist in the long term (Wintle, Kujala et al., 2019). The purpose of this analysis was to distinguish between different patches of the TEC based on guidance in Conservation Advices to enable a more meaningful evaluation of impacts and overall outcomes of the Plan based on available data.

31.4.3 RESULTS

The results of the TEC viability analysis are presented throughout this chapter for each TEC assessment.

31.5 MEETING AUSTRALIA'S INTERNATIONAL OBLIGATIONS REGARDING THREATENED ECOLOGICAL COMMUNITIES

To satisfy approval requirements under the EPBC Act (specifically, requirements associated with section 146B and 146K of the Act), the Plan must not be inconsistent with Australia's obligations under:

- The Biodiversity Convention
- The Convention of the Conservation of Nature in the South Pacific (Apia Convention)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This section provides an overview of how the Plan is not inconsistent with these obligations. The remainder of Chapter 31 assesses the relevant threatened ecological communities in detail.

31.5.1 BIODIVERSITY CONVENTION

The objectives of the Biodiversity Convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the use of genetic resources.

The conservation of biological diversity is a key priority of the Plan, and is achieved through commitments to avoid and minimise impacts (Commitments 2, 3 and 4), commitments to mitigate indirect impacts (Commitments 5, 6 and 7), commitments to conserve flora, fauna and habitat (Commitment 8, 9, 10, 11, 12, 13 and 14), commitments to manage landscape threats (Commitments 15, 16, 17, 18, 19), and commitments to build knowledge and capacity in the community to bolster conservation efforts (Commitments 20, 21, 22 and 23).

Overall, the Plan is not considered to be inconsistent with the Biodiversity Convention.

31.5.2 APIA CONVENTION

The Apia Convention encourages the creation of protected areas which, together with existing protected areas, will safeguard representative samples of natural ecosystems (including endangered species), as well as superlative scenery, striking geological formations, and regions and objects of aesthetic interest or historic, cultural or scientific value.

The Apia Convention was suspended with effect from 13 September 2006. While this Convention has been suspended, Australia's obligations under the Convention have been taken into consideration.

The Plan will lead to the creation of multiple new protected areas within the Strategic Assessment Area, which will contribute to the protection of a range of MNES (Commitments 8, 9, 10, 11, 12, 13 and 14). A specific example of this is the creation of the Georges River Koala Reserve (Commitment 10), which will safeguard the iconic Koala population of Southern Sydney. Further, the protection of important biodiversity areas within the Strategic Assessment Area will be increased, through the implementation of new mechanisms such as the SEPP (Strategic Conservation Planning) and Ministerial Direction.

The Plan is not inconsistent with the Convention which has the general aims of conservation of biodiversity.

31.5.3 CITES

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The Plan is not inconsistent with CITES as the actions under the Plan do not involve international trade.

TECS SUBJECT TO DIRECT IMPACTS

31.6 SHALE SANDSTONE TRANSITION FOREST OF THE SYDNEY BASIN BIOREGION

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	The TEC is a forest or open woodland with an overstorey dominated by various Eucalypt species and an understorey comprising sclerophyll shrubs, grasses, and herbs. It occurs primarily on soils derived from shale substrates and is also found on weathered sandstone substrates. The TEC occurs in the transition zone between the Wianamatta Group shale that underlies the Cumberland Plain and the sandstone-dominated Hawkesbury Group of the surrounding subregions. The canopy is usually a mix of two or more of the following native tree species: Grey Gum (*Eucalyptus punctata*), Narrow-leaved Ironbark (*E. crebra*), Broad-leaved Ironbark (*E. fibrosa* subsp. *fibrosa*), Forest Red Gum (*E. tereticornis* subsp. *tereticornis*), Red Mahogany (*E. resinifera* subsp. *resinifera*), one or more stringybarks (*E. eugenioides* or *E. globoidea*), and Narrow-leaved Apple (*Angophora bakeri*). The mid-layer is commonly dominated by eucalypt species and Black She-oak (*Allocasuarina littoralis*). If a shrub layer is present, it is typically well-developed, diverse, and dominated by *Bursaria spinosa* (blackthorn) in areas with low sandstone influence. The ground layer is diverse and dominated by grasses, graminoids and herbs. (DoE, 2014a) The following PCTs are associated with the TEC: • 792 Deane's Gum - Mountain Grey Gum - Turpentine tall moist forest on shale, Sydney Basin Bioregion • 1281 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion • 1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion A range of fauna species occur in the TEC, including reptiles, amphibians, birds, micro-bats, and marsupials. Most of these fauna species are not restricted to the TEC and occur in, and are likely to rely on, adjacent wetlands, grasslands, woodlands, and forests. The TEC is equivalent to the NSW BC Act-listed TEC Shale Sandstone Transition Forest where key diagnostic and condition thresholds are met (DoE, 2014a).

EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, understorey native vegetation cover, number of tree hollows, or whether the patch is contiguous with other native vegetation patches. Details of the thresholds are provided in the Conservation Advice (DoE, 2014a).
DISTRIBUTION	The TEC is confined to the Sydney Basin bioregion, on the edge of the Cumberland subregion and the adjacent Hornsby, Woronora, and Lower Blue Mountains Plateau. The TEC primarily occurs at elevations below 200 m (but may occur up to 350 m in the Blue Mountains and 600 m in the Southern Highlands) with mean annual rainfall of 800 - 1100 mm. The TEC generally occurs on soils that are primarily derived from shale substrates with some influence from weathered sandstone substrates. It is also strongly associated with the Mittagong Formation (DoE, 2014a).
SOS SITES	The NSW BC Act-listed TEC of the same name has been categorised under the 'widespread' management stream for TECs under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. Three management sites have been identified for the TEC: • Diamond Hill Reserve • Matheson Park • Singletons Reserve
RELEVANT PLANS AND POLICIES	Approved Conservation Advice (including listing advice) for Shale Sandstone Transition Forest of the Sydney Basin Bioregion (EC25R) (DoE, 2014a) Key Threatening Processes relevant to the TEC are identified in Section 2.1 of the Conservation Advice There is no adopted or made Commonwealth Recovery Plan for the TEC Threat Abatement Plans relevant to the TEC are identified in Table 31-2
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=146

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition.

	Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area. It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCTs are associated with the TEC: • 792 Deane's Gum - Mountain Grey Gum - Turpentine tall moist forest on shale, Sydney Basin Bioregion • 1281 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion • 1395 Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based on applying the condition thresholds at a landscape scale to the available data: • Patch size ≥ 0.5 ha, AND • > 50% of the perennial understorey vegetation cover is made up of native species (based on field verification), AND • Rainfall 800-1100 mm pa, AND • Growing on Shale or sandstone soil substrates OR • Patch size ≥ 2 ha, AND • > 50% of the perennial understorey vegetation cover is made up of native species (based on field verification), AND • Rainfall 800-1100 mm pa, AND • Growing on Shale or sandstone soil substrates OR • Patch size ≥ 0.5 ha, AND • ≥ 30% perennial understorey vegetation made up of natives, AND

	• The patch has at least one tree with hollows per ha or at least one large tree (≥ 80 cm dbh) per ha (based on field verification), OR, the patch is contiguous with a native vegetation remnant ≥1 ha • Rainfall 800-1100 mm pa, AND • Growing on Shale or sandstone soil substrates OR • Patch size ≥ 0.5 ha, AND • ≥ 50% perennial understorey vegetation made up of natives (based on field verification), AND • Rainfall 800-1100 mm pa, AND • Growing on Shale or sandstone soil substrates
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.
VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-6 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment mapped approximately 8,301.5 ha of the TEC within the Strategic Assessment Area (see Table 31-3 for further details). Of this, approximately 5,877.2 ha has been identified as higher viability through the viability analysis. The TEC occurs in the following main locations within the Strategic Assessment Area: • In the north-west, around North Richmond • In the mid-west, near Silverdale, Oakdale, and Werombi • In the south, around Wilton and the southern part of GMAC It occurs in the following nominated areas: • Wilton – 1,068.2 ha total, 522 ha of this identified as higher viability • GMAC – 1,766.7 ha total, 1,121.3 ha of this identified as higher viability • GPEC – 1.7 ha total, 0 ha of this identified as higher viability It does not occur in WSA or the transport corridors outside the nominated areas. The Conservation Advice does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. The Conservation Advice states that all areas that meet the

	minimum condition thresholds as defined in the advice (categories A to D) are considered habitat critical to the survival of the TEC. These are generally: • Patch size ≥ 0.5 ha with ≥ 30% native understory • Well-connected patches ≥ 1 ha in area or the patch has at least one tree with hollows or at least one large locally indigenous tree (> 80 cm dbh) The Conservation Advice also identifies several factors affecting the value of a patch, including: • A larger size and/or a high area to boundary ratio • Part of a larger remnant of native vegetation or linking other remnants • Evidence of recruitment of key plant species/range of age cohorts • High native species richness • Presence of threatened species • Low level of weeds and pest animals The TEC is highly fragmented across the Strategic Assessment Area, comprising 699 patches with an average patch size of 11.9 ha.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

31.6.1 NOMINATED AREAS

The baseline mapping for this assessment mapped 2,197.4 of the TEC within the nominated areas (not including excluded lands). Approximately 2,016.7 ha (91.8 per cent) has been avoided as part of the design of the urban capable land and transport corridors (not including excluded lands). Of this:

- 1,769.1 ha was avoided for biodiversity purposes
- 247.6 ha was avoided for other purposes

An additional 639.2 ha occurs on excluded lands.

A breakdown of avoidance across each nominated area is provided in Table 31-4.

It is important to note that the avoidance calculations in Table 31-4, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 31-4 shows the amounts of habitat within excluded lands for context only.

31.6.2 TRANSPORT

Avoidance results are only reported for urban capable land within the nominated areas, as detailed design of the footprint within the transport corridors has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8, and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will lead to direct impacts to the TEC (see Section 31.6.3 for discussion) but will not generally increase fragmentation (see Section 31.6.4 for discussion).

31.6.3 DIRECT IMPACTS TO THE TEC

Implementation of the Plan will lead to a loss of a total of 180.7 ha of the TEC within Wilton and GMAC. There will be no direct impacts within WSA, GPEC, or transport corridors outside the nominated areas. These impacts represent approximately 2.2 per cent of the remaining TEC in the Strategic Assessment Area and 6.4 per cent of the TEC in the nominated areas. A breakdown of direct impacts is provided in Table 31-5.

The majority of the TEC that will be impacted within Wilton and southern GMAC:

- Is in thinned condition (124.5 ha or 68.9 per cent), with 23.6 per cent of direct impacts occurring to patches in intact condition
- Comprises small patches (less than 5 ha) (approximately 90.5 per cent)
- Is not mapped as higher viability, with only 31.5 ha of higher viability TEC being directly impacted

The most notable direct impacts to the TEC occur in Wilton and southern GMAC due to urban and industrial development. The threat to the TEC in these locations is reduced because:

- Impacts generally occur only to the edges of patches of the TEC that remain connected to larger patches of native vegetation associated with the gullies and gorges of Wilton and GMAC, and will not generally fragment or isolate patches of the TEC
- Potential habitat corridors along waterways that may be used by species associated with the TEC will be maintained
- The impact in the context of the amount remaining in the Strategic Assessment Area is relatively minor

31.6.4 FRAGMENTATION OF THE TEC

As outlined above, impacts largely occur to the edges of patches within Wilton and GMAC and will not result in a loss of connectivity (and therefore will not lead to fragmentation). Areas of the TEC that will not be impacted within these two nominated areas generally provide important habitat for Koalas and often form part of primary, secondary, and tertiary corridors for the species. As outlined in Chapter 30, a significant focus of the Plan is protecting these Koala corridors and maintaining connectivity for Koalas. These processes have helped avoid any notable fragmentation to the TEC.

31.6.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the TEC, the Plan includes a commitment (Commitment 8.1) to secure 675 ha of the TEC as part of the conservation program.

This would:

- Lead to the protection and management of an additional 8.1 per cent of the ecological community within the Strategic Assessment Area
- Increase the level of protection and management of the ecological community by approximately 91.6 per cent on top of what is currently secured in the Strategic Assessment Area

A significant proportion of the offsets will come from within two of the proposed reserves in the form of direct offsets and ecological restoration. They are:

- The Georges River Koala Reserve which is on the eastern side of the Strategic Assessment Area near GMAC. The area contains approximately 413 ha of the TEC
- The Gulguer Reserve investigation area which occurs on the western side of the Strategic Assessment Area. The Plan proposes to implement the reserve over the first 20 years of the Plan. The area contains approximately 520 ha of the TEC

Under Commitment 13, ecological restoration will be undertaken to account for up to a maximum of 25% of the Plan's offset target for native vegetation. This includes a number of actions, with the most relevant to the outcome of the TEC being:

- Develop a Restoration Implementation Strategy, and enter into written agreements with delivery partners and engage specialist providers where necessary to implement the strategy
- Undertake ecological restoration to restore koala habitat, which will primarily include areas of the TEC
- Undertake up to a maximum of 1,331.3 ha of ecological restoration targeting the TEC and several others

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile or conservation advice, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.6.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DoE, 2014a) identifies a range of threats to the TEC. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna

Climate change is also a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

Impacts from inappropriate grazing regimes, soil salinisation, and mining were also identified in the Conservation Advice as key threats. However, none of these are considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these risks across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for this TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes can affect the structure and species composition of the TEC (DoE, 2014a). This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges of burns in proximity to human habitation

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban capable land. Bushfire management by authorities is also likely in areas close to new urban capable land. For the TEC this includes areas in and around Wilton and the southern part of GMAC where significant areas of the TEC are present.

The key factors that influence the appropriateness of a fire regime are fire frequency, intensity and season of occurrence (DECCW, 2011). The Conservation Advice (DoE, 2014a) and the Cumberland Plain Recovery Plan (DECCW, 2011) provide information on fire regimes suitable for the TEC.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the Strategic Assessment Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes.

Also relevant for the TEC is the fact that it largely overlaps with Koala habitat which is a key focus of the Plan in terms of protection and management. Significant areas of Koala habitat will be managed which will include the application of the fire management strategy and a set of measures to control access to bushland which will help minimise risks around arson and accidental fires.

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable land which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas
- The measures in the Plan for Koalas in terms of protecting and managing habitat, and constraining access to bushland will help protect the TEC

The commitments and actions under the Plan are consistent with a number of high priority actions in the Conservation Advice (DoE, 2014a). For example:

- To “integrate fire…management regimes”
- To “implement appropriate fire management regimes that take into account results from research”

WEED INVASION

The TEC is threatened with invasion of weeds. Weeds can displace native plants and reduce the diversity and regenerative capacity of the TEC (DoE, 2014a). Weed incursion in the TEC is associated with agricultural activities as well as urban development.

Key weeds that can occur in the TEC include: African Olive (*Olea europaea* subsp. *cuspidata*), Fireweed (*Senecio madagascariensis*), Spear Thistle (*Cirsium vulgare*), Cat's Ear (*Hypochaeris radicata*), Pigeon Grass (*Setaria gracilis*), Plantain (*Plantago lanceolata*), Paddy's Lucerne (*Sida rhombifolia*), Bridal Creeper (*Myrsiphyllum asparagoides*), Sow Thistle (*Sonchus oleraceus*), and Broad-leafed and Small-leaf Privet (*Ligustrum lucidum* and *L. Sinense*) in wetter areas.

The most serious threats to the TEC are from Bridal Creeper and African Olive as they are highly competitive and difficult to manage (DoE, 2014a).

These weeds are already present within the Strategic Assessment Area and pose a threat to the TEC. However, development within urban capable land and transport corridors have the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban capable land occurs adjacent to the TEC and introduces edge effects. Key risk areas are:

- In the north and north-west of Wilton, where the urban capable land impacts the edges of patches of the TEC connected to gorges and gullies on the edge of the nominated area
- In the southern part of GMAC, where the urban capable land impacts the edges of patches of the TEC connected to gorges and gullies on the edge and middle of the nominated area

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Importantly for the TEC, weeds will be actively managed within the 675 ha to be added to conservation as part of the offset program.

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

These controls are consistent with a number of threat abatement actions in the Conservation Advice about the management of invasive species.

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Conservation Advice (DoE, 2014a) as a threat to the TEC. This relates to a wide range of different mechanisms for disturbance including:

- Inappropriate mowing, slashing, or scrubbing of the understorey for reasons such as bushfire fuel reduction, grazing and perceived aesthetics
- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants
- Inappropriate recreational activities such as ad hoc track building and trail bike use which can directly impact areas of the TEC and facilitate processes such as erosion
- Removal of wood which changes the structure and habitat features of the TEC
- Inadvertent disturbance during construction which has the potential to directly impact the TEC outside approved development areas

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the Strategic Assessment Area may increase due to development within the nominated areas. Occurrences of the TEC considered most at risk are those that occur in close proximity to development within Wilton and GMAC.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Commitments (Commitments 5 and 6) to mitigate indirect impacts from urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors on Koalas. This is relevant to the TEC because the vast majority of the TEC is identified as important Koala habitat. Of relevance to habitat disturbance are associated actions around the use of exclusion fencing which will assist in controlling access to Koala habitat. These measures will help minimise inappropriate habitat disturbance to the TEC within both Wilton and GMAC
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the 675 ha for the TEC)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas. This commitment is consistent with a number of actions in the Conservation Advice around educating the community about the TEC

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- The measures in the Plan for Koalas in terms of protecting and managing habitat, and constraining access to bushland will help protect the TEC
- A program of education for the community will be run to help them understand the biodiversity values they live near

CHANGES TO HYDROLOGY

The creation of hard surfaces associated with urban capable land and transport corridors results in changes to the hydrology of surrounding areas. The main threat to the TEC associated with altered hydrology is increased runoff into patches of the TEC carrying high nutrient and sediment loads, as well as weed seeds or propagules. This can both encourage weed invasion and cause erosion (DoE, 2014a).

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban or transport development occurs adjacent (and upstream or upslope) to the TEC. Key risk areas are:

- In the north and north-west of Wilton
- In the southern part of GMAC

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for transport projects based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines. These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

The commitments and actions under the Plan are consistent with the following high priority action in the Conservation Advice (DoE, 2014a): "Manage any changes to hydrology or disruptions to water flows that may result in changes to water table levels and/or increased run-off, salinity, sedimentation or pollution".

DISEASES, PATHOGENS, AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens, and dieback which can substantially affect their long-term viability. Recognised threats include myrtle rust and dieback caused by the root-rot fungus *Phytophthora cinnamomi*.

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with diseases, pathogens, and dieback. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

The commitments and actions under the Plan are consistent with a number of high priority actions in the Conservation Advice (DoE, 2014a). For example:

- To "manage any other known, potential or emerging threats such as rural tree dieback"
- To "use appropriate hygiene to minimise the introduction or spread of plant diseases and weeds at susceptible sites"

INVASIVE FAUNA

The Conservation Advice (DoE, 2014a) identifies introduced animals and aggressive native species as a threat to the TEC. These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as foxes, rats, house mice, and rabbits, which are primarily related to agricultural development
- Aggressive bird species which compete for resources including the introduced Indian myna, and native species such as the sulphur-crested cockatoo

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers. The main areas of concern relate to new urban development in Wilton and the southern section of GMAC, where the current density of houses is low.

Agricultural development within Wilton and GMAC is not part of the Plan. As a result, a substantial increase in pest species (other than feral cats or wild dogs) is not expected to occur as a result of implementation of the Plan.

In relation to aggressive bird species, the two main drivers for increasing the threat within the TEC are:

- Fragmentation of habitat which creates greater edge effects and facilitates access by aggressive bird species. As outlined above in the analysis of direct impacts, the Plan is considered unlikely to lead to any notable fragmentation to the TEC and as such is not considered an issue
- Habitat disturbance through inappropriate land management which can change the structure of the TEC and facilitate access by aggressive bird species. As outlined above in relation to inappropriate habitat disturbance, the Plan includes a package of measures which are expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of general measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the Strategic Conservation Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

The package of measures in the Plan is expected to adequately manage the risk to the TEC from invasive fauna because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls following development

The commitments and actions under the Plan are consistent with the following high priority action in the Conservation Advice (DoE, 2014a): "Control introduced pest animals, including domestic pets, to allow natural regeneration and to manage threats, especially to threatened species".

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

In addition to predicted impacts due to urban development analysed above, there is the potential for impacts to the TEC to occur due to development of essential infrastructure within nominated areas but outside the urban capable land.

The TEC does not occur within the vicinity of the tunnel footprints for transport and is therefore not at risk of additional impacts from tunnels.

31.6.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The TEC occurs on avoided land within Wilton (825.7 ha) and GMAC (1,190.9 ha), but not WSA or GPEC. It is possible that some of the areas on avoided land within Wilton and GMAC will be impacted by essential infrastructure. Impacts to the TEC are probable as the majority of the TEC occurs within lands avoided for biodiversity purposes between urban capable land and on the edge of GMAC bordering with Wilton.

The Plan includes a number of general measures to protect TECs from impacts associated with essential infrastructure, which are described below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including limiting cumulative direct impacts for certain TECs

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect the TEC from impacts from essential infrastructure. These include:

- Commitment 2.1, which states to "limit the total cumulative direct impacts within avoided lands to Shale Sandstone Transition Forest over the life of the Plan to no more than 23.8 ha in GMAC and 16.5 ha in Wilton".
- A measure in the *Cumberland Plain Conservation Plan Guideline for Infrastructure*, which requires that avoidance of impacts to the TEC be prioritised

The maximum additional impact to the TEC from essential infrastructure will be 40.3 ha. It is likely that the actual impacts will be less due to the proposed avoidance processes. In addition, any impacts that do occur will be adequately mitigated and offset through the application of the BAM. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.6.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2014a) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the TEC in relation to implementation of the Plan. They are:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Inappropriate fire regimes
  - Weed invasion
  - Inappropriate habitat disturbance
  - Changes to hydrology
  - Diseases, pathogens, and dieback
  - Invasive fauna

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan may lead to the loss of 180.7 ha of the TEC within the urban capable land within the nominated areas, and potentially an additional 34.9 ha within avoided lands due to essential infrastructure. However, it is not considered likely that this will threaten the long-term viability of the TEC because:

- The majority of the remaining areas of the TEC in the nominated areas have been avoided and are not impacted by the Plan, including:
  - 1,769.1 ha avoided for biodiversity purposes
  - 247.6 ha avoided for other purposes
- The majority of impacts are to lower viability areas of the TEC. Impacts to higher viability areas of the TEC include:
  - 0.5 per cent of higher viability TEC across the Strategic Assessment Area
  - 1.9 per cent of higher viability TEC within the nominated areas
- The impacts are unlikely to increase the level of fragmentation
- The offsets proposed by the Plan (675 ha of the TEC), including significant areas to be protected in proposed reserves, will provide a substantial addition to the level of protection of the TEC and will support a key high priority action in the Conservation Advice to increase the area of larger, high-quality patches of TEC that is secured and managed for conservation

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, weed invasion, inappropriate habitat disturbance, changes to hydrology, diseases, pathogens and dieback, and invasive fauna have been analysed and determined to be adequately managed and mitigated through a number of commitments and actions in the Plan.

Indirect impacts are not expected to influence the long-term viability of the TEC.

CONCLUSION

Development under the Plan will lead to some impacts to the TEC, however, implementation of the Plan is not expected to negatively influence the long-term viability of the TEC for the following key reasons:

- The Plan will lead to the protection of 675 ha of the TEC within the SCA and proposed reserves, and as part of the restoration program, which will contribute substantially to the level of existing protection

- The TEC will benefit significantly from the protection of Koala habitat which is a key focus of the Plan
- Potential impacts to the TEC from essential infrastructure will be limited through Commitment 2.1
- Potential indirect impacts are addressed through general management measures in the Plan

31.6.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.6.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 31-2 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan is not inconsistent with any of the relevant TAPs. Please refer to Section 15.9 of Chapter 15 for a detailed discussion of each TAP and the relationship of the Plan.

Table 31-2: Key Threatening Processes and relevant Threat Abatement Plans for Shale Sandstone Transition Forest of the Sydney Basin Bioregion

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	There is no relevant TAP
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi)*	There is no relevant TAP
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 31-3: Occurrence of Shale Sandstone Transition Forest of the Sydney Basin Bioregion in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**8,301.5**	**739.0**
Intact	6,604.1	684.2
Thinned	1,637.0	54.7
Scattered Trees	60.4	0.0
Higher Viability TEC	5,877.2	625.1

Table 31-4: Avoidance of impacts to Shale Sandstone Transition Forest of the Sydney Basin Bioregion within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL TEC IN NOMINATED AREA (ha)	**1,068.2**	**1,766.7**	**0.0**	**1.7**	**2,836.6**
Intact	537.7	1,294.2	0.0	0.0	1,832.0
Higher Viability TEC	522.0	1,121.3	0.0	0.0	1,643.3
TEC WITHIN EXCLUDED LANDS (ha)	168.2	469.3	0.0	1.7	639.2
TEC WITHOUT EXCLUDED LANDS (ha)	**900.0**	**1,297.4**	**0.0**	**0.0**	**2,197.4**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	756.6	1,012.5	0.0	0.0	1,769.1
Intact	402.5	824.4	0.0	0.0	1,226.9
Higher Viability TEC	392.8	738.2	0.0	0.0	1,131.0
AVOIDANCE FOR BIODIVERSITY PURPOSE (% TEC WITHOUT EXCLUDED LANDS)	**84.1**	**78.0**	**N/A**	**N/A**	**80.5**
AVOIDANCE FOR OTHER REASONS (ha)	69.1	178.5	0.0	0.0	247.6
Intact	54.6	160.9	0.0	0.0	215.5
Higher Viability TEC	54.2	145.4	0.0	0.0	199.6
AVOIDANCE FOR OTHER REASONS (% TEC WITHOUT EXCLUDED LANDS)	**7.7**	**13.8**	**N/A**	**N/A**	**11.3**
TOTAL AVOIDANCE (ha)	825.7	1,190.9	0.0	0.0	2,016.7
Intact	457.1	985.3	0.0	0.0	1,442.4
Higher Viability TEC	447.0	883.6	0.0	0.0	1,330.6
TOTAL AVOIDANCE (% TEC WITHOUT EXCLUDED LANDS)	**91.7**	**91.8**	**N/A**	**N/A**	**91.8**

Table 31-5: Direct impacts to Shale Sandstone Transition Forest of the Sydney Basin Bioregion

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO TEC (ha)	**74.3**	**106.4**	**0.0**	**0.0**	**0.0**	**180.7**
Intact	10.5	32.1	0.0	0.0	0.0	**42.6**
Thinned	59.7	64.9	0.0	0.0	0.0	**124.5**
Scattered Trees	4.1	9.5	0.0	0.0	0.0	**13.6**
Higher Viability TEC	9.2	22.3	0.0	0.0	0.0	**31.5**

31.7 CUMBERLAND PLAIN SHALE WOODLANDS AND SHALE-GRAVEL TRANSITION FOREST

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	The TEC is a temperate eucalypt woodland which is endemic to the shale hills and plains of the Sydney Basin bioregion and is mostly found within the Cumberland subregion. The TEC ranges from grassy woodland to forest, with the understorey ranging from mostly grassy to mostly shrubby. Occasional stands of this TEC are dense, particularly in shale-gravel transition areas. The TEC may have an upper tree layer, lower tree layer, shrub layer and a ground layer, although one or more layers may be sparse or absent. It must have an upper tree layer present, in addition to either a ground or shrub layer, to meet the EPBC definition of the TEC. The upper tree canopy is often dominated by *Eucalyptus moluccana, E. tereticornis, E. fibrosa, E. crebra* or other canopy species that may be locally dominant in some areas. The lower tree layer may include *Acacia* species, *Melaleuca* species, *Exocarpos,* and young eucalypts. Shrub layers may be present and are often dominated by *Bursaria spinosa,* with a number of other species present. Ground layers comprise perennial native grasses, graminoids and non-woody plants. A range of fauna species occur in the TEC, including reptiles, amphibians, birds, micro-bats, and marsupials. Most of these fauna species are not restricted to the TEC and occur in, and are likely to rely on, other native vegetation in the Cumberland subregion. The TEC correlates to two NSW BC Act listed TECs (Cumberland Plain Woodland, and Shale Gravel Transition Forest) where key diagnostic and condition thresholds are met. (DEWHA, 2009a)
EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as projected foliage cover percentage, patch size, understorey native vegetation cover, number of tree hollows, or whether the patch is contiguous with other native vegetation patches. Details of the thresholds are provided in the listing advice (TSSC, 2009).

DISTRIBUTION	The TEC is confined to the Sydney Basin bioregion and mostly restricted to the Cumberland subregion. The TEC is scattered across the subregion. The TEC primarily occurs in a coastal valley rain shadow, with mean annual rainfall of 700 to 900 mm (TSSC, 2009) and may occur in some elevated areas with higher (orogenic) rainfall. It occurs on flat to undulating or hilly terrain, up to 350 m or slightly higher, and is mostly found on clay soils derived from the Wianamatta Group geological unit (DEWHA, 2009a).
SOS SITES	The two NSW BC Act-listed TECs that correlate to the TEC have been categorised under the 'widespread' management stream under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. There are six management sites for Cumberland Plain Woodland: • Active: Scheyville National Park, Wianamatta National Park, Prospect Nature Reserve • Proposed contributing sites: Mulgoa Nature Reserve, Leacock Regional Park, Edmondson Regional Park Currently no management sites have been identified for Shale Gravel Transition Forest.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (DEWHA, 2009a) Listing Advice for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (TSSC, 2009) Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest Policy Statement 3.31 (DEWHA, 2010) There is no adopted or made Commonwealth Recovery Plan for the TEC. The TEC is included in the Cumberland Plain Recovery Plan (NSW) (DECCW, 2011) Key Threatening Processes and Threat Abatement Plans relevant to the TEC are identified in Table 31-6
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=112

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area.

	It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCTs are associated with the TEC: • 724 Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion • 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion • 850 Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based on applying the condition thresholds at a landscape scale to the available data: • Patch size ≥ 0.5 ha, AND • > 10% canopy cover • > 50% perennial understorey vegetation made up of natives (based on field verification), AND • Generally below 350 m elevation, AND • Growing on clay soils derived from Wianamatta OR • Patch size ≥ 5 ha, AND • > 10% canopy cover • > 30% perennial understorey made up of natives (based on field verification), AND • Generally below 350 m elevation, AND • Growing on clay soils derived from Wianamatta OR • Patch size ≥ 0.5 ha, AND • > 30% perennial understorey vegetation made up of natives, AND • The patch is contiguous with a native vegetation remnant ≥ 0.5 ha, AND • Generally below 350 m elevation, AND

	• Growing on clay soils derived from Wianamatta OR • Patch size ≥ 0.5 ha, AND • > 30% perennial understorey vegetation made up of natives, AND • The patch has at least one tree with hollows per ha or at least one large tree (≥80 cm) per ha (based on field verification), AND • Generally below 350 m elevation, AND • Growing on clay soils derived from Wianamatta
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.
VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-5 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment has mapped approximately 9,954.3 ha of the TEC within the Strategic Assessment Area (see Table 31-7 for further details). Of this, approximately 4,315.5 ha has been identified as higher viability through the viability analysis. The TEC occurs in the following main locations in the Strategic Assessment Area: • Scheyville National Park (474 ha) • Orchard Hills (426.6 ha) • Holsworthy (patch size 238 ha) • Wianamatta Regional Park (185 ha) • Cobbitty (145 ha) • Agnes Banks (138 ha) • Bringelly (137 ha) It occurs in the following nominated areas: • Wilton – 12.6 ha including 1.2 ha that is higher viability • GMAC – 131.2 ha including 8.1 ha that is higher viability • WSA – 109.6 ha none of which is higher viability

	• GPEC – 1,040.2 ha including 314 ha that is higher viability 44.5 ha also occurs in transport corridors outside the nominated areas. Of this, 6.6 ha is higher viability. The Listing Advice (TSSC, 2009) does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. It states that all patches meeting the minimum condition thresholds as defined in the advice are considered habitat critical to the survival of the TEC. These are generally: • Patches ≥ 0.5 ha with a predominately native understory • Patches that are well-connected to other large (≥ 5 ha) native vegetation remnants in the landscape • Patches that have large mature trees (≥ 80 cm dbh) or trees with hollows The Listing Advice also identifies several factors affecting the value of a patch, including: • A larger size and/or a high area to boundary ratio • Part of a larger remnant of native vegetation or linking other remnants • Evidence of recruitment of key plant species/range of age cohorts • Low level of weeds and pest animals • High native species richness, particularly in the ground layer • Presence of threatened species The TEC is highly fragmented across the Strategic Assessment Area, comprising 1,752 patches with an average patch size of 5.6 ha. A total of eight patches are greater than 100 ha, and 27 patches are greater than 50 ha in size. A number of patches are connected to areas of other vegetation types, which improves vegetation connectivity and provides some buffer from potential impacts associated with edge effects that would otherwise be expected with such a scattered distribution.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

31.7.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 247.2 ha of the TEC within the nominated areas (not including excluded lands). Approximately 111.5 ha (45.1 per cent) has been avoided as part of the design of the urban capable land and transport corridors (not including excluded lands). Of this:

- 85.9 ha was avoided for biodiversity purposes
- 25.6 ha was avoided for other purposes

An additional 1,046.5 ha occurs on excluded lands.

A breakdown of avoidance across each nominated area is provided in Table 31-8.

It is important to note that the avoidance calculations in Table 31-8, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 31-8 shows the amounts of habitat within excluded lands for context only.

31.7.2 TRANSPORT

Avoidance results are only reported for urban capable land within the nominated areas, as detailed design of the footprint within the transport corridors has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8, and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will lead to direct impacts to the TEC (see Section 31.7.3 for discussion) but will not generally increase fragmentation (see Section 31.7.4 for discussion).

31.7.3 DIRECT IMPACTS TO THE TEC

Implementation of the Plan will lead to a loss of a total of 180.3 ha of the TEC within the nominated areas and transport corridors. This loss represents approximately 1.8 per cent of the remaining TEC in the Strategic Assessment Area and 10.5 per cent of the TEC in the nominated areas. A breakdown of direct impacts is provided in Table 31-9.

The majority of the TEC impacted:

- Is in thinned condition (151.6 ha or 84.1 per cent), with only 13.5 per cent of direct impacts occurring to patches in intact condition
- Comprises small patches (0.5-5 ha)
- Is not mapped as higher viability, with only 12.9 ha of higher viability TEC being impacted

The most notable direct impacts to the TEC occur in the following locations:

- Within GPEC, which will result in the loss of several small (0.5-5 ha) generally isolated patches of the TEC and reduce the size of a few larger patches. Less than 0.1 ha of these impacted areas is mapped as higher viability
- The loss of an area of partially connected patches associated with a riparian corridor in the southern portion of WSA near Luddenham and Bringelly. Less than 0.1 ha of these impacted areas is mapped as higher viability
- At Cobbitty due to the OSO and Shanes Park due to the M7 link

The threat to the TEC in these locations is reduced because:

- The Plan mainly impacts patches of the TEC that are generally isolated and exposed to edge effects
- The amount of impact in the context of the amount remaining in the Strategic Assessment Area is relatively minor
- Impacts account for 0.3 per cent of mapped higher viability TEC across the Strategic Assessment Area

31.7.4 FRAGMENTATION OF THE TEC

As outlined above, impacts largely occur to small, isolated patches or to the edge of patches and are not expected to further fragment the TEC.

31.7.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the TEC, the Plan includes a commitment (Commitment 8.1) to secure 665 ha of the TEC as part of the conservation program. Following public exhibition of the Plan, new areas of the TEC have been added to the Strategic Conservation Area (SCA) and will be available to be selected as potential offsets during the life of the Plan. In particular, the Blaxlands Creek/Kings Hill corridor which includes approximately 30 ha of the TEC, of which around 66 per cent is intact condition.

This would:

- Lead to the protection and management of an additional 6.7 per cent of the ecological community within the Strategic Assessment Area
- Increase the level of protection and management of the ecological community by approximately 31.8 per cent on top of what is currently secured in the Strategic Assessment Area

A significant proportion of the offsets will come from within the three proposed reserves in the form of direct offsets and ecological restoration. They are:

- The Georges River Koala Reserve which is on the eastern side of the Strategic Assessment Area near GMAC. The area contains approximately 19 ha of the TEC and restoration potential
- The Gulguer Reserve investigation area which occurs on the western side of the Strategic Assessment Area. The Plan proposes to implement the reserve over the first 20 years of the Plan. The area contains approximately 180 ha of the NSW-listed Cumberland Plain Woodland TEC and includes up to 490 ha of cleared land for potential restoration to promote the return of several ecological communities and create habitat for species
- The Confluence Reserve investigation area which occurs in the north of the Strategic Assessment Area and to the east of Londonderry. The Plan proposed to implement the reserve over the first 15 years of the Plan. The area contains patches of the TEC and includes up to 365 ha of cleared land for potential reconstruction

Under Commitment 13, ecological restoration will be undertaken to account for up to a maximum of 25% of the Plan's offset target for native vegetation. This includes a number of actions, with the most relevant to the outcome of the TEC being:

- Develop a Restoration Implementation Strategy, and enter into written agreements with delivery partners and engage specialist providers where necessary to implement the strategy
- Undertake ecological restoration to restore koala habitat, which will primarily include areas of the TEC
- Undertake up to a maximum of 1,331.3 ha of ecological restoration targeting the TEC and several others

These offsets also help address an identified threat in the Conservation Advice around the low level of protection of the TEC in reserves.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile or conservation advice, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.7.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DEWHA, 2009a) identifies a range of threats to the TEC. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes

- Weed invasion
- Inappropriate habitat disturbance

In addition to the threats identified in the Conservation Advice, the following potential indirect impacts are considered relevant to the TEC:

- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna

Climate change is also a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

Impacts from inappropriate grazing regimes was also identified in the Conservation Advice as a key threat. However, this is not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate this risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for this TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes can affect the structure and species composition of the TEC. This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Altered fire regimes can affect the structure and species composition of the TEC, particularly the understorey layers. Fire intervals of 4 to 12 years are likely to maintain most understorey species within the TEC. Fire intervals which are too short are associated with reduced native plant diversity (NSW Scientific Committee, 2009).

An absence of fire for extended periods of time can also result in proliferation of Blackthorn (*Bursaria spinosa*). Dense occurrences occur when fire has been absent from the TEC for a number of decades. Blackthorn has been recorded in densities of up to 1,000 plants per ha in unburnt patches of this TEC, leading to the decline of ground layer species. High densities of Blackthorn currently occur in many TEC remnants (TSSC, 2009).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban capable land. Bushfire management by authorities is also likely in areas close to new urban capable land. For the TEC this includes areas in and around GPEC, WSA, and GMAC, and to a lesser degree in Wilton where the TEC is much less extensive.

The key factors that influence the appropriateness of a fire regime are fire frequency, intensity, and season of occurrence (DECCW, 2011).

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the Strategic Assessment Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy

  - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable land which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

WEED INVASION

The TEC is threatened with invasion of weeds. Weeds can displace native plants and reduce the diversity and regenerative capacity of the TEC. The most serious threats to the TEC include African Olive (O*lea europa* subsp. *cuspidata*), Bridal Creeper (*Asparagus asparagoides*), and a range of exotic grasses (DEWHA, 2009a).

These weeds are already present within the Strategic Assessment Area and pose a threat to the TEC. However, urban development and transport have the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban capable land occurs adjacent to the TEC and introduces edge effects. Key risk areas include in and around GPEC, WSA, and GMAC, and to a lesser degree in Wilton where the TEC is much less extensive.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
  - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
  - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
  - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
  - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
  - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies

  - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Importantly for the TEC, weeds will be actively managed within the 665 ha to be added to conservation as part of the offset program.

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

These controls are consistent with a number of threat abatement actions in the Conservation Advice about the management of invasive weeds.

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Conservation Advice as a threat to the TEC. This relates to a wide range of different mechanisms for disturbance including:

- Inappropriate mowing, slashing, or scrubbing of the understorey for reasons such as bushfire fuel reduction, grazing and perceived aesthetics
- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants
- Inappropriate recreational activities such as ad hoc track building and trail bike use which can directly impact areas of the TEC and facilitate processes such as erosion
- Removal of wood which changes the structure and habitat features of the TEC
- Inadvertent disturbance during construction which has the potential to directly impact the TEC outside approved development areas

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the Strategic Assessment Area may increase due to development within the nominated areas. Occurrences of the TEC considered most at risk are those in and around GPEC, WSA and GMAC, and to a lesser degree in Wilton where the TEC is much less extensive.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the 665 ha for the TEC)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing

- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

CHANGES TO HYDROLOGY

The creation of hard surfaces associated with urban capable land and transport corridors results in changes to the hydrology of surrounding areas. The main threat to the TEC associated with altered hydrology is increased runoff into patches of the TEC carrying high nutrient and sediment loads, as well as weed seeds or propagules. This can both encourage weed invasion and cause erosion.

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban or transport development occurs adjacent (and upstream or upslope) to the TEC. Key risk areas include in and around GPEC, WSA, and GMAC, and to a lesser degree in Wilton where the TEC is much less extensive.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures for major transport corridors based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines. These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

DISEASES, PATHOGENS, AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens, and dieback which can substantially affect their long-term viability. Recognised threats include myrtle rust and dieback caused by the root-rot fungus *Phytophthora cinnamomi*.

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with diseases, pathogens, and dieback. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

INVASIVE FAUNA

TECs can be threatened by introduced animals and aggressive native species. These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as foxes, rats, house mice, and rabbits, which are primarily related to agricultural development
- Aggressive bird species which compete for resources including the introduced Indian myna, and native species such as the sulphur-crested cockatoo

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers.

In relation to aggressive bird species, the two main drivers for increasing the threat within the TEC are:

- Fragmentation of habitat which creates greater edge effects and facilitates access by aggressive bird species. As outlined above in the analysis of direct impacts, the Plan is considered unlikely to lead to any notable fragmentation to the TEC and as such is not considered an issue
- Habitat disturbance through inappropriate land management which can change the structure of the TEC and facilitate access by aggressive bird species. As outlined above in relation to inappropriate habitat disturbance, the Plan includes a package of measures which are expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of general measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the Strategic Conservation Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
  - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
  - Preparation of a Pest Animal Control Implementation Strategy
  - A process to enter into written agreements with delivery partners to implement the pest animal control program
  - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
  - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
  - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
  - Require appropriate management and control of pest animals relevant to development sites

The package of measures in the Plan is expected to adequately manage the risk to the TEC from invasive fauna because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls following development

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

In addition to predicted impacts within the urban capable land and transport corridors, there is the potential for impacts to the TEC to occur due to:

- Development of essential infrastructure within nominated areas but outside the urban capable land (see Section 31.6.7 for discussion)
- Development of tunnels within the transport corridors (see Section 31.6.8 for discussion)

31.7.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The TEC occurs on avoided land within GMAC (36 ha), GPEC (47.8 ha), and WSA (27.7 ha). It is possible that some of these areas will be impacted by essential infrastructure as the majority of the avoided TEC occurs on lands avoided for biodiversity purposes (85.9 ha). Impacts are more likely where the TEC occurs on avoided lands between areas of urban capable land.

The Plan includes a number of general measures to protect TECs from impacts associated with essential infrastructure, which are described below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:

- It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
- It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including limiting cumulative direct impacts for certain TECs

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect the TEC from impacts from essential infrastructure. These include:

- Commitment 2.1, which states to "limit the total cumulative direct impacts within avoided lands to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest over the life of the Plan to no more than 0.7 ha in GMAC, 1.0 ha in GPEC, and 0.6 ha in WSA"
- A measure in the *Cumberland Plain Conservation Plan Guideline for Infrastructure*, which requires that avoidance of impacts to the TEC be prioritised

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

31.7.8 POTENTIAL IMPACTS FROM TUNNELS

The TEC occurs within the tunnel footprints for the Metro Rail Future Extension (39.5 ha) and the Outer Sydney Orbital (58.6 ha). Most patches are relatively small, generally isolated and in low condition (thinned or scattered trees). Several large (>20 ha) and intact condition patches of the TEC occur within and in the vicinity of the tunnel footprints in the Mater Dei BioBank site and Metro Offset site.

The Plan includes some general measures to protect TECs from impacts associated with the development of tunnels, which are described below.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels

- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

In particular, Commitment 4.2 requires TfNSW to specifically avoid and minimise direct impacts to the TEC within the Mater Dei BioBank site and Metro Offset site.

These commitments are expected to adequately address threats to the TEC from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above. It also discusses the results of the trend analysis that was undertaken to understand how one of the PCTs that comprise the TEC (PCT 849) is likely to fare over the life of the Plan.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.7.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DEWHA, 2009a) and other relevant TEC documents identify the following key issues that are likely to have the greatest influence on the long-term viability of the TEC in relation to implementation of the Plan. They are:

- Habitat loss and fragmentation
- Indirect impacts including:
    - Inappropriate fire regimes
    - Weed invasion
    - Inappropriate habitat disturbance
    - Changes to hydrology
    - Diseases, pathogens, and dieback
    - Invasive fauna

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan may lead to the loss of 180.3 ha of the TEC. However, it is not considered likely that this will threaten the long-term viability of the TEC because:

- The scale of impacts is relatively minor when considering the mapped extent of the TEC across the Strategic Assessment Area (approximately 1.8 per cent)
- The majority of impacts are to lower viability areas of the TEC:
    - Approximately 0.3 per cent of higher viability TEC in the Strategic Assessment Area
    - Approximately 4 per cent of higher viability TEC in the nominated areas
- The impacts are unlikely to increase the level of fragmentation
- The offsets proposed by the Plan (665 ha of the TEC), including significant areas to be protected in proposed reserves, will provide a substantial addition to the level of protection of the TEC and address a key threat identified in the Conservation Advice around its current low level of protection
- The SCA includes 4,132.3 ha of potential restoration areas for the TEC. While it is unknown how much restoration will be undertaken, it will provide an important benefit by:
    - Adding to the known extent of TEC by rehabilitating degraded areas of vegetation that do not currently meet the EPBC listing criteria

- Improving the resilience of patches of the TEC where restoration occurs in strategic locations (e.g. by increasing the size of an existing patch, or connecting existing patches)

Trend analysis

This conclusion is supported by the trend analysis that was undertaken by RMIT University (A Gordon & Peterson, 2019) that examined the predicted extent and condition of PCT 849 over the life of the Plan under various scenarios. PCT 849 is one of several PCTs that make up the EPBC listed TEC and the results of the analysis provide valuable information about the long-term viability of the TEC as a whole.

The trend analysis examined the potential impacts of development and offsetting under various scenarios on PCT 849 in the Cumberland subregion over the life of the Plan. This is an important analysis because the typical impact assessment approach considers impacts and offsets largely in a static sense (i.e. they are unable to consider quantitative trends over time in biodiversity values because of the complexity involved). The trend analysis provided the opportunity to model how a key part of the TEC would fare over time and included consideration of the baseline pressures on vegetation. It was informed by expert elicitation with a range of well-regarded experts in the vegetation of the Cumberland subregion and is a robust analysis.

The scenarios analysed through the project are largely consistent with commitments in the Plan. Key findings were:

- Existing landscape scale threats across the Cumberland subregion (e.g. weeds) are significant and will result in an approximate 5.8 per cent decline in the extent and condition of the PCT over the life of the Plan unless additional areas are managed. These threats will operate with or without the Plan
- The proposed impacts of development under the Plan that were modelled in the analysis (noting that further avoidance has occurred since that time) will lead to approximately the same magnitude of losses (~5.8 per cent) to the PCT that will occur due to existing landscape threats
- High intensity management (which includes restoration) and early offsetting will provide the greatest benefits to the outcomes of the PCT over the life of the Plan. This type of management occurs in reserves and biodiversity stewardship sites
- Securing approximately 1,605 ha of offsets for PCT 849 (it is important to note that the actual target in the Plan is 2,150 ha which is substantially greater than the amount modelled in the trend analysis) will compensate for the impacts of development where earlier offsetting and higher intensity management is preferred by improving the extent and condition of the PCT over the life of the Plan. This was measured by considering the extent and condition of the PCT over time. This approach also has the potential to contribute significantly to addressing the predicted declines across the subregion due to existing landscape scale threats

This last point is a critical one. Not only will the offsets in the Plan compensate for the impacts, but they have the potential to address the predicted declines in the PCT that are occurring across the Strategic Assessment Area due to current threats.

Supporting Document D provides further details regarding the methodology and results of the trend analysis.

Strategic priority

The Conservation Advice sets out a strategic priority for the TEC which is to take "an appropriate broad scale landscape approach" to ensure the TEC is "given adequate consideration in decision making". This is one of the key premises behind the Plan which is taking a landscape scale approach to both development planning and conservation.

Two key points raised in the Conservation Advice about the strategic priority are:

- "The program should therefore identify those remnants that are most important for long-term conservation and recovery of the community. Consideration should be given to position inside and out of planned urban growth areas, proximity of smaller remnants to larger native vegetation remnants, conserving habitat values (e.g. large trees with hollows) and functionality as corridors or 'stepping stones' for fauna and flora"
- "Whilst the connectivity of remnants that meet the Description and Condition Thresholds in the listing advice for the national ecological community is a high priority, reconnection to lower-quality remnants, other ecological communities or native plantings should also be considered in order to optimise biodiversity outcomes across the landscape"

Both the avoidance processes used to define the urban capable land (see Chapter 14) and the conservation program have specifically addressed these points. Key areas of the TEC have been avoided in the design of the urban capable land, and the conservation program is applying a process to identify:

- Remnants that are the most important for long-term conservation
- Corridors and connectivity for biodiversity
- Areas that are suitable for restoration including lower-quality remnants of the TEC and derived grasslands

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, weed invasion, inappropriate habitat disturbance, changes to hydrology, diseases, pathogens and dieback, and invasive fauna have been analysed and determined to be adequately managed and mitigated through a number of commitments and actions in the Plan.

Indirect impacts are not expected to influence the long-term viability of the TEC.

CONCLUSION

Development under the Plan will lead to some impacts to the TEC, however, implementation of the Plan is not expected to negatively influence the long-term viability of the TEC for the following key reasons:

- The Plan will lead to the protection of 665 ha of the TEC within the SCA and proposed reserves, and as part of the restoration program, which will contribute substantially to the level of existing protection
- Potential impacts to the TEC from essential infrastructure will be limited through Commitment 2.1
- Potential impacts to the TEC within the Mater Dei BioBank and Metro offset sites within the tunnel footprints will be avoided and minimised through Commitment 4.2
- Potential indirect impacts are addressed through general management measures in the Plan

31.7.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.7.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 31-6 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan is not inconsistent with any of the relevant TAPs. Please refer to Section 15.9 of Chapter 15 for a detailed discussion of each TAP and the relationship of the Plan.

Table 31-6: Key Threatening Processes and relevant Threat Abatement Plans for Cumberland Plain Shale Woodlands and Shale-gravel Transition Forest

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 31-7: Occurrence of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**9,954.3**	**2,097.6**
Intact	6,530.8	1,560.7
Thinned	3,403.6	536.5
Scattered Trees	19.9	0.4
Higher Viability TEC	4,315.5	1,229.0

Table 31-8: Avoidance of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL TEC IN NOMINATED AREA (ha)	**12.6**	**131.2**	**109.6**	**1,040.2**	**1,293.7**
Intact	1.2	49.0	1.1	370.9	422.3
Higher Viability TEC	1.2	8.1	0.0	314.0	323.3
TEC WITHIN EXCLUDED LANDS (ha)	3.0	74.1	9.2	960.2	1,046.5
TEC WITHOUT EXCLUDED LANDS (ha)	**9.6**	**57.1**	**100.5**	**80.0**	**247.2**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	31.7	11.6	42.6	85.9
Intact	0.0	12.8	0.0	7.1	19.9
Higher Viability TEC	0.0	0.2	0.0	0.0	0.2
AVOIDANCE FOR BIODIVERSITY PURPOSE (% TEC WITHOUT EXCLUDED LANDS)	**0.0**	**55.5**	**11.6**	**53.2**	**34.8**
AVOIDANCE FOR OTHER REASONS (ha)	0.0	4.3	16.0	5.2	25.6
Intact	0.0	2.4	0.0	0.0	2.4
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR OTHER REASONS (% TEC WITHOUT EXCLUDED LANDS)	**0.0**	**7.5**	**16.0**	**6.5**	**10.3**
TOTAL AVOIDANCE (ha)	0.0	36.0	27.7	47.8	111.5
Intact	0.0	15.1	0.0	7.1	22.3
Higher Viability TEC	0.0	0.2	0.0	0.0	0.2
TOTAL AVOIDANCE (% TEC WITHOUT EXCLUDED LANDS)	**0.0**	**63.0**	**27.6**	**59.7**	**45.1**

Table 31-9: Direct impacts to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO TEC (ha)	**9.6**	**21.1**	**72.8**	**32.2**	**44.5**	**180.3**
Intact	1.2	7.1	1.1	0.2	14.6	**24.3**
Thinned	5.6	13.2	70.9	32.0	29.9	**151.6**
Scattered Trees	2.8	0.8	0.7	<0.1	0.0	**4.3**
Higher Viability TEC	1.2	5.0	0.0	<0.1	6.6	**12.9**

31.8 RIVER-FLAT EUCALYPT FOREST ON COASTAL FLOODPLAINS OF SOUTHERN NEW SOUTH WALES AND EASTERN VICTORIA

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

NAME	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
EPBC ACT LISTING	Critically Endangered
DESCRIPTION	The TEC is a eucalypt forest that occurs on quaternary alluvial soils on coastal floodplains on the south-east coast of Australia in warm to hot and sub-tropical climate zones. The TEC generally ranges from tall open forest to woodland. Occasional localised stands of the TEC are closed forest and/or low forest. The TEC occurs in a lower and less dense structure on the open floodplains and taller, denser forest on the upper floodplains that include stream flats in the surrounding hills of the floodplain. The TEC may have a canopy layer, mid-layer, climbing species and scramblers and understorey. While there is regional variation and intergradation of key species, the structure and function of the TEC stays largely similar throughout its extent. The canopy layer varies but is generally dominated by *Eucalyptus* and *Angophora* as a single species or a mix of several species. The mid-layer is characterised over its entire range by a number of paperbarks including *Melaleuca linariifolia* (Flax-leaved Paperbark) and *M. styphelioides* (Prickly-leaved Paperbark) and other species including *Acacia floribunda* (White Sally), *Breynia oblongifolia* (Breynia, Coffee Bush), *Bursaria spinosa* (Sweet Bursaria Blackthorn, Kurwan-D'harawal), *Goodenia ovata* (Hop Goodenia), *Pittosporum revolutum* (Hairy Pittosporum) and *Plectranthus parviflorus* (Cockspur flower). Other paperbarks and species occur in the mid-layer on a local or regional basis. Scrambling species that occur in the ground layer are *Desmodium varians* (Slender Trefoil) and *Veronica plebeia* (Trailing Speedwell) while *Glycine clandestine* (Twining Glycine) and *Stephania japonica* var. *discolor* (Snake Vine) may be found in the sub-canopy and mid-layer. The understory layer is dominated by species that have adapted to a higher level of soil moisture and include perennial forbs, grasses, sedges, rushes, and ferns. The draft NSW PCTs that are likely to be associated with the TEC are listed in Table 10 of the Conservation Advice. A large range of fauna species may occur in the TEC, including mammals (arboreal, ground and burrowing), marsupials, birds, frogs, reptiles, and invertebrates. The TEC provides important habitat for fauna species in terms of food, nesting, roosting, or hunting. The fauna in turn also play an important role in the ecology of the TEC through pollination, seed dispersal and soil turnover.

	The TEC correlates closely with parts of the NSW BC Act-listed TEC *River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* and the southern parts of the TEC form parts of Victorian Ecological Vegetation Classes. (DAWE, 2020b)
EPBC DEFINITION	Only patches of the TEC that meet the minimum size and condition thresholds will be considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, understorey native vegetation cover, ground cover richness, number of large trees or tree hollows per hectare, evidence of particular mammal species, or whether the patch is contiguous with other native vegetation patches. Details of the proposed thresholds are provided in the Conservation Advice (DAWE, 2020b).
DISTRIBUTION	The TEC's extent of occurrence stretches from Sale in Victoria to just north of Newcastle in NSW. It extends through two IBRA Bioregions: South-East Corner and Sydney Basin. It generally occurs along water courses and drainage lines. The community is important in maintaining river ecosystems and riverbank stability. The TEC primarily occurs on elevations below 50 m but may occur on localised floodplain pockets up to and occasionally beyond 250 m. It occurs in riparian corridors, floodplains prone to inundation, older floodplain terraces, and floodplain depressions. The community forms mosaics with other floodplain forest communities and wetlands. (DAWE, 2020b)
SOS SITES	The NSW BC Act-listed River-Flat Eucalypt Forest on Coastal Floodplains has been categorised under the 'widespread' management stream for TECs under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. Six management sites have been identified for the TEC: • Active: Lower and Upper Deua River, Burra Creek Catchment, Upper Deua River • Proposed contributing sites: Berowra Valley National Park, Mulgoa Nature Reserve, Leacock Regional Park
RELEVANT PLANS AND POLICIES	Conservation Advice for the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (DAWE, 2020b) Key Threatening Processes relevant to the TEC are identified in Table 2 of the Conservation Advice There is no adopted or made Commonwealth Recovery Plan for the TEC. The NSW BC Act-listed TEC, River-flat Eucalypt Forest, is included in the Cumberland Plain Recovery Plan (NSW) (DECCW, 2011) Threat Abatement Plans relevant to the TEC are identified in Table 31-10
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=154

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area. It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCT is associated with the TEC: • 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based on applying the condition thresholds at a landscape scale to the available data: • Patch size ≥ 0.5 ha and not within a larger area of native vegetation' ≥ 5 ha AND • > 50 per cent perennial native understorey AND • > 6 native ground cover species present AND • > 10 large trees per hectare OR • Patch size is ≥ 0.5 ha is within a larger area of native vegetation ≥ 5 ha AND • > 30 per cent perennial native understorey AND • > 4 native ground cover species present OR • Patch size is > 2 ha AND • > 30 per cent perennial native understorey AND • > 4 native ground cover species present

PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.
VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio It should be noted that due to the general linear nature of the TEC, the viability assessment had less relevance for this TEC than for others in the Strategic Assessment Area that typically occur in more consolidated patches.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-2 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment mapped approximately 6,667 ha of the TEC within the Strategic Assessment Area (see Table 31-11 for further details). It mainly occurs as long and narrow patches of vegetation along riparian corridors throughout the Strategic Assessment Area, which may or may not be connected to broader areas of native vegetation. Where the TEC is not buffered by the wider presence of native vegetation it is likely to be exposed to significant edge effects, particularly where it occurs in urban areas. Within the nominated areas, it occurs mainly in GPEC and WSA, with smaller amounts in GMAC. There is no TEC mapped in Wilton. The Conservation Advice does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. Rather, it states that all patches that meet the minimum conditions of a reasonable size and in the highest condition categories as defined in the advice (categories A to C) are considered habitat critical to the survival of the TEC. These are generally: • Patch size ≥ 0.5 ha with > 30% native understorey • Well-connected patches ≥ 0.5 ha in area with ground cover richness of ≥ 4 native species per sample plot The Conservation Advice also identifies several factors affecting the value of a patch, including: • A larger size and/or a high area to boundary ratio • Part of a larger remnant of native vegetation or linking other remnants • Evidence of recruitment of key plant species/range of age cohorts • High native species richness • Presence of threatened species • Low level of weeds and feral animals

	• Heavily cleared or degraded patches, or patches at the edge of its range The TEC is highly fragmented across the Strategic Assessment Area, comprising 1,192 patches (greater than 0.5 ha) with an average patch size of 5.6 ha.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

31.8.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 259.3 ha of the TEC within the nominated areas (not including excluded lands). Approximately 145 ha (55.9 per cent) was avoided as part of the design of the urban capable land and transport corridors (not including excluded lands).

Of this:

- 54.7 ha was avoided for biodiversity purposes
- 90.3 ha was avoided for other purposes

An additional 725.4 ha occurs on excluded lands.

A breakdown of avoidance across each nominated area is provided in Table 31-12.

It is important to note that the avoidance calculations in Table 31-12, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 31-12 shows the amounts of habitat within excluded lands for context only.

31.8.2 TRANSPORT

Avoidance results are only reported for urban capable land within the nominated areas, as detailed design of the footprint within the transport corridors has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8, and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will lead to direct impacts to the TEC (see Section 31.8.3 for discussion) and increase fragmentation in a number of locations (see Section 31.8.4 for discussion).

31.8.3 DIRECT IMPACTS TO THE TEC

Implementation of the Plan will lead to a loss of a total of 159.2 ha of the TEC within the nominated areas and transport corridors (see Table 31-13 for detailed stats). This loss represents approximately 2.4 per cent of the remaining TEC in the Strategic Assessment Area and 16.2 per cent of the TEC in the nominated areas.

The majority of the TEC impacted:

- Is in thinned or scattered condition (129.2 ha or 81.1 per cent), with 18.9 per cent of direct impacts occurring to patches in intact condition
- Comprises small patches (0.5-5 ha) (103 of the 113 patches impacted, approximately 91.2 per cent)

The urban footprint within the nominated areas has generally avoided riparian corridors, and therefore avoids the majority of areas mapped as the TEC.

The most notable direct impacts to the TEC occur in the following locations:

- Within the Outer Sydney Orbital Transport Corridor within WSA and GPEC, which will impact sections of riparian corridors along Cosgroves Creek, Wianamatta (South Creek) and Ropes Creek. These areas of TEC are connected along the corridors, as well as to larger areas of the TEC within Wianamatta Regional Park
- Within the Outer Sydney Orbital Transport Corridor outside the nominated areas, which will impact several small (0.5-5 ha) and medium (5-20 ha) patches and reduce the size of a some larger patches

The risks to the TEC from direct impacts are mitigated to a degree because development will impact:

- Patches of the TEC that are generally isolated and exposed to edge effects
- Areas that are generally in lower condition (thinned or scattered)

31.8.4 FRAGMENTATION OF THE TEC

The Conservation Advice identifies fragmentation as a threat to the TEC (DAWE, 2020b). The most notable fragmentation impacts are associated with the direct impacts from the Outer Sydney Orbital in GPEC. In this area:

- The Outer Sydney Orbital will intersect the middle of several patches of the TEC in Wianamatta Regional Park that form part of a larger, well-connected patch of native vegetation to the west and Ropes Creek riparian corridor to the south
- The Outer Sydney Orbital will impact the connectivity of a large area of the riparian corridor around Wianamatta (South Creek), north and south of the Western Motorway near St Marys

Fragmentation of the TEC will increase its susceptibility to weed invasion and other edge effects and has the potential to reduce its long-term viability in these locations.

31.8.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the ecological community, the Plan includes a commitment to secure 570 ha of the TEC as part of the conservation program.

This would:

- Lead to the protection and management of an additional 8.5 per cent of the ecological community within the Strategic Assessment Area
- Increase the level of protection and management of the ecological community by approximately 85.5 per cent on top of what is currently secured in the Strategic Assessment Area

A significant proportion of the offsets will come from within the Confluence Reserve investigation area in the form of direct offsets and ecological restoration. The Confluence Reserve investigation area occurs in the north of the Strategic Assessment Area and to the east of Londonderry. The Plan proposes to implement the reserve over the first 15 years. The area contains approximately 41 ha of the TEC and includes up to 365 ha of cleared land for potential reconstruction

Under Commitment 13, ecological restoration will be undertaken to account for up to a maximum of 25% of the Plan's offset target for native vegetation. This includes a number of actions, with the most relevant to the outcome of the TEC being:

- Develop a Restoration Implementation Strategy, and enter into written agreements with delivery partners and engage specialist providers where necessary to implement the strategy
- Undertake up to a maximum of 1,331.3 ha of ecological restoration targeting the TEC and several others

These actions are consistent with an action in the Conservation Advice to "undertake restoration work".

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile or draft conservation advice, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.8.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice (DAWE, 2020b) identifies a range of threats to the TEC. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance (includes vegetation and firewood removal, and disturbance from urbanisation and recreational activity)
- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna
- Urban heat island effect

Climate change is also a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

Impacts from agricultural activities, including grazing and nutrient enrichment are also identified in the Conservation Advice as key threats. However, these are not considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate the risk across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for this TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

High frequency fires are identified as a key threat to the TEC, particularly where the TEC occurs in urban areas (OEH, 2004). High intensity or too frequent fires can prevent regeneration and lead to changes in vegetation structure which in turn can negatively impact upon fauna. Fauna are essential to the long-term health of the TEC as they provide important functions such as soil turnover and seed dispersal.

Inappropriate fire regimes can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban capable land. Bushfire management by authorities is also likely in areas close to new urban capable land. For the TEC this includes areas throughout GPEC and WSA, with small parts of GMAC.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the Strategic Assessment Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable land which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

These controls are consistent with an action in the Conservation Advice to ensure that fire management activities do not have detrimental impacts on the integrity of the TEC (DAWE, 2020b).

WEED INVASION

Invasion by non-native plants, especially exotic perennial grasses, is identified as a major threat to the TEC especially close to urban areas (DAWE, 2020b).

Weed incursion often occurs as a result of physical disturbance to the TEC, rubbish dumping, polluted agricultural and/or urban runoff, road/utility construction activities and grazing of livestock, but can also happen after natural disturbances such as flooding (DAWE, 2020b).

A large number of weeds are recognised as threats to the TEC, including several grasses, vines and small shrubs and trees, including Lantana (*Lantana camara*), Privets (*Ligustrum sp.*) and African Olive (*Olea europaea*) (DAWE, 2020b).

These weeds are already present within the Strategic Assessment Area and pose a threat to the TEC. However, urban and transport development within the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban development or transport corridors occur adjacent to the TEC and/or fragments patches of the TEC into smaller patches and introduces edge effects. Key risk areas include:

- Transport corridors within GPEC and WSA, which will result in direct impacts to the TEC and will increase fragmentation in some locations
- Urban development within GPEC and WSA, which will increase exposure of the TEC along riparian corridors to edge effects associated with urban land uses

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Importantly for the TEC, weeds will be actively managed within the 570 ha to be added to conservation as part of the offset program.

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from the increased risk of weeds associated with development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

These controls are consistent with an action in the Conservation Advice to minimise the risk of indirect impacts to the TEC (DAWE, 2020b).

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Conservation Advice as a threat to the TEC. This relates to a wide range of different mechanisms for disturbance including:

- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants

- Inappropriate recreational activities such as ad hoc track building and trail bike use which can directly impact areas of the TEC and facilitate processes such as erosion
- Removal of woody debris and firewood collection which changes the structure and habitat features of the TEC
- Inadvertent disturbance during construction which has the potential to directly impact the TEC outside approved development areas

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the Strategic Assessment Area may increase due to development within the nominated areas. Occurrences of the TEC considered most at risk are those within GPEC and WSA, and to a lesser extent in GMAC.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

These controls are consistent with an action in the Conservation Advice to "undertake effective community engagement and education to highlight the importance of minimising disturbance and of minimising pollution and littering" (DAWE, 2020b).

CHANGES TO HYDROLOGY

Altered hydrological regimes, including narrowing of riparian corridors, installation of flood mitigation and/or drainage infrastructure, and changes in water quality, have all been identified as threats to the TEC (DAWE, 2020b).

The TEC is most susceptible to the following threats:

- Increase of polluted runoff from development under the Plan where new urban development or transport corridors occur adjacent to the potential TEC. Key risk areas for this threat are located in GPEC and WSA
- Potential installation of flood mitigation and/or drainage infrastructure in localities adjacent to where the TEC will be cleared for development of transport corridors. Key risk areas for this threat include areas in proximity to the Outer Sydney Orbital in GPEC and WSA

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
  - Water cycle management. For example:
    - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
    - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
  - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
  - Soil erosion and sedimentation. For example:
    - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
    - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures to transport projects based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines. These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

These controls are consistent with an action in the Conservation Advice to avoid disruption to hydrological processes in areas surrounding, and upstream of, the TEC (DAWE, 2020b).

DISEASES, PATHOGENS, AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens, and dieback which can substantially affect their long-term viability. Recognised threats to the TEC include dieback resulting from Armillaria root rot caused by *Armillaria* spp. (honey fungus) and infection by myrtle rust (*Austropuccinia psidii*) (DAWE, 2020b)

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with diseases, pathogens, and dieback. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
  - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
  - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

INVASIVE FAUNA

The TEC can be threatened by introduced animals and aggressive native species (DAWE, 2020b). These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as foxes, rats, house mice, and rabbits, which are primarily related to agricultural development
- Aggressive bird species which compete for resources including the Noisy Miner

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers.

In relation to aggressive bird species, the two main drivers for increasing the threat within the TEC are:

- Fragmentation of habitat which creates greater edge effects and facilitates access by aggressive bird species. As outlined above, the TEC is already highly fragmented and subject to edge effects
- Habitat disturbance through inappropriate land management which can change the structure of the TEC and facilitate access by aggressive bird species. As outlined above in relation to inappropriate habitat disturbance, the Plan includes a package of measures which are expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of general measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the Strategic Conservation Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

The package of measures in the Plan is expected to adequately manage the risk to the TEC from invasive fauna because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls following development

These controls are consistent with actions in the Conservation Advice to "control introduced pest animals through coordinated landscape-scale control programs" and "contain pets in nearby residential areas" (DAWE, 2020b).

URBAN HEAT ISLAND EFFECT

The urban heat island effect is also noted as a threat in the Conservation Advice. Urban structures, houses, paved and concreted areas absorb and then radiate heat, which leads to elevated temperatures (DAWE, 2020b). Changes in the local micro-climate can negatively affect patches of the TEC (DAWE, 2020b).

New urban areas and roads in the Strategic Assessment Area could increase the risk to the TEC. Key risk areas are where patches of the TEC occur close to urban capable land and major transport corridors in GPEC and WSA.

The Plan includes the following measures which will minimise the risk to the TEC:

- Strategic avoidance under the Plan has resulted in clearing less vegetation
- Avoided areas and the Strategic Conservation Area will be protected under the SEPP (Strategic Conservation Planning) which decreases the risk of those areas being cleared and will ensure the cooling effect of the surrounding vegetation remains
- The Plan includes mitigations measures under Commitment 5 to retain large trees in urban capable land in each nominated area, which will help to provide ongoing canopy cover
- Buffers either side of riparian corridors, consistent with the *Water Management Act 2000* will be avoided

In addition, the Plan supports the delivery of two of the *Premier's Priorities* to increase green space which will contribute further:

- Greening our city – to increase tree canopy and green cover across Greater Sydney by planting 1 million trees by 2022
- Greener public spaces – increase the proportion of homes in urban areas within 10 minutes' walk of quality green, open and public space by 10% by 2023

Overall, it is considered that the Plan adequately minimises the risk of impacts to the TEC associated with the urban heat island effect.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

In addition to predicted impacts within the urban capable land and transport corridors, there is the potential for impacts to the TEC to occur due to:

- The development of essential infrastructure within nominated areas but outside the urban capable land
- Tunnels associated with transport projects

31.8.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The TEC occurs on avoided land within GMAC (15.6 ha), GPEC (38.5 ha), and WSA (90.9 ha). It is possible that some of these areas will be impacted by essential infrastructure. However, the nature of the TEC and its association with riparian corridors reduces its likelihood of being substantially impacted as these areas occur away from the typical locations for essential infrastructure.

The Plan includes a number of general measures to protect TECs from impacts associated with essential infrastructure, which are described below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including limiting cumulative direct impacts for certain TECs

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect the TEC from impacts from essential infrastructure. These include:

- Commitment 2.1, which states to "limit the total cumulative direct impacts within avoided lands to River-flat Eucalypt Forest over the life of the Plan to no more than 0.3 ha in GMAC, 0.8 ha in GPEC, and 1.8 ha in WSA"
- A measure in the *Cumberland Plain Conservation Plan Guideline for Infrastructure*, which requires that avoidance of impacts to the TEC be prioritised

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

31.8.8 POTENTIAL IMPACTS FROM TUNNELS

The TEC occurs within the tunnel footprints for the Metro Rail Future Extension (8.7 ha) and the Outer Sydney Orbital (25.7 ha). Most patches are relatively small and/or narrow and in low condition (thinned or scattered trees). A large (>20 ha) and intact condition patch of the TEC occurs within the Registered Property Agreement site within the OSO footprint at Camden Airport.

The Plan includes some general measures to protect TECs from impacts associated with the development of tunnels, which are described below.

As outlined in Chapter 36, the Plan includes commitments (Commitment 4 and Commitment 6) to avoid and minimise direct impacts and mitigate indirect impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. This must be undertaken in accordance with:

- Major transport corridors class of action description in the Plan, including the NSW State Significant Infrastructure (SSI) (or equivalent) approval, as well as the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed)
- Specific mitigation measures to address indirect impacts on biodiversity values prescribed in Appendix E

Actions under commitment 4 and 6 require Transport for NSW to implement:

- On-ground surveys to determine the biodiversity values within the tunnel footprints to inform avoidance and minimisation of impacts
- Measures to avoid impacts to biodiversity values through detailed design, with specific consideration to the MNES values identified in Commitments 4.2 and 4.3 relating to the tunnels
- Measures to mitigate any potential indirect impacts, including specific measures identified Appendix E of the Plan
- Measures to offset any residual impacts in accordance with the offset requirements of the BAM and EPBC Act Environmental Offsets Policy should there be long-term detrimental impacts from subsidence due to the tunnels
- Reporting to the Department and executive implementation committee on avoidance outcomes and mitigation measures proposed to manage the impacts of each transport project

In particular, Commitment 4.2 requires TfNSW to specifically avoid and minimise direct impacts to the TEC within the Registered Property Agreement site.

These commitments are expected to adequately address threats to the TEC from the construction and operation of the tunnels. See Section 36.6 in Chapter 36 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice, and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any potentially relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.8.9 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DAWE, 2020b) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the TEC:

- Habitat loss and fragmentation
- Indirect impacts including:
  - Inappropriate fire regimes
  - Weed invasion
  - Inappropriate habitat disturbance
  - Changes to hydrology
  - Diseases, pathogens, and dieback
  - Invasive fauna

HABITAT LOSS AND FRAGMENTATION

While implementation of the Plan will result in the loss of 159.2 ha of the TEC, this is not expected to substantially influence the long-term viability of the TEC because:

- Although the Plan authorises the clearing of 159.2 ha (approximately 2.4 per cent of the remaining TEC), most of this is in thinned and scattered condition. 30.1 ha occurs in intact condition
- The majority of impacts are to small patches, or to the edges of patches
- Transport projects will apply future efforts to avoid impacts to the TEC. These processes are set out in Chapter 36
- The Plan commits to protecting and managing 570 ha of the TEC, including areas to be protected and restored in proposed reserves. Other areas will occur in strategic locations as part of the Plan's conservation program

Securing high conservation value TEC in the SCA directly supports a priority action in the Conservation Advice to protect and conserve remaining areas of the ecological community.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, weed invasion, inappropriate habitat disturbance, changes to hydrology, diseases, pathogens and dieback, invasive fauna, and urban heat effects have been analysed and determined to be adequately managed and mitigated through a number of commitments and actions in the Plan.

Indirect impacts are not expected to influence the long-term viability of the TEC.

CONCLUSION

The nature of the impacts to the TEC (mostly to smaller patches in lower condition) combined with the commitments to protect 570 ha of the TEC and manage indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the TEC.

Development under the Plan will lead to some impacts to the TEC, however, implementation of the Plan is not expected to negatively influence the long-term viability of the TEC for the following key reasons:

- The Plan will lead to the protection of 570 ha of the TEC within the SCA and proposed reserves, and as part of the restoration program, which will contribute substantially to the level of existing protection
- Potential impacts to the TEC from essential infrastructure will be limited through Commitment 2.1
- Potential impacts to the TEC within the Registered Property Agreement site within the OSO tunnel footprint will be avoided and minimised through Commitment 4.2
- Potential indirect impacts are addressed through general management measures in the Plan

31.8.10 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.8.11 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 31-10 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan is not inconsistent with any of the relevant TAPs. Please refer to Section 15.9 of Chapter 15 for a detailed discussion of each TAP and the relationship of the Plan.

Table 31-10: Key Threatening Processes and relevant Threat Abatement Plans for River-flat Eucalypt Forest on Coastal Floodplains of Southern NSW and Eastern Victoria

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	There is no relevant TAP
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoEE, 2016b)
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 31-11: Occurrence of River-flat Eucalypt Forest on Coastal Floodplains of Southern NSW and Eastern Victoria in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**6,667.0**	**666.2**
Intact	2,580.4	419.7
Thinned	1,253.5	160.7
Scattered Trees	2,833.0	85.8
Higher Viability TEC	1,323.1	318.4

Table 31-12: Avoidance of impacts to River-flat Eucalypt Forest on Coastal Floodplains of Southern NSW and Eastern Victoria within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL TEC IN NOMINATED AREA (ha)	**0.0**	**165.5**	**148.5**	**670.8**	**984.7**
Intact	0.0	57.4	13.4	316.1	386.9
Higher Viability TEC	0.0	8.0	0.0	246.8	254.8
TEC WITHIN EXCLUDED LANDS (ha)	0.0	142.2	20.8	562.4	725.4
TEC WITHOUT EXCLUDED LANDS (ha)	**0.0**	**23.3**	**127.6**	**108.4**	**259.3**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	8.1	30.4	16.2	54.7
Intact	0.0	0.0	0.0	0.0	0.0
Higher Viability TEC	0.0	1.4	0.0	0.0	1.4
AVOIDANCE FOR BIODIVERSITY PURPOSE (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**35.0**	**23.8**	**14.9**	**21.1**
AVOIDANCE FOR OTHER REASONS (ha)	0.0	7.5	60.5	22.3	90.3
Intact	0.0	6.3	7.5	3.7	17.4
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR OTHER REASONS (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**32.2**	**47.4**	**20.6**	**34.8**

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL AVOIDANCE (ha)	0.0	15.6	90.9	38.5	145.0
Intact	0.0	6.3	7.5	3.7	17.4
Higher Viability TEC	0.0	1.4	0.0	0.0	1.4
TOTAL AVOIDANCE (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**67.1**	**71.2**	**35.5**	**55.9**

Table 31-13: Direct impacts to River-flat Eucalypt Forest on Coastal Floodplains of Southern NSW and Eastern Victoria within the nominated areas and transport corridors

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO TEC (ha)	**0.0**	**7.7**	**36.7**	**69.9**	**44.9**	**159.2**
Intact	0.0	1.3	0.6	11.8	16.4	**30.1**
Thinned	0.0	6.4	25.5	57.4	6.1	**95.3**
Scattered Trees	0.0	0.0	10.7	0.7	22.4	**33.9**
Higher Viability TEC	0.0	0.8	0.0	4.9	12.5	**18.2**

31.9 COOKS RIVER/CASTLEREAGH IRONBARK FOREST OF THE SYDNEY BASIN BIOREGION

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	The TEC is a dry sclerophyll open forest to low woodland community with an overstorey dominated by *Eucalyptus fibrosa* and *Melaleuca decora*. *Eucalyptus longifolia* is also often present. The midstory is usually moderate to dense, commonly including *Melaleuca nodosa* and *Lissanthe strigosa*, and to a lesser extent *Melaleuca decora.* The ground layer is variable and generally sparse with a mix of grasses and other graminoids, forbs, and low shrubs. The TEC can intergrade into Shale-Gravel Transition Forest (where the alluvium is shallow), Castlereagh Swamp Woodland (in moist depressions) and Castlereagh Scribbly Gum Woodland (on sandier soils). The following PCT is associated with the TEC: 725 Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin bioregion. A range of fauna species occur in the TEC, including reptiles, amphibians, birds, micro-bats, and marsupials. Most of these fauna species are not restricted to the TEC and occur in, and are likely to rely on, other native vegetation in the Cumberland subregion. Most plant species in the TEC are able to regenerate from lignotubers and buds beneath the bark as well as seeds stored in the soil (OEH, 2019d). The TEC is equivalent to the NSW BC Act listed TEC Cooks River/Castlereagh Ironbark Forest where key diagnostic and condition thresholds are met. The EPBC conditions include a treeless, shrubby state that is not included in the NSW-listed TEC. (DoE, 2015c)
EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, understorey native vegetation cover, number of tree hollows, or whether the patch is contiguous with other native vegetation patches. Details of the thresholds are provided in the Conservation Advice (DoE, 2015c)
DISTRIBUTION	The TEC is confined to the Sydney Basin bioregion and mostly restricted to the Cumberland subregion.

	The majority of the TEC is found in larger patches in the north-west part of the subregion in the Castlereagh area between Penrith and Richmond. Other significant patches occur in the Kemps Creek and Holsworthy areas. Smaller patches of the TEC occur in the eastern part of the subregion, such as the upper Cooks River valley. The TEC primarily occurs in elevations below 100 m with mean annual rainfall of 800-1000 mm. It generally occurs on clay soils derived from Tertiary alluvium and on Wianamatta Shale soils found next to Tertiary alluvium. In the eastern areas of its distribution, the TEC can be found on soils with a sandstone influence. (DoE, 2015c)
SOS SITES	The TEC has been categorised under the 'widespread' management stream for TECs under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. There are four active management sites for the TEC: • George Street Reserve, Bligh Park • Castlereagh Nature Reserve • Wianamatta Nature Reserve • Lt Cantello Reserve, Hammondville
RELEVANT PLANS AND POLICIES	Approved Conservation Advice (including listing advice) for Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (DoE, 2015c) There is no adopted or made Commonwealth Recovery Plan for the TEC. The TEC is included in the Cumberland Plain Recovery Plan (NSW) (DECCW, 2011) Key Threatening Processes and Threat Abatement Plans relevant to the TEC are identified in Table 31-18
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=129

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area. It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-

	based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCT is associated with the TEC: • 725 Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin bioregion.
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based on applying the condition thresholds at a landscape scale to the available data: • Patch size ≥ 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone), AND • ≥ 30% of perennial understorey vegetation cover is native (field verification), AND • Below 100 m elevation, AND • Rainfall 800-1000 mm per year, AND • Growing on Clay rich soils derived from tertiary alluvium and on Wianamatta derived shale soils found next to tertiary alluvium, AND • Patch is contiguous with native vegetation remnant >1ha, OR the patch has at least one tree with hollows or at least one large locally indigenous tree (>80 cm) (based on field verification) OR • Patch size ≥ 0.5 ha (Patch size > 0.1 ha in areas east of Riverstone), AND • ≥ 50% of perennial understorey vegetation cover is native (based on field verification), AND • Below 100 m elevation, AND • Rainfall 800-1000 mm per year, AND • Growing on clay rich soils derived from tertiary alluvium and on Wianamatta derived shale soils found next to tertiary alluvium
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.

VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-4 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment has mapped approximately 794.4 ha of the TEC within the Strategic Assessment Area (see Table 31-15 for further details). Of this, approximately 592 ha has been identified as higher viability through the viability analysis. The TEC occurs in the following main locations within the Strategic Assessment Area: • Northern part of the Strategic Assessment Area between Windsor Downs, Llandilo and Agnes Banks associated with larger remnants of native vegetation in this locality • Northern part of GPEC within Wianamatta Regional Park and near Ropes Crossing • Southern part of WSA near Kemps Creek It occurs in the following nominated areas: • WSA – 32.9 ha. None of this is mapped as higher viability • GPEC – 101.1 ha including 39.2 ha that is higher viability The Conservation Advice does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. It states that all patches that meet the minimum condition categories as defined in the advice are considered habitat critical to the survival of the TEC. The Conservation Advice also identifies several factors affecting the value of a patch, including: • A larger size and/or a high area to boundary ratio • Part of a larger remnant of native vegetation or linking other remnants • Evidence of recruitment of key plant species/range of age cohorts • High native species richness • Presence of threatened species • Low level of weeds and pest animals The TEC is highly fragmented across the Strategic Assessment Area, comprising approximately 129 patches most of which (96) are less than 5 ha. Only seven patches are greater than 20 ha. However, the TEC intergrades into other native vegetation types, and many patches of the TEC are surrounded by or connected to larger areas of native vegetation, providing a buffer to edge effects.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

31.9.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped 55.6 ha of the TEC within the nominated areas (not including excluded lands). Approximately 24.7 ha (44.5 per cent) was avoided as part of the urban capable land and transport corridors (not including excluded lands). All of this was avoided for biodiversity purposes.

An additional 78.4 ha occurs on excluded lands.

A breakdown of avoidance across each nominated area is provided in Table 31-16.

It is important to note that the avoidance calculations in Table 31-16, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 31-16 shows the amounts of habitat within excluded lands for context only.

31.9.2 TRANSPORT

Avoidance results are only reported for urban capable land within the nominated areas, as detailed design of the footprint within the transport corridors has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8, and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will lead to direct impacts to the TEC (see Section 31.9.3 for discussion) and increase fragmentation in one location (see Section 31.9.4 for discussion).

31.9.3 DIRECT IMPACTS TO THE TEC

Implementation of the Plan will lead to loss of a total of 30.9 ha of the TEC within GPEC and WSA. This loss represents approximately 3.9 per cent of the remaining TEC in the Strategic Assessment Area and 23 per cent of the TEC in the nominated areas. A breakdown of direct impacts is provided in Table 31-17.

The majority of the TEC impacted within GPEC and WSA:

- Is in thinned condition (13.4 ha)
- Comprises small patches (less than 5 ha) (16 out of the 18 impacted patches)
- Is not mapped as higher viability. Impacts will occur to 10.8 ha of higher viability TEC

The most notable direct impacts to the TEC occur to patches impacted by the Outer Sydney Orbital in the northern part of GPEC within Wianamatta Regional Park (19.3 ha). Impacts in this location will occur to patches that:

- Are of moderate size (> 5 ha)

- Are mostly in intact condition and that are known to contain several threatened flora species (see Chapter 29), which (consistent with the Conservation Advice) makes them of higher conservation value
- Form part of a larger, well-connected patch of native vegetation associated with the Wianamatta Regional Park

However, the Plan includes a specific commitment (Commitment 3) to avoid and minimise impacts to TECs within certified major transport corridors, which includes the OSO in Wianamatta Regional Park.

Impacts in WSA (7.8 ha) will occur to a number of small patches that are predominately in thinned condition.

31.9.4 FRAGMENTATION OF THE TEC

The Conservation Advice identifies fragmentation as a key threat to the TEC (DoE, 2015c).

Fragmentation of the TEC will occur due to the direct impacts from the Outer Sydney Orbital in Wianamatta Regional Park (GPEC). In this area, the Outer Sydney Orbital will intersect the middle of several patches of the TEC that form part of a larger, well-connected patch of native vegetation to the west and Ropes Creek riparian corridor to the south. The TEC is also marginally connected to a larger patch of the TEC to the east at Ropes Crossing.

Fragmentation of the TEC may increase the susceptibility of the TEC to weed invasion and other edge effects and has the potential to reduce its long-term viability in this location.

Fragmentation is not expected to occur to the TEC in WSA.

31.9.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the TEC, the Plan includes a commitment to secure 125 ha of the TEC as part of the conservation program. A proportion of this could be secured in the proposed Confluence Reserve Investigation Area, as the TEC is present in the area. This would:

- Lead to the protection and management of an additional 15.7 per cent of the TEC within the Strategic Assessment Area
- Increase the level of protection and management of the ecological community by approximately 29.6 per cent on top of what is currently secured in the Strategic Assessment Area

These offsets are consistent with the following two high priority actions in the Conservation Advice:

- "Protect and conserve patches of this ecological community…"
- "Promote formal conservation arrangements, management agreements and covenants on private land. For crown and private land, promote inclusion in reserve tenure"

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile or conservation advice, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.9.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice identifies a range of threats to the TEC. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to

mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna

To help address these potential indirect impacts, the Plan includes a requirement to undertake mitigation in accordance with the *Best Practice Guidelines: Cooks River/Castlereagh Ironbark Forest* (DECC, 2008a) within and adjacent to the TEC. These are discussed further below in relation to specific indirect impacts.

Climate change is also a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

Impacts from dryland salinity due to historical clearing and uncontrolled grazing were also identified in the Conservation Advice as key threats. However, none of these are considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these risks across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for this TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes can affect the structure and species composition of the TEC (DoE, 2015c). This can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Altered fire regimes, particularly increased fire frequency due to arson, can affect the structure and species composition of the TEC by altering the mid and ground layers. This is despite most plant species in the TEC being able to regenerate after fire from lignotubers and buds beneath the bark, as well as seeds stored in the soil (OEH, 2019d). While most impacts to the TEC are associated with increased fire, in some areas the TEC is threatened due to a lack of fire (DoE, 2015c).

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban capable land. Bushfire management by authorities is also likely in areas close to new urban capable land. For the TEC this includes areas in the north of GPEC, and the south-east of WSA.

The key factors that influence the appropriateness of a fire regime are fire frequency, intensity and season of occurrence (DECCW, 2011).

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the Strategic Assessment Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values

  - A process to work with delivery partners to implement the fire management strategy
  - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
  - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
  - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes
- A specific requirement in Appendix E of the Plan to apply the best practice guidelines for managing the TEC (DECC, 2008a). This includes specific information around fire management and is consistent with a high priority action in the Conservation Advice

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable land which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas
- The fire management requirements for the TEC specified in the best practice guidelines will be applied

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of fire.

WEED INVASION

The TEC is threatened with invasion and competition by weeds. It typically occurs on soils that are richer in nutrients compared to other soil types in the Sydney Basin bioregion, which means it is particularly susceptible to threats from weeds (DECC, 2008a).

The most serious threats are:

- Mid-storey weeds:
  - Green cestrum (*Cestrum parqui*), which is dispersed by birds and water
  - Mickey mouse bush (*Ochna serrulata*), which is dispersed by birds and dumped garden waste. This weed can establish in undisturbed bushland
- Ground-layer weeds: Ground Asparagus (*Asparagus aethiopicus*), dispersed by birds and dumped garden waste. This weed affects availability of nutrients and water
- Grassy weeds:
  - Panic veldt grass (*Ehrharta erecta*), which is dispersed by water, birds, contaminated soil, and dumped garden waste
  - Kikuyu (*Cenchrus clandestinus*), which is dispersed by dumped garden waste
  - Common couch (*Cynodon dactylon*), which can escape from pastures and lawns
- Vines: Bridal creeper (*Asparagus asparagoides*)

These weeds are already present within the Strategic Assessment Area and pose a threat to the TEC. However, urban and transport development within the northern half of the Strategic Assessment Area has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban development or transport corridors occur adjacent to the TEC and/or fragments patches of the TEC into smaller patches and introduces edge effects. Key risk areas include:

- Northern part of GPEC where the Outer Sydney Orbital corridor fragments TEC patches
- South-eastern part of WSA where urban development occurs immediately adjacent to several connected TEC patches

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

Importantly for the TEC, weeds will be actively managed within the 125 ha to be added to conservation as part of the offset program.

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction
- The weed management requirements for the TEC specified in the best practice guidelines will be applied

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of weeds.

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Conservation Advice as a threat to the TEC. This relates to a wide range of different mechanisms for disturbance including:

- Inappropriate mowing, slashing, or scrubbing of the understorey for reasons such as bushfire fuel reduction, grazing and perceived aesthetics
- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants
- Inappropriate recreational activities such as ad hoc track building and trail bike use which can directly impact areas of the TEC and facilitate processes such as erosion
- Removal of wood which changes the structure and habitat features of the TEC
- Inadvertent disturbance during construction which has the potential to directly impact the TEC outside approved development areas

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the Strategic Assessment Area may increase due to development within the nominated areas. Occurrences of the TEC considered most at risk are those to the north of GPEC, and the south-east of WSA.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the 125 ha for the TEC)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of disturbance.

CHANGES TO HYDROLOGY

The creation of hard surfaces associated with urban capable land and transport corridors results in changes to the hydrology of surrounding areas. The main threat to the TEC associated with altered hydrology is increased runoff into patches of the TEC carrying high nutrient and sediment loads, as well as weed seeds or propagules. This can both encourage weed invasion and cause erosion.

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban or transport development occurs adjacent (and upstream or upslope) to the TEC. Key risk areas are those in the north of GPEC and the south-east of WSA.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology for the TEC.:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures to transport projects based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines. These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

DISEASES, PATHOGENS, AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens, and dieback which can substantially affect their long-term viability. Recognised threats include myrtle rust and dieback caused by the root-rot fungus *Phytophthora cinnamomi*.

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with diseases, pathogens, and dieback. In summary, these include:

- A commitment (Commitment 19) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

INVASIVE FAUNA

TECs can be threatened by introduced animals and aggressive native species. These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as foxes, rats, house mice, and rabbits, which are primarily related to agricultural development
- Aggressive bird species which compete for resources including the introduced Indian myna, and native species such as the sulphur-crested cockatoo

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers.

In relation to aggressive bird species, the two main drivers for increasing the threat within the TEC are:

- Fragmentation of habitat which creates greater edge effects and facilitates access by aggressive bird species. As outlined above in the analysis of direct impacts, fragmentation is likely to occur in the vicinity of the Wianamatta Regional Park but not in other areas of the TEC
- Habitat disturbance through inappropriate land management which can change the structure of the TEC and facilitate access by aggressive bird species. As outlined above in relation to inappropriate habitat disturbance, the Plan includes a package of measures which are expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of general measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the Strategic Conservation Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

The package of measures in the Plan is expected to adequately manage the risk to the TEC from invasive fauna because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls following development

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

In addition to predicted impacts within the urban capable land and transport corridors, there is the potential for impacts to the TEC to occur due to development of essential infrastructure within the avoided lands of WSA.

The TEC does not occur within the vicinity of the tunnel footprints for transport and is therefore not at risk of additional impacts from tunnels.

31.9.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

The TEC occurs on avoided land within WSA (24.5 ha) and GPEC (0.2 ha). Of the 24.7 ha, 18.9 ha is in good (intact) condition. Impacts are more likely where the TEC occurs on avoided land between areas of urban capable land.

The Plan includes a number of general measures to protect TECs from impacts associated with essential infrastructure, which are described below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
    - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including limiting cumulative direct impacts for certain TECs

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect the TEC from impacts from essential infrastructure. These include:

- Commitment 2.1, which states to "limit the total cumulative direct impacts within avoided lands to Cooks River/Castlereagh Ironbark Forest over the life of the Plan to no more than 0 ha in GPEC and 0.5 ha in WSA"
- A measure in the *Cumberland Plain Conservation Plan Guideline for Infrastructure*, which requires that avoidance of impacts to the TEC be prioritised

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.9.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoE, 2015c) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the TEC:

- Habitat loss and fragmentation
- Indirect impacts including:
    - Inappropriate fire regimes
    - Weed invasion
    - Inappropriate habitat disturbance
    - Changes to hydrology
    - Diseases, pathogens, and dieback
    - Invasive fauna

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan may lead to the loss of 30.9 ha of the TEC (7.8 ha in WSA and 23.1 ha in GPEC). This equates to 3.9 per cent of the remaining TEC in the Strategic Assessment Area.

The impacts in WSA are not expected to threaten the long-term viability of the TEC because:

- Impacts are to a number of smaller already fragmented patches
- Of the 7.8 ha to be impacted, only 0.6 ha is in intact condition and none of it is mapped as higher viability
- The impacts are unlikely to increase the level of fragmentation of the TEC

The impacts in GPEC are more complex in relation to the implications for the long-term viability of the TEC. This is because:

- The impacts from the Outer Sydney Orbital will lead to fragmentation within the Wianamatta Regional Park
- Of the 23.1 ha to be impacted, 10.8 ha is mapped as higher viability. This represents 1.8 per cent of the higher viability TEC in the Strategic Assessment Area (592 ha)

It is noted that the Plan commits (Commitment 3) to avoid and minimise impacts to the TEC due to the construction of the Outer Sydney Orbital in GPEC. It will be critical that this process avoids and minimise impacts as far as possible to reduce the scale of impacts. As part of this process, Transport for NSW will report to the Department on avoidance achieved within the transport corridors. The Department will use this information to track impacts and adjust offset

requirements through the Plan's reconciliation accounting process. This process provides an incentive for Transport for NSW to avoid impacts to this TEC and reduce offset requirements.

To address the overall residual risks associated with direct impacts the Plan commits to protecting 125 ha of the TEC. This will provide a substantial contribution to the area of the TEC that is protected within the Strategic Assessment Area (an additional 15.7 per cent) and supports a number of high priority actions in the Conservation Advice.

As part of this commitment, the Plan is also prioritising restoration of up to 29.6 per cent of the offset target for the TEC. Restoration provides the potential for substantial improvements in the long-term viability of the TEC by:

- Adding to the known extent of TEC by rehabilitating degraded areas of vegetation that do not currently meet the EPBC listing criteria
- Improving the resilience of patches of the TEC where restoration occurs in strategic locations (e.g. by increasing the size of an existing patch, or connecting existing patches)

Given the extent of impacts from the Outer Sydney Orbital, the timing of offsetting will be critical for the TEC. Offsets should be provided early during the implementation of the Plan and ideally be in place before the construction of the Outer Sydney Orbital. If this were to occur, the long-term viability of the TEC will not be adversely affected.

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, weed invasion, inappropriate habitat disturbance, changes to hydrology, diseases, pathogens and dieback, and invasive fauna have been analysed and determined to be adequately managed and mitigated through a number of commitments and actions in the Plan.

Indirect impacts are not expected to influence the long-term viability of the TEC.

CONCLUSION

Development under the Plan will lead to some impacts to the TEC, however, implementation of the Plan is not expected to negatively influence the long-term viability of the TEC for the following key reasons:

- The Plan will lead to the protection of 125 ha of the TEC within the SCA and proposed reserves, and as part of the restoration program, which will contribute substantially to the level of existing protection. This outcome is reliant on early offsetting occurs and successful restoration of the TEC
- Potential impacts to the TEC from essential infrastructure will be limited through Commitment 2.1
- Potential indirect impacts are addressed through general management measures in the Plan

31.9.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.9.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 31-14 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan is not inconsistent with any of the relevant TAPs. Please refer to Section 15.9 of Chapter 15 for a detailed discussion of each TAP and the relationship of the Plan.

Table 31-14: Key Threatening Processes and relevant Threat Abatement Plans for Cooks River/Castlereagh Ironbark Forest

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant TAP

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 31-15: Occurrence of Cooks River/Castlereagh Ironbark Forest in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**794.4**	**417.4**
Intact	705.8	411.4
Thinned	87.0	6.0
Scattered Trees	1.7	0.0
Higher Viability TEC	592.0	347.2

Table 31-16: Avoidance of impacts to Cooks River/Castlereagh Ironbark Forest within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL TEC IN NOMINATED AREA (ha)	**0.0**	**0.0**	**32.9**	**101.1**	**134.0**
Intact	0.0	0.0	19.6	86.5	106.1
Higher Viability TEC	0.0	0.0	0.0	39.2	39.2
TEC WITHIN EXCLUDED LANDS (ha)	0.0	0.0	0.6	77.7	78.4
TEC WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**32.3**	**23.3**	**55.6**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	24.4	0.2	24.6
Intact	0.0	0.0	18.9	0.0	18.9
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR BIODIVERSITY PURPOSE (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**N/A**	**75.6**	**0.9**	**44.3**
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	0.1	0.0	0.1
Intact	0.0	0.0	0.0	0.0	0.0
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR OTHER REASONS (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**N/A**	**0.3**	**0.1**	**0.2**
TOTAL AVOIDANCE (ha)	0.0	0.0	24.5	0.2	24.7
Intact	0.0	0.0	18.9	0.0	18.9
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
TOTAL AVOIDANCE (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**N/A**	**75.9**	**1.0**	**44.5**

Table 31-17: Direct impacts to Cooks River/Castlereagh Ironbark Forest

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO TEC (ha)	**0.0**	**0.0**	**7.8**	**23.1**	**0.0**	**30.9**
Intact	0.0	0.0	0.6	15.1	0.0	**15.7**
Thinned	0.0	0.0	5.4	8.0	0.0	**13.4**
Scattered Trees	0.0	0.0	1.7	0.0	0.0	**1.7**
Higher Viability TEC	0.0	0.0	0.0	10.8	0.0	**10.8**

31.10 COASTAL SWAMP OAK (*CASUARINA GLAUCA*) FOREST OF NSW AND SOUTH EAST QUEENSLAND

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	The TEC varies from open forest to low woodlands, depending on landscape location and disturbance history, with an overstorey dominated by *Casuarina glauca* (swamp oak, swamp she-oak). *Eucalyptus* species may also be present. *Melaleuca* species may also occur in the overstorey, midstorey or as emergent in freshwater patches of the TEC. The midstorey is not always present in occurrences of the TEC. Instead, a sub-canopy of smaller trees may often be present. This sub-canopy typically consists of juvenile canopy species. The climbing plant species that is most commonly found in the TEC is *Parsonsia straminea*. The ground layer is typically a contiguous to semi-contiguous layer of forbs, ferns, sedges, grasses, and plant litter. The composition of this ground layer is influenced by groundwater salinity. The following PCT is associated with the TEC: 1800 Swamp Oak open forest on river flats of the Cumberland Plain and Hunter valley. A range of fauna species occur in the TEC, including reptiles, amphibians, birds, micro-bats, and marsupials. Most of these fauna species are not restricted to the TEC and occur in, and are likely to rely on, adjacent wetlands, grasslands, woodlands, and forests. The TEC is equivalent to the NSW BC Act-listed TEC Swamp Oak Floodplain Forest where key diagnostic and condition thresholds are met. (DoEE, 2018d)
EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, understorey native vegetation cover, number of tree hollows, or whether the patch is contiguous with other native vegetation patches. Details of the thresholds are provided in the Conservation Advice (DoEE, 2018d)
DISTRIBUTION	The TEC has a broad extent of occurrence along the east coast of Australia from Curtis Island in Queensland to Bermagui in NSW. However, its area of occupancy is limited. It occurs within the subregion from Cranebrook in the north to Bow Bowing in the south. The TEC primarily occurs in coastal catchments at elevations of less than 50 m, typically within 30 km of the coast. It generally occurs on unconsolidated sediments including alluvium deposits.

	The soils are hydrosols that are grey-black clay-loam and/or sandy loam soils and are saturated with water for long periods of time. It can also occur on peaty soils. (DoEE, 2018d)
SOS SITES	The NSW BC Act-listed TEC, Swamp Oak Floodplain Forest, has been categorised under the 'widespread' management stream for TECs under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. There are ten management sites for the NSW TEC: Active: Jali Indigenous Protected Area, Barcoo Court - Toormina, Tuckers Island, Warrell Close - Scotts Head, Berowra Valley National Park, Towra Point Nature Reserve, Somervale Proposed: Marramarra National Park, Muogamarra Nature Reserve, Garigal National Park
RELEVANT PLANS AND POLICIES	Conservation Advice (including listing advice) for Coastal Swamp Oak *(Casuarina glauca)* Forest of New South Wales and South East Queensland ecological community (DoEE, 2018d). Key Threatening Processes relevant to the TEC are identified in Table 8 of the Conservation Advice. There is no Recovery Plan for the TEC. Threat Abatement Plans relevant to the TEC are identified in Chapter 15.
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=142

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area. It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11. It is also important to note that limited mapping exists for PCT 1800 outside of the nominated areas as the PCT has historically been included in mapping for other PCTs. It is expected that more PCT 1800 exists outside of the nominated areas than identified in the best available data.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCT is associated with the TEC: 1800 Swamp Oak open forest on river flats of the Cumberland Plain and Hunter valley
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based on applying the condition thresholds at a landscape scale to the available data: • Patch size ≥ 5 ha, OR • Patch size at least 2 ha and < 5 ha, OR • Patch is at least 0.5 ha and < 2 ha and is connected to a larger area of native vegetation of at least 5 ha, AND • Non-native species comprise < 20% of total understorey vegetation cover OR • Patch size ≥ 5 ha, OR • Patch size at least 2 ha and < 5 ha, OR • Patch is at least 0.5 ha and < 2 ha and is connected to a larger area of native vegetation of at least 5 ha, AND • Non-native species comprise < 50% of total understorey vegetation cover OR • Patch size ≥ 5 ha, OR • Patch size at least 2 ha and < 5 ha, OR • Patch is at least 0.5 ha and < 2 ha and is connected to a larger area of native vegetation of at least 5 ha, AND • Non-native species comprise < 80% of total understorey vegetation cover
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.
VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review

	found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio It should be noted that due to the general linear nature of the TEC, the viability assessment had less relevance for this TEC than for others in the Strategic Assessment Area that typically occur in more consolidated patches.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-3 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment has mapped approximately 269.3 ha of the TEC within the Strategic Assessment Area (see Table 31-19 for further details). None of the TEC is identified as higher viability. This is because none of the mapped TEC occurs in intact condition which is one of the criteria that must be met to be mapped as higher viability. The TEC occurs mainly along waterways and is scattered within and outside the nominated areas in the northern half of the Strategic Assessment Area. The TEC occurs in GPEC, WSA, and GMAC. The Conservation Advice does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. The Conservation Advice states that all patches of a reasonable size and in the highest condition categories as defined in the advice (categories A and B) are considered habitat critical to the survival of the TEC. These are generally: • Large (≥ 5 ha) or moderate patches (≥ 2 ha and < 5 ha) with a predominately native understory • Well-connected smaller patches (< 2 ha and ≥ 0.5 ha) with a predominately native understory The Conservation Advice also identifies several factors affecting the value of a patch, including: • A larger size and/or a high area to boundary ratio • Part of a larger remnant of native vegetation or linking other remnants • Patches in catchments or tidal areas with minimal modification to natural hydrology • Evidence of recruitment of key plant species/range of age cohorts • High native species richness • Presence of threatened species • Low level of weeds and pest animals The TEC is highly fragmented across the Strategic Assessment Area, comprising 99 patches with an average patch size of 2.6 ha. The TEC mostly occurs as long and narrow patches along riparian corridors surrounded by either urban development or farming.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

31.10.1 NOMINATED AREAS

The baseline mapping for this assessment has mapped approximately 35.9 ha of the TEC within the nominated areas (not including excluded lands). Approximately 28.1 ha (78.2 per cent) has been avoided as part of the design of the urban capable land and transport corridors (not including excluded lands). Of this:

- 2.9 ha was avoided for biodiversity purposes
- 25.2 ha was avoided for other purposes

An additional 63.8 ha occurs on excluded lands.

A breakdown of avoidance across each nominated area is provided in Table 31-20.

It is important to note that the avoidance calculations in Table 31-20, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 31-20 shows the amounts of habitat within excluded lands for context only.

31.10.2 TRANSPORT

Avoidance results are only reported for urban capable land within the nominated areas, as detailed design of the footprint within the transport corridors has not yet occurred.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8, and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will lead to direct impacts to the TEC (see Section 31.10.3 for discussion) but will not generally increase fragmentation (see Section 31.10.4 for discussion).

31.10.3 DIRECT IMPACTS TO THE TEC

Implementation of the Plan will lead to the loss of 8 ha of the TEC predominantly within transport corridors in WSA. This loss represents 3 per cent of the remaining TEC in the Strategic Assessment Area, and 8 per cent of the TEC in the nominated areas. A breakdown of direct impacts is provided in Table 31-21.

The majority of the TEC impacted within WSA:

- Is in thinned condition (1.2 ha)
- Comprises small patches (less than 5 ha) (11 of 12 impacted patches)

The majority of the loss in WSA is from transport within the nominated area. The threat to the TEC is reduced because:

- Only small areas of the TEC will be impacted
- Impacts are to patches in thinned or scattered condition. There are no impacts to intact patches
- Impacts generally occur to the edges of patches that are isolated and not well connected to native vegetation

31.10.4 FRAGMENTATION OF THE TEC

As outlined above, impacts largely occur to the edges of patches and will not result in a loss of connectivity and therefore will not lead to fragmentation.

31.10.5 OFFSETS FOR RESIDUAL DIRECT IMPACTS

To compensate for the predicted direct impacts to the TEC, the Plan includes a commitment to secure 20 ha of the TEC as part of the conservation program. This would:

- Lead to the protection and management of an additional 7.4 per cent of the ecological community within the Strategic Assessment Area
- Increase the level of protection and management of the ecological community by approximately 125 per cent on top of what is currently secured in the Strategic Assessment Area

These offsets are consistent with a number of high priority actions in the Conservation Advice to protect the TEC.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile or conservation advice, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.10.6 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice identifies a range of threats to the TEC. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology
- Invasive fauna

In addition to the threats identified in the Conservation Advice, the following potential indirect impact is considered relevant to the TEC: diseases, pathogens, and dieback.

Climate change is also a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

Impacts from agricultural activities, including grazing were also identified in the Conservation Advice as key threats. However, none of these are considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these risks across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) and from major transport corridors (Commitment 6) on TECs, including

meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for this TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

The TEC occurs in fire adapted landscapes and may be affected by fires that are too frequent or not frequent enough. However, the impact of inappropriate fire regimes are not well understood (DoEE, 2018d). Inappropriate fire regimes can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban capable land. Bushfire management by authorities is also likely in areas close to new urban capable land. For the TEC this includes areas in GPEC, WSA, and the northern part of GMAC.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the Strategic Assessment Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from the TEC. While these APZs are designed to provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable land which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

These controls are consistent with a number of priority actions in the Conservation Advice about the management of fire.

WEED INVASION

The TEC is threatened with invasion and competition by weeds. Weed incursions in this TEC are caused by (DoEE, 2018d):

- Physical disturbance to vegetation within the community (the predominant cause of weed incursions), such as through landfill, waste dumping and soil disturbance
- Encroachment of garden plants
- Altered hydrology and polluted runoff from urban and agricultural areas which alters conditions within the TEC to favour weed growth
- Grazing from feral animals
- Inappropriate fire regimes

Key weeds include Bridal Creeper (*Asparagus asparagoides*), Bitou Bush (*Chrysanthemoides monilifera*), Camphor Laurel (*Cinnamomum camphora*), Umbrella Tree (*Schefflera actinophylla*), Privets (*Ligustrum* spp.), Winter Senna (*Senna pendula*), invasive grasses (*Pennisetum* spp. and *Stenotaphrum secundatum*), and Lantana (*Lantana camara*). The TEC is also threatened by aquatic weeds such as Water Hyacinth (*Eichhornia crassipes*), *Ludwigia* spp. and Salvinia (*Salvinia molesta*) (DoEE, 2018d).

Urban and transport development within the Strategic Assessment Area has the potential to increase the spread of weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds. However, all mapped areas of this TEC within the Strategic Assessment Area are considered to have significant edge effects and occur in close proximity to urban capable land or farming and are already significantly exposed to weed incursion.

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban development or transport corridors occur adjacent to the TEC and/or fragments patches of the TEC into smaller patches and introduces edge effects. Key risk areas include parts of GPEC, WSA, and the northern part of GMAC:

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of weeds.

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Conservation Advice as a threat to the TEC, with impacts resulting from recreational activity identified as a particular issue. As discussed for the other TECs in this Chapter, inappropriate habitat disturbance may also occur through other mechanisms such as:

- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants
- Inadvertent disturbance during construction which has the potential to directly impact the TEC outside approved development areas

Inappropriate habitat disturbance within the Strategic Assessment Area may increase due to development within the nominated areas. Occurrences of the TEC considered most at risk are those that occur in GPEC, WSA, and the northern part of GMAC.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations (including the 20 ha for the TEC)
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of disturbance.

CHANGES TO HYDROLOGY

The creation of hard surfaces associated with urban capable land and transport corridors results in changes to the hydrology of surrounding areas. The main threats to the TEC are associated with reduced water quality, sedimentation and eutrophication (DoEE, 2018d).

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban or transport development occurs adjacent (and upstream or upslope) to the TEC. Key risk areas are those that occur in GPEC, WSA, and the northern part of GMAC.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application
- The implementation of mitigation measures to transport projects based on the outcomes of environmental assessment of detailed designs in accordance with published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines. These include a range of provisions to mitigate and minimise changes to hydrology

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because:

- Development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC
- Transport projects will apply best practice approaches to avoiding and minimising any potential impacts to the TEC

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of hydrological impacts.

INVASIVE FAUNA

TECs can be threatened by introduced animals and aggressive native species. These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as feral pigs, foxes, rats, house mice, and rabbits, which are primarily related to agricultural development
- Aggressive bird species which compete for resources including the Noisy Miner

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that the majority of these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that (in particular) the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers.

In relation to aggressive bird species, the two main drivers for increasing the threat within the TEC are:

- Fragmentation of habitat which creates greater edge effects and facilitates access by aggressive bird species. As outlined above in the analysis of direct impacts, fragmentation is not considered likely to occur
- Habitat disturbance through inappropriate land management which can change the structure of the TEC and facilitate access by aggressive bird species. As outlined above in relation to inappropriate habitat disturbance, the Plan includes a package of measures which are expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of general measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the Strategic Conservation Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Development controls that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

The package of measures in the Plan is expected to adequately manage the risk to the TEC from invasive fauna because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls following development

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of invasive fauna.

DISEASES, PATHOGENS, AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens, and dieback which can substantially affect their long-term viability. Recognised threats include myrtle rust and dieback caused by the root-rot fungus *Phytophthora cinnamomi*.

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with diseases, pathogens, and dieback. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
  - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
  - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

In addition to predicted impacts within the urban capable land and transport corridors, there is the potential for impacts to the TEC to occur due to development of essential infrastructure within the avoided lands of WSA.

The TEC does not occur within the vicinity of the tunnel footprints for transport and is therefore not at risk of additional impacts from tunnels.

31.10.7 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

Areas of the TEC occur within the avoided lands of GPEC (3.3 ha) and WSA (24.8 ha). Impacts to the TEC are possible where it occurs within land avoided for biodiversity purposes (2.9 ha). The likelihood of impact is reduced where the TEC occurs in riparian corridors (25.2 ha).

The Plan includes a number of general measures to protect TECs from impacts associated with essential infrastructure, which are described below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
  - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
  - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including limiting cumulative direct impacts for certain TECs

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes species-specific mitigation measures to protect the TEC from impacts from essential infrastructure. These include:

- Commitment 2.1, which states to "limit the total cumulative direct impacts within avoided lands to Coastal Swamp Oak (Casuarina glauca) over the life of the Plan to no more than 0.1 ha in GPEC and 0.5 ha in WSA"
- A measure in the *Cumberland Plain Conservation Plan Guideline for Infrastructure*, which requires that avoidance of impacts to the TEC be prioritised

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.10.8 IMPLICATIONS FOR LONG-TERM VIABILITY

The Conservation Advice (DoEE, 2018d) identifies the following key issues that are likely to have the greatest influence on the long-term viability of the TEC in relation to implementation of the Plan. They are:

- Habitat loss and fragmentation
- Indirect impacts including:
    - Inappropriate fire regimes
    - Weed invasion
    - Inappropriate habitat disturbance
    - Changes to hydrology
    - Invasive fauna

HABITAT LOSS AND FRAGMENTATION

As outlined above, implementation of the Plan may lead to the loss of 8 ha of the TEC. However, it is not considered likely that this will threaten the long-term viability of the TEC because:

- The scale of impacts are minor when considering the mapped extent of the TEC across the Strategic Assessment Area (3 per cent) and more broadly within the context of the entire range of the TEC
- There is no mapped higher viability TEC in the Strategic Assessment Area and all impacts occur to thinned or scattered condition vegetation

- There will be no fragmentation
- The offsets proposed by the Plan (20 ha of the TEC) will increase the level of protection of the TEC and address a number of actions in the Conservation Advice about improving the area of the TEC that is protected and managed

INDIRECT IMPACTS

The potential indirect impacts associated with inappropriate fire regimes, weed invasion, inappropriate habitat disturbance, changes to hydrology, and invasive fauna have been analysed and determined to be adequately managed and mitigated through a number of commitments and actions in the Plan.

Indirect impacts are not expected to influence the long-term viability of the TEC.

CONCLUSION

The nature of the impacts to the TEC combined with the commitments to protect 20 ha of the TEC and manage indirect impacts will ensure that the implementation of the Plan does not adversely influence the long-term viability of the TEC.

31.10.9 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.10.10 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 31-18 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan is not inconsistent with any of the relevant TAPs. Please refer to Section 15.9 of Chapter 15 for a detailed discussion of each TAP and the relationship of the Plan.

Table 31-18: Key Threatening Processes and relevant Threat Abatement Plans for Coastal Swamp Oak (*Casuarina Glauca*) Forest of NSW and South East Queensland

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	There is no relevant TAP
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	There is no relevant TAP

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 31-19: Occurrence of Coastal Swamp Oak *(Casuarina glauca)* Forest of New South Wales and South East Queensland in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**269.3**	**17.0**
Intact	0.2	0.0
Thinned	267.5	17.0
Scattered Trees	1.7	0.0
Higher Viability TEC	0.0	0.0

Table 31-20: Avoidance of impacts to Coastal Swamp Oak *(Casuarina glauca)* Forest of New South Wales and South East Queensland within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL TEC IN NOMINATED AREA (ha)	**0.0**	**2.5**	**33.0**	**64.1**	**99.7**
Intact	0.0	0.0	0.2	0.0	0.2
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
TEC WITHIN EXCLUDED LANDS (ha)	0.0	2.5	6.8	54.4	63.8
TEC WITHOUT EXCLUDED LANDS (ha)	**0.0**	**0.0**	**26.3**	**9.7**	**35.9**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	0.0	2.6	0.3	2.9
Intact	0.0	0.0	0.0	0.0	0.0
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR BIODIVERSITY PURPOSE (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**N/A**	**9.8**	**3.1**	**8.0**
AVOIDANCE FOR OTHER REASONS (ha)	0.0	0.0	22.2	3.0	25.2
Intact	0.0	0.0	0.2	0.0	0.2
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR OTHER REASONS (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**N/A**	**84.5**	**31.4**	**70.2**
TOTAL AVOIDANCE (ha)	0.0	0.0	24.8	3.3	28.1
Intact	0.0	0.0	0.2	0.0	0.2
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
TOTAL AVOIDANCE (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**N/A**	**94.3**	**34.5**	**78.2**

Table 31-21: Direct impacts to Coastal Swamp Oak *(Casuarina glauca)* Forest of New South Wales and South East Queensland

	WILTON	GMAC	WSA	GPEC	TRANSPORT OUTSIDE THE NOMINATED AREAS	TOTAL IMPACTS
DIRECT IMPACTS TO TEC (ha)	**0.0**	**0.0**	**1.7**	**6.3**	**0.0**	**8.0**
Intact	0.0	0.0	0.0	0.0	0.0	**0.0**
Thinned	0.0	0.0	1.2	6.3	0.0	**7.5**
Scattered Trees	0.0	0.0	0.5	0.0	0.0	**0.5**
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0	**0.0**

TECS NOT DIRECTLY IMPACTED

31.11 CASTLEREAGH SCRIBBLY GUM AND AGNES BANKS WOODLANDS OF THE SYDNEY BASIN BIOREGION

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Endangered
DESCRIPTION	The TEC is a low woodland community with an overstorey dominated by *Angophora bakeri*, *Eucalyptus racemosa*, *E. parramattensis* subsp. *parramattensis*. *Melaleuca decora* and *Eucalyptus fibrosa* may also be present and prominent (DoE, 2015b). The midstorey is a shrub layer that commonly includes *Banksia* and *Melaleuca* species and to a lesser extent *Leptospermum trinervium*, *Dillwynia sericea*, *Monotoca scoparia*, *Platysace ericoides*, *Persoonia nutans*, *Pimelea linifolia* subsp. *linifolia* and *Hakea sericea*. The ground layer consists of a mix of grasses, other graminoids and forbs (DoE, 2015b). The TEC can intergrade into Cooks River/Castlereagh Ironbark Forest (on gravel-clay soils), Castlereagh Swamp Woodland (in moist depressions) and Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (on clay soils) (DoE, 2015b). The following PCTs are associated with the TEC: • 883 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion • 958 Narrow-leaved Apple - Hard-leaved Scribbly Gum heathy woodland on sand at Agnes Banks, Sydney Basin Bioregion A range of fauna species occur in the TEC, including reptiles, amphibians, birds, micro-bats, marsupials and invertebrates. Most of these species are not restricted to the TEC and also occur in, and are likely to rely on, other native vegetation in the Cumberland subregion (DoE, 2015b). Most plant species in the TEC are able to regenerate from lignotubers and buds beneath the bark as well as seeds stored in the soil (OEH, 2010). The TEC is equivalent to two NSW BC Act listed TECs (Castlereagh Scribbly Gum Woodland and Agnes Banks Woodland) where key diagnostic and condition thresholds are met (DoE, 2015b).

EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, understorey native vegetation cover, number of tree hollows, or whether the patch is contiguous with other native vegetation patches. Details of the thresholds are provided in the Conservation Advice (DoE, 2015b).
DISTRIBUTION	The TEC is confined to the Sydney Basin bioregion and occurs across the Cumberland subregion, and on the margins of Sydney Cataract, Wollemi and Burragorang subregions. Most of the TEC is found in larger patches in the north-west part of the Cumberland subregion in the Castlereagh area between Richmond and Llandilo. Other significant patches occur in the Holsworthy area with smaller occurrences at Tahmoor, Kemps Creek and Longneck Lagoon. The TEC primarily occurs in elevations below 80 m with mean annual rainfall of 700-900 mm. It generally occurs on Tertiary sands and gravels of the Hawkesbury-Nepean river system. At Agnes Banks, the TEC primarily occurs aeolian sands overlying Tertiary alluvium. (DoE, 2015b)
SOS SITES	The Castlereagh Scribbly Gum Woodland component of the TEC (PCT 883) has been categorised under the 'widespread' management stream for TECs under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. There is one management site at Londonderry Woodlands Reserve in Penrith. The Agnes Banks component of the TEC (PCT 958) is in the 'range-restricted' category and has a cluster of management sites near to and including Agnes Banks Nature Reserve.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice (including listing advice) for Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion (DoE, 2015b) Key Threatening Processes relevant to the TEC are identified in Appendix D of the Conservation Advice There is no adopted or made Commonwealth Recovery Plan for the TEC. The TEC is included in the Cumberland Plain Recovery Plan (NSW) (DECCW, 2011)
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=119

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area.

	It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCTs are associated with the TEC: • 883 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion • 958 Narrow-leaved Apple - Hard-leaved Scribbly Gum heathy woodland on sand at Agnes Banks, Sydney Basin Bioregion
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based on applying the condition thresholds at a landscape scale to the available data: • Patch size ≥ 0.5 ha, AND • ≥ 30% (< 50%) of the perennial understorey vegetation cover is made up of native species (based on field verification), AND • The patch is contiguous with a native vegetation remnant >1 ha in area, AND • Growing on tertiary sands and gravels of the Hawkesbury-Nepean river system OR • Patch size ≥ 0.5 ha, AND • ≥ 70% of the perennial understorey vegetation cover is made up of native species, AND • Elevations below 80 m, AND • Growing on tertiary sands and gravels of the Hawkesbury-Nepean river system OR • Patch size is ≥ 2 ha, AND • ≥ 50% of the perennial understorey vegetation cover is made up of native species (based on field verification)
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.

VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-1 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment has mapped approximately 2,769.3 ha of the TEC within the Strategic Assessment Area (see Table 31-23 for further details). Of this, 2,605.7 ha has been identified as higher viability through the viability analysis. The TEC occurs in the following main locations within the Strategic Assessment Area: • The vast majority occurs outside the nominated areas north of GPEC between Castlereagh and Windsor Downs where it is connected with larger remnants of native vegetation • Two smaller patches occur to the south of WSA near Kemps Creek • Several patches occur outside the nominated areas around Holsworthy and Pitt Town It does not occur in any of the nominated areas or transport corridors. The Conservation Advice does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. It states that all patches that meet the minimum (moderate class) condition thresholds as defined in the advice (categories A and B) are considered habitat critical to the survival of the TEC. These are generally: • Patch sizes ≥ 0.5 ha with ≥ 30% native understorey and patches that are well-connected to a native vegetation remnant of ≥ 1 ha in area • Patch sizes ≥ 0.5 ha with ≥ 50% native understorey The Conservation Advice also identifies several factors affecting the value of a patch, including: • A larger size and/or large area to boundary ratio • Part of a larger remnant of native vegetation or linking other remnants • Evidence of recruitment of key plant species/range of age cohorts • Good faunal habitat • High native species richness • Presence of threatened species • Low level of weeds and pest animals

	The TEC is highly fragmented across the Strategic Assessment Area, comprising approximately 140 patches with an average patch size of approximately 19.8 ha. Because the TEC intergrades into other vegetation types, many patches of the TEC are surrounded by larger areas of native vegetation, which provides some buffer from potential impacts associated with edge effects.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

None of the TEC was mapped within the nominated areas or transport corridors. Avoidance of the TEC was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8 and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will not lead to direct impacts or fragmentation of the TEC. As a result, the Plan does not provide offsets for the TEC.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.11.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice identifies a range of threats to the TEC. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion

- Inappropriate habitat disturbance
- Diseases, pathogens, and dieback
- Invasive fauna

Climate change is a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

A number of other threats were identified in the Conservation Advice. However, none of these are considered likely to impact the TEC. They are:

- Changes to hydrology. The distance of the TEC away from urban and transport development areas means that changes in hydrology is not a relevant indirect impact
- Grazing. Implementation of the Plan will not exacerbate this risk across the Strategic Assessment Area

INAPPROPRIATE FIRE REGIMES

Inappropriate fire regimes can affect the structure and species composition of the TEC by altering the mid and ground layers. Low seedling recruitment has been observed in the TEC, which is thought to be associated with extended dry periods and too frequent fire. Many plant species in the TEC can survive for decades as seeds stored in the soil, bulbs, corms, rhizomes, rootstocks or lignotubers (DoE, 2015b).

While most impacts to the TEC are associated with increased fire, in some areas the TEC is threatened due to a lack of fire because of its proximity to residential areas. This generally occurs where the TEC has not been burnt for over 30 years (DoE, 2015b).

Inappropriate fire regimes can be caused by:

- Increased fire frequency due to arson and accidental lighting of fires
- Increased fire frequency due to the application of fire by authorities to manage fire risk
- In other cases, a lack of fire due to challenges in burns in proximity to human habitation

While it is noted that the TEC does not occur in any of the nominated areas, increased human activity across the Strategic Assessment Area may increase the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban capable land. For the TEC, the closest areas are to the north of GPEC (Londonderry area) and to the south of WSA (near Kemps Creek).

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, the relevant measures for this TEC include a commitment (Commitment 17) to manage fire in strategic locations across the Strategic Assessment Area. This includes a number of actions with the most relevant to the outcome for the TEC being:

- Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
- Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
- A process to work with delivery partners to implement the fire management strategy
- Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans

The measures in the Plan are expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas.

These controls are consistent with a high priority conservation action in the Conservation Advice to “Undertake appropriate fire management practices…”.

WEED INVASION

The TEC is threatened with invasion and competition by weeds. Weed incursion in the TEC is associated with agricultural activities as well as urban development. The most serious threats are: Cootamundra wattle (*Acacia baileyana*), Flat weed (*Hypochaeris radicata*), African love grass (*Eragrostis curvula*), Kikuyu (*Cenchrus clandestinus*) and several other grasses and vines (DoE, 2015b).

These weeds are already present within the Strategic Assessment Area and pose a threat to the TEC. However, the development has the potential to increase the spread of these weeds by providing more opportunities for weed dispersal or changing conditions to favour weeds.

While it is noted that the TEC does not occur in any of the nominated areas, the TEC may be susceptible to the landscape threat of weeds driven by new urban development.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, the relevant measures for this TEC include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because the Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC.

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of weeds.

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Conservation Advice as a threat to the TEC. This relates to a wide range of different mechanisms for disturbance including:

- Inappropriate mowing, slashing, or scrubbing of the understorey for reasons such as bushfire fuel reduction, grazing and perceived aesthetics
- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants
- Inappropriate recreational activities such as ad hoc track building and trail bike use which can directly impact areas of the TEC and facilitate processes such as erosion
- Removal of wood which changes the structure and habitat features of the TEC

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the Strategic Assessment Area may increase due to development within the nominated areas.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing

- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

DISEASES, PATHOGENS, AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens, and dieback which can substantially affect their long-term viability. Recognised threats include myrtle rust and dieback caused by the root-rot fungus *Phytophthora cinnamomi*.

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

While many of these disease pathways are not relevant to the TEC given the distance it occurs from the nominated areas, the Plan incorporates a range of general measures to manage the risks associated with diseases, pathogens, and dieback. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs
- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

INVASIVE FAUNA

TECs can be threatened by introduced animals and aggressive native species. These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as foxes, rats, house mice, and rabbits, which are primarily related to agricultural development
- Aggressive bird species which compete for resources including the introduced Indian myna, and native species such as the sulphur-crested cockatoo

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers.

In relation to aggressive bird species, the two main drivers for increasing the threat within the TEC are:

- Fragmentation of habitat which creates greater edge effects and facilitates access by aggressive bird species. As outlined above there will be no direct impacts due to implementation of the Plan and no fragmentation of the TEC
- Habitat disturbance through inappropriate land management which can change the structure of the TEC and facilitate access by aggressive bird species. As outlined above in relation to inappropriate habitat disturbance, the Plan includes a package of measures which are expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of general measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the Strategic Conservation Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:
    - Ensure that domestic animals are appropriately contained at urban/bushland interfaces
    - Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
    - Require appropriate management and control of pest animals relevant to development sites

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

Given the TEC does not occur within the nominated areas or transport corridors, there is no risk of additional impacts from essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.11.2 IMPLICATIONS FOR LONG-TERM VIABILITY

As outlined above, implementation of the Plan will not lead to any direct impacts to the TEC and potential indirect impacts will be managed. This will ensure that the implementation of the Plan does not adversely influence the long-term viability of the TEC.

31.11.3 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.11.4 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 31-22 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan is not inconsistent with any of the relevant TAPs. Please refer to Section 15.9 of Chapter 15 for a detailed discussion of each TAP and the relationship of the Plan.

Table 31-22: Key Threatening Processes and relevant Threat Abatement Plans for Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoEE, 2018g)
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Novel biota and their impact on biodiversity	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data table for occurrence. Cross references to the table are provided throughout the text above.

Table 31-23: Occurrence of Castlereagh Scribbly Gum and Agnes Banks Woodlands in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**2,769.3**	**491.8**
Intact	2,658.3	488.7
Thinned	111.1	3.0
Scattered Trees	0.0	0.0
Higher Viability TEC	2,605.7	456.8

31.12 ELDERSLIE BANKSIA SCRUB FOREST IN THE SYDNEY BASIN BIOREGION

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	The TEC is a type of scrubby forest or woodland limited to sandy substrates associated with deep Tertiary sand deposits on the Nepean River floodplain (DAWE, 2020a) . The canopy may include *Banksia intergrifolia* subsp. *intergrifolia* (Coast Banksia), *Angophora subvelutina*, *Eucalyptus botryoides* x *E. saligna* and other *Eucalyptus* species, with a subcanopy of Coast Banksia, or *Melaleuca decora* and *M. linariifolia* in wetter areas (DAWE, 2020a). The midstorey is a shrub layer that commonly includes *Acacia* species, *Aotus ericoides*, *Brachyloma daphnoides*, *Dillwynia glaberrima*, and *Persoonia linearis* (DAWE, 2020a). In some areas, the TEC has elements associated with dry rainforest and riverflat forest, including *Clematis* species, *Clerodendrum tomentosum*, *Duboisia myoporoides*, *Kunzea ambigua* and *Platysace lanceolate*. The ground layer consists of a mix of ferns, graminoids and forbs. A range of fauna species may occur in the TEC, including amphibians, reptiles, birds, and mammals. However, as a result of historical modifications to the structure of the TEC and a loss of important habitat features, remnants of the TEC are likely to be of value only to the more disturbance-tolerant or highly mobile species (DAWE, 2020a). The TEC is equivalent to the BC Act listed TEC of the same name, which is equivalent to PCT 774. It also includes areas that intergrade with surrounding forest described in NSW as either River Flat Eucalypt Forest (PCT 835), Moist Shale Woodland (PCT 830) or Cumberland Plain Woodland (PCT 849 or 850), provided that the key diagnostic characteristics are met (DAWE, 2020a).
EPBC DEFINITION	Condition thresholds have not been applied to this TEC because of the very small size of patches and extent of the TEC remaining. All remaining patches are considered to comprise the TEC and are critical to the survival of the community, including degraded patches (DAWE, 2020a).
DISTRIBUTION	The TEC is restricted to the Cumberland subregion within the Sydney Basin bioregion. It is only known from the Camden LGA. Known patches are small and occur in an extensively cleared and mined Tertiary sand deposit at Spring Farm, near Elderslie (DAWE, 2020a). The TEC primarily occurs in elevations of 60-100 m with mean annual rainfall of approximately 750 mm (DAWE, 2020a).
SOS SITES	The TEC is in the 'range-restricted' category under the SOS program. Currently there is one management site at Spring Farm in Camden.

RELEVANT PLANS AND POLICIES	Conservation Advice for the Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion (DAWE, 2020a) Key Threatening Processes relevant to the TEC are identified in Appendix C of the Conservation Advice There is no adopted or made Commonwealth Recovery Plan for the TEC
SPRAT LINK	https://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=145

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area. It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed

	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands • **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species
ASSOCIATED PCTs	The following PCT is associated with the TEC: • 774 Coast Banksia scrub on sand in the Elderslie area
MAPPING APPROACH	PCT 774 was used to map the TEC. Note that as no condition thresholds have been applied to the TEC under the Conservation Advice, all remaining patches of PCT 774 would comprise the EPBC TEC provided that the key diagnostic characteristics are met.
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.
VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio It is important to note that the viability assessment is less relevant for this TEC given its highly restricted extent and distribution.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-9 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment has mapped approximately 9.4 ha of the TEC within the Strategic Assessment Area (see Table 31-23 for further details). The TEC occurs in the one location within the Strategic Assessment Area – in Spring Farm, north of the Nepean River and south-east of Camden. The TEC does not occur in any of the nominated areas or transport corridors. The closest urban capable land occurs in GMAC approximately 3 km to the east. The OSO tunnel occurs approximately 4.5 km to the west, and the Metro Rail Future Extension tunnel occurs approximately 1.8 km to the north-east. The Conservation Advice states that, due to the very small size of patches and extent of the TEC remaining, all remaining patches are considered habitat critical to the survival of the TEC. The TEC is fragmented and comprises three patches with an average patch size of approximately 2.9 ha. Because the TEC intergrades into other vegetation types, some patches of the TEC are

	surrounded by larger areas of native vegetation, which provides some buffer from potential impacts associated with edge effects.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

None of the TEC was mapped within the nominated areas or transport corridors. Avoidance of the TEC was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8 and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will not lead to direct impacts or fragmentation of the TEC. As a result, the Plan does not provide offsets for the TEC.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.12.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice identifies a range of threats to the TEC. As outlined in Chapter 15 (Section 15.5 and Attachment A), consideration was given to the potential relevance of these threats as indirect impacts that may result from implementation of the Plan.

Given the limited extent of the TEC in the Strategic Assessment Area, the distance that it occurs from the nominated areas and transport corridors, and its location within and immediately adjacent to existing urban areas, it is considered unlikely that implementation of the Plan would exacerbate most of the identified threats and would therefore not generally result in indirect impacts on the TEC. However, there is some potential for the OSO and Metro Rail Future Extension tunnels to cause hydrological impacts that may affect the TEC.

Climate change is a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

It is also worth noting that the Plan includes a range of landscape scale measures that will protect biodiversity (e.g. protection of large areas of land, fire management strategy, Weed Control Strategy, and pest animal control implementation strategy). These measures will benefit all biodiversity in the Cumberland subregion and may potentially relate to this TEC.

CHANGES TO HYDROLOGY

The Conservation Advice identifies changes to hydrology as a threat to the TEC. The main hydrology-related threat identified in the advice is increased runoff into patches of the TEC from surrounding urban capable land, carrying high nutrient and sediment loads, as well as weed seeds or propagules. This can both encourage weed invasion and cause erosion (DAWE, 2020a). The Plan is unlikely to exacerbate this threat to the TEC.

However, the OSO and Metro Rail Future Extension tunnels have the potential to cause groundwater level drawdown into the tunnel void and water quality impacts from the disposal of poor-quality groundwater and surface water drainage from the tunnels during operation. While the tunnels occur some distance from the TEC, there is potential for this to affect groundwater flows in the area, which may affect the TEC. The Conservation Advice identifies that groundwater discharge may be the cause of the some of the wetter areas within the TEC (DAWE, 2020a).

The Metro Rail Future Extension tunnel is also near the top of the sub-catchment of Spring Creek. The Conservation Advice identifies that remnants of the TEC occur along Spring Creek, and further pollution of this waterway risks additional contamination of its riparian soils (DAWE, 2020a).

The Plan includes a commitment to mitigate indirect impacts from the major transport corridors (Commitment 6). This commitment will be delivered through NSW environmental assessment and approval processes. As described in Part 2 and assessed in Chapter 36, each transport project will be subject to future strategic planning and detailed design and a process of environmental assessment and approval. For the transport corridors outside the nominated areas (where biodiversity impacts have not been assessed under the BC Act - see Part 1), including the OSO and Metro Rail Future Extension tunnels, this process will involve assessment under both:

- State Significant Infrastructure approval process (or equivalent)
- BC Act and BAM (or equivalent)

The process under the BC Act and BAM will address the potential indirect impacts of the tunnels on biodiversity values and the State Significant Infrastructure approval process (or equivalent) will assess the other environmental impacts and matters that need to be considered prior to construction and operation of the transport project. These processes will include an assessment of risks to the environment and the identification of mitigation measures to manage these risks from impacts related to hydrology and water quality, including groundwater drawdown.

This commitment and process to assess and mitigate the indirect impacts of the tunnels through a future environmental assessment and approval processes is considered adequate to address any risk of hydrology impacts to the TEC.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

Given the TEC does not occur within the nominated areas or transport corridors, there is no risk of additional impacts from essential infrastructure. The OSO and Metro Rail Future Extension tunnels have the potential to cause hydrological impacts. This is discussed above.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.12.2 IMPLICATIONS FOR LONG-TERM VIABILITY

As outlined above, implementation of the Plan will not lead to any direct impacts to the TEC and potential indirect impacts associated with the OSO and Metro Rail Future Extension tunnels are considered to be adequately managed. This will ensure that the implementation of the Plan does not adversely influence the long-term viability of the TEC.

31.12.3 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.12.4 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Given the lack of direct impacts and limited indirect impacts, there are no relevant Key Threatening Processes (KTPs) or associated Threat Abatement Plans (TAPs).

DATA TABLES

This section sets out the data table for occurrence. Cross references to the table are provided throughout the text above.

Table 31-24: Occurrence of Elderslie Banksia Scrub Forest in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**9.4**	**2.5**
Intact	9.4	2.5
Thinned	0.0	0.0
Scattered Trees	0.0	0.0
Higher Viability TEC	0.0	0.0

31.13 TURPENTINE-IRONBARK FOREST OF THE SYDNEY BASIN BIOREGION

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	The TEC is an open forest with a canopy of eucalypts and other trees that can reach 30 m tall. The midstorey comprises shrubs and small trees with a ground layer of herbs and grasses. The canopy is normally dominated by Turpentine (*Syncarpia glomulifera*) and a variety of eucalypt species. The midstorey may include small trees such as Sweet Pittosporum (*Pittosporum undulatum*), Native peach (*Trema aspera*) and Parramatta Wattle (*Acacia parramattensis*), and a shrub layer with Elderberry Panax (*Polyscias sambucifolia*), Mock Olive (*Notelaea longifolia*), and Prickly Beard-heath (*Leucopogon juniperinus*) amongst others. The ground layer may include Forest Hedgehog-grass (*Echinopogon ovatus*), Weeping Grass (*Microlaena stipoides*) and Kangaroo Grass (*Themeda triandra*) (DoE, 2014i). The occurrence of the TEC is transitional between Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest in drier areas, and Blue Gum High Forest in areas with higher rainfall. The following PCTs are associated with the TEC: • 792 Deane's Gum - Mountain Grey Gum - Turpentine tall moist forest on shale, Sydney Basin Bioregion • 1183 Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion • 1281 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion • 1284 Turpentine - Smooth-barked Apple moist shrubby forest of the lower Blue Mountains, Sydney Basin Bioregion A range of fauna species occur in the TEC, including small mammals, birds, reptiles, amphibians, and a large range of invertebrates. Most of these fauna species are not restricted to the TEC and occur in, and are likely to rely on, other native vegetation in the Cumberland subregion. The TEC is equivalent to two NSW BC Act listed TECs – Sydney Turpentine-Ironbark Forest, and Blue Mountains Shale Cap Forest – where key diagnostic and condition thresholds are met (DoE, 2014i).

EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, understorey native vegetation cover, number of tree hollows, or whether the patch is contiguous with other native vegetation patches. Details of the thresholds are provided in the Conservation Advice (DoE, 2014i).
DISTRIBUTION	The TEC is confined to the Sydney Basin bioregion and mostly restricted to the Cumberland subregion and immediate surrounds. It has a scattered distribution to the west of Richmond, Penrith and Picton and in the north-east of the subregion. The TEC primarily occurs in the Cumberland subregion and up to 750 m on shale caps of the Woronora, Blue Mountains and Hornsby Plateaux, with mean annual rainfall of 800 - 1100 mm per year. It generally occurs on fertile clay soils derived from Wianamatta shale, and clay of shale lenses within Hawkesbury Sandstone (DoE, 2014i).
SOS SITES	The TEC has been categorised under the 'widespread' management stream for TECs under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. Currently there are two proposed management sites for this TEC: • Lane Cove National Park • Wallumatta Nature Reserve
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for Turpentine–Ironbark Forest in the Sydney Basin Bioregion (DoE, 2014i) Key Threatening Processes relevant to the TEC are identified in Page 4 of the Conservation Advice There is no Recovery Plan for the TEC
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=38

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area. It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-

	based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCTs are associated with the TEC: • 792 Deane's Gum - Mountain Grey Gum - Turpentine tall moist forest on shale, Sydney Basin Bioregion • 1183 Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion • 1281 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion • 1284 Turpentine - Smooth-barked Apple moist shrubby forest of the lower Blue Mountains, Sydney Basin Bioregion
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based applying the condition thresholds at a landscape scale to the available data: • Condition class (A or B, low and moderate), AND • Patch > 1 ha, AND • Tree canopy cover > 10% (field verification) OR • Condition class (A or B, low and moderate), AND • Patch > 1 ha, AND • Tree canopy cover < 10% (field verification), AND • Part of a remnant of native vegetation > 5 ha
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.
VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches".

	The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches • Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-7 for a map of the TEC across the Strategic Assessment Area.

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment has mapped approximately 44.4 ha of the TEC within the Strategic Assessment Area (see Table 31-25 for further details). Of this, approximately 6.4 ha has been identified as higher viability through the viability analysis.
	The TEC occurs in the following main locations within the Strategic Assessment Area:
	• In the north-west, next to the Blue Mountains National Park, 16.4 km from GPEC
	• In the southeast, near Minto Heights:
	  ○ 1 km from the boundary of GMAC
	  ○ 5.2 km from the GMAC urban capable footprint
	There are no mapped occurrences of the TEC within the nominated areas or transport corridors.
	The Conservation Advice does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. The Conservation Advice states that all patches meeting the condition thresholds in the listing advice are eligible to be considered under the EPBC Act for actions that may require referral. These are generally:
	• Patches > 1 ha with tree canopy cover of > 10%
	• Patches > 1 ha with tree canopy < 10% only if they are part of a remnant of native vegetation ≥ 5 ha in area
	The TEC is fragmented across the Strategic Assessment Area, comprising 10 patches with an average patch size of 4.4 ha.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

None of the TEC was mapped within the nominated areas or transport corridors. Avoidance of the TEC was therefore not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8 and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will not lead to direct impacts or fragmentation of the TEC. As a result, the Plan does not provide offsets for the TEC.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.13.1 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice identifies a range of threats to the TEC. As outlined in Chapter 15 (Section 15.5 and Attachment A), consideration was given to the potential relevance of these threats as indirect impacts that may result from implementation of the Plan.

Given the limited extent of the TEC in the Strategic Assessment Area and the distance that it occurs from the nominated areas, it was considered unlikely that implementation of the Plan would exacerbate any of the identified threats and would therefore not result in any indirect impacts.

Climate change is a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

It is worth noting that the Plan includes a range of landscape scale measures that will protect biodiversity (e.g. protection of large areas of land, fire management strategy, Weed Control Strategy, and pest animal control implementation strategy). These measures will benefit all biodiversity in the Cumberland subregion and may potentially relate to this TEC.

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*

- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

Given the TEC does not occur within the nominated areas or transport corridors, there is no risk of additional impacts from essential infrastructure or tunnels.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.13.2 IMPLICATIONS FOR LONG-TERM VIABILITY

As outlined above, implementation of the Plan will not lead to any direct or indirect impacts to the TEC. This will ensure that the implementation of the Plan does not adversely influence the long-term viability of the TEC.

31.13.3 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.13.4 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Given the lack of direct and indirect impacts, there are no relevant Key Threatening Processes (KTPs) or associated Threat Abatement Plans (TAPs).

DATA TABLES

This section sets out the data table for occurrence. Cross references to the table are provided throughout the text above.

Table 31-25: Occurrence of Turpentine–Ironbark Forest in the Sydney Basin Bioregion in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**44.4**	**1.3**
Intact	6.4	<0.1
Thinned	36.9	1.3
Scattered Trees	1.1	0.0
Higher Viability TEC	6.4	0.0

31.14 WESTERN SYDNEY DRY RAINFOREST AND MOIST WOODLAND ON SHALE

This assessment analyses the implications of implementation of the Cumberland Plain Conservation Plan on the TEC in accordance with the EPBC Terms of Reference. It sets out:

- *TEC background*
- *Approach to baseline data*
- *Occurrence in the Strategic Assessment Area*
- *Avoidance of impacts*
- *Direct impacts and offsets*
- *Potential indirect impacts and mitigation*
- *Potential additional impacts from essential infrastructure and tunnels*
- *Likely effects of implementation of the Plan on the long-term viability of the TEC*
- *Data tables*

THREATENED ECOLOGICAL COMMUNITY BACKGROUND

This section sets out the basic information about the TEC. It provides a description of the TEC, and an overview of the listing definition and its distribution. These provide context for the impact assessment. At the end of the section are links to key documents that provide additional background information.

EPBC ACT LISTING	Critically Endangered
DESCRIPTION	The TEC varies from low closed rainforest on lower slopes and in gullies, to more open, moist woodland on upper slopes and in disturbed sites. The rainforest form of this TEC is dominated by non-eucalypts including Prickly-leaved Paperbark (*Melaleuca styphelioides*), Hickory Wattle (*Acacia implexa*), Native Quince (*Alectryon subcinereus*) and White Euodia (*Melicope micrococca*). The woodland form has a more open canopy dominated by eucalypts, including Forest Red Gum (*Eucalyptus tereticornis*) and Coastal Grey Box (*E. moluccana*). The lower layers of the TEC may include shrubs of varying density, and a sparse groundcover of grasses, herbs, and forbs. Vines and scramblers may also be present. This TEC is also characterised by a number of moisture-dependent plants such as ferns and broad-leaved shrubs. The following PCTs are associated with the TEC: • 830 Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion • 877 Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion Vine thickets within this TEC provide good habitat for birds and mammals. A range of fauna species occur in the TEC, including small mammals (particularly microbats), birds, reptiles, frogs, and a large range of invertebrates. Most of these fauna species are not restricted to the TEC and also occur in, and are likely to rely on, other native vegetation in the Cumberland subregion. The TEC is equivalent to the NSW BC Act listed Western Sydney Dry Rainforest and Moist Shale Woodland TECs where key diagnostic and condition thresholds are met (DoE, 2015h; DSEWPC, 2012b; OEH, 2019j; TSSC, 2013).
EPBC DEFINITION	Only patches of the TEC that meet minimum size and condition thresholds are considered part of the TEC under the EPBC Act. Thresholds relate to factors such as patch size, species richness and weed cover. Details of the thresholds are provided in the listing advice (TSSC, 2013).
DISTRIBUTION	The TEC has a highly restricted distribution, and is confined to the Sydney Basin bioregion, with most occurrences within the Cumberland subregion. Remnants of this TEC occur in the Wollondilly, Camden, Campbelltown, Holroyd, Fairfield, Liverpool, Penrith, Hawkesbury, and The Hills LGAs.

	The TEC is restricted to shale soils of the Wianamatta Group, and is found in sheltered slopes, gullies, and steep land. It is generally limited to elevations below 300 m. Only approximately 28 per cent of the pre-European extent of the TEC remains. Remnants of the TEC are highly fragmented, with 99 per cent of patches under 10 ha in size, and 60 per cent of fragments under 1 ha in size. It is estimated that the TEC has a total remaining area of 950 ha (DSEWPC, 2012b; TSSC, 2013).
SOS SITES	The two NSW BC Act-listed TECs that correlate to the TEC have been categorised under the 'widespread' management stream under the SOS program. Management of this category of TECs focuses on planning and regulatory processes, policy and programs, and private land conservation and reservation of land. There are four active management sites for Western Sydney Dry Rainforest: • Sugarloaf • West Hoxton • Mt. Annan • Razorback Range For Moist Shale Woodland, there is one proposed management site at Mulgoa Nature Reserve.
RELEVANT PLANS AND POLICIES	Approved Conservation Advice for Western Sydney Dry Rainforest and Moist Woodland on Shale (DSEWPC, 2012b) Listing advice for Western Sydney Dry Rainforest and Moist Woodland on Shale (TSSC, 2013) Key Threatening Processes relevant to the TEC are identified in Page 3 of the Conservation Advice There is no Recovery Plan for the TEC Threat Abatement Plans relevant to the TEC are identified in Table 31-26
SPRAT LINK	http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=106

APPROACH TO BASELINE DATA

This section provides an overview of the approach to baseline data for the TEC. It:

- *Provides a summary of the approach to vegetation mapping for the strategic assessment which forms the baseline for the TEC mapping*
- *Outlines the vegetation condition states used in the mapping*
- *Identifies the NSW Plant Community Types (PCTs) that are associated with the TEC*
- *Summarises the approach to mapping the EPBC TEC*
- *Summarises the approach to the patch size analysis for the TEC*
- *Summarises the approach to identifying areas of likely higher long-term viability in the Strategic Assessment Area*

Please refer to Section 11.3 (in Chapter 11) for details about the methods for mapping native vegetation, and Section 11.4.3 for details about the mapping methods for EPBC TECs.

APPROACH TO VEGETATION MAPPING	Native vegetation was mapped at two levels for the strategic assessment. Within the nominated areas, native vegetation was mapped using a method consistent with the BAM. This involved using a combination of API, existing desktop mapping, previous surveys and studies, rapid assessment ground-truthing, and field surveys (including floristic plot surveys). This process resulted in detailed maps of PCTs categorised by condition. Outside the nominated areas, native vegetation was mapped using the best available data integrated into a single dataset. Vegetation condition states were also applied across the broader area. It should be noted that comprehensive on-ground surveys across all native vegetation within the nominated areas was not possible and no surveys were undertaken outside the nominated areas. This means that a set of assumptions around the available data was required to translate the site-

	based condition thresholds for the EPBC TEC so that it could be mapped at the scale of the Strategic Assessment Area. These assumptions are summarised below and explained in detail in Section 11.4.3 of Chapter 11.

VEGETATION CONDITION STATES	Vegetation condition was mapped using the following five condition states. These states generally range from better (intact) to worse (urban native/exotic) condition and are:
	• **Intact:** This condition state was assigned to areas of wooded vegetation community, including regrowth, that displays a range of structural layers and habitat features (e.g. tree hollows and large trees, fallen timber, leaf litter) with a largely unmodified canopy density and a range of age classes and species present
	• **Thinned:** This condition state was assigned to native vegetation in various states of modification, including:
	  ○ Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact PCT
	  ○ Wooded vegetation that has been under scrubbed
	• **Scattered trees:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed
	• **Grasslands:** Grasslands included two separate state zones – exotic grassland and native grasslands
	• **Urban native/exotic:** This condition type was assigned to areas of vegetation within urban areas that consisted of street trees, urban parks and other patches of planted vegetation that could provide habitat for native species

ASSOCIATED PCTs	The following PCTs are associated with the TEC: • 830 Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion • 877 Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion
MAPPING APPROACH	Mapping of the TEC across the Strategic Assessment Area used the following criteria which are based applying the condition thresholds at a landscape scale to the available data: • Patch size ≥ 0.1 ha, AND • At least 20 native species present in sample 0.04 ha plot (based on field verification), AND • Non-native perennial plants no more than 50 per cent of total vegetation cover (based on field verification), AND • Below 300 m elevation, AND • Growing on clay soils derived from Wianamatta Group sediments
PATCH SIZE ANALYSIS	As outlined in Section 31.3, a patch size analysis for the ecological community was undertaken to identify the number and size of patches across the Strategic Assessment Area.
VIABILITY ASSESSMENT	As outlined in Section 31.4, an analysis was undertaken to identify areas of likely higher long-term viability for the TEC in the Strategic Assessment Area The purpose of the analysis was to identify the patches of the TEC within the Strategic Assessment Area that are more likely to be viable in the longer term to inform the evaluation of the overall outcome of the Plan for the TEC. Viability is defined in a qualitative sense as the "probability of long-term survival of TEC patches". The approach involved reviewing Conservation Advices for each TEC to identify the factors that influence the long-term viability or conservation significance of a patch of the TEC. This review found that Conservation Advices generally identify a similar set of factors that influence long-term viability. Key factors included: • Larger patches are generally more viable than smaller patches • Better condition patches are generally more viable than poorer condition patches • Connected patches are generally more viable than poorer connected patches

	• Patches with a lower edge/area ratio are generally more viable than patches with a higher edge/area ratio

OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA

This section describes the occurrence of the TEC in the Strategic Assessment Area. It includes reference to a map which can be viewed as a separate file. The map provides critical context for the assessment and should be viewed in conjunction with the text presented in this assessment. This section also provides a qualitative description of where the TEC occurs.

MAP	See Map 31-8 for a map of the TEC across the Strategic Assessment Area.
OCCURRENCE IN THE STRATEGIC ASSESSMENT AREA	The baseline mapping for this assessment has mapped approximately 968.1 ha of the TEC within the Strategic Assessment Area (see Table 31-27 for further details). Of this, approximately 664 ha has been identified as higher viability through the viability analysis. The majority of the TEC occurs in the southern part of the Strategic Assessment Area around Picton, in a landscape that has been heavily cleared for farming. In this locality, the TEC often occurs as small to moderate patches along the edges of escarpments surrounded by farmland. In the nominated areas it occurs within: • GMAC (16.2 ha) in the central portion near to Rosemeadow • GPEC (2.4 ha) on the western side near the Mulgoa Nature Reserve It does not occur in the other nominated areas or transport corridors. The Conservation Advice does not specifically identify any sites in the Strategic Assessment Area that are important to the TEC. The Conservation Advice states that all patches of a reasonable size and in the highest condition categories as defined in the advice (categories A and B) are considered habitat critical to the survival of the TEC. These are generally: • Large (≥ 5 ha) or moderate patches (≥ 2 ha and < 5 ha) with a predominately native understory • Well-connected smaller patches (< 2 ha and ≥ 0.5 ha) with a predominately native understory The Conservation Advice also identifies several factors affecting the value of a patch, including: • A larger size and/or a high area to boundary ratio • Part of a larger remnant of native vegetation or linking other remnants • Evidence of recruitment of key plant species/range of age cohorts • High native species richness • Presence of threatened species • Low level of weeds and pest animals The TEC is highly fragmented across the Strategic Assessment Area, comprising 196 patches with an average patch size of 4.8 ha. Only 10 patches are greater than 20 ha. A large number of patches occur in close proximity to existing urban development or farmland and are likely to be exposed to substantial edge effects.

AVOIDANCE OF IMPACTS

This section provides an overview of the area of the TEC that was avoided through the design of the urban capable land within the nominated areas. Avoidance of impacts to biodiversity was a critical part of the process to develop the Plan. A detailed explanation of the avoidance process and terminology is provided in Chapter 14.

31.14.1 NOMINATED AREAS

The baseline mapping for this assessment mapped 15.2 ha of the TEC within the nominated areas (not including excluded lands). All of this has been avoided as part of the design of the urban capable land and transport corridors (not including excluded lands). Of this:

- 10.5 ha was avoided for biodiversity purposes
- 4.7 ha was avoided for other purposes

An additional 3.3 ha occurs on excluded lands.

A breakdown of avoidance across each nominated area is provided in Table 31-28.

It is important to note that the avoidance calculations in Table 31-28, including for 'avoidance for biodiversity purposes', 'avoidance for other reasons', and 'total avoidance', have been calculated without including excluded lands as these lands are not covered by the Plan. Table 31-28 shows the amounts of habitat within excluded lands for context only.

31.14.2 TRANSPORT

None of the TEC occurs in transport corridors so avoidance of impacts was not necessary.

DIRECT IMPACTS AND OFFSETS

This section provides an analysis of any direct impacts and (if appropriate) identifies the need for any offsets to compensate for these direct impacts. It considers:

- *Predicted impacts within urban capable land and transport corridors*
- *Potential issues associated with fragmentation*
- *Potential additional impacts from essential infrastructure (within nominated areas but outside the urban capable land) and tunnels associated with transport projects*

Offsets are provided for any TECs that are subject to direct impacts. The rationale and process for setting offset targets for TECs is set out in Section 8.5.2 of Chapter 8 and explained in detail in the Conservation Priorities Method that supports the Plan.

Implementation of the Plan will not lead to direct impacts or fragmentation of the TEC. The Plan provides a small offset target of 0.2 ha for this TEC.

POTENTIAL INDIRECT IMPACTS AND MITIGATION

This section identifies the relevant potential indirect impacts to the TEC that may occur as a result of development under the Plan. Indirect impacts were identified as being relevant to the TEC if:

- *The indirect impact is identified as a threat in a relevant profile, conservation advice or recovery plan, and*
- *The threat is present in the Cumberland subregion, and*
- *The Plan has the potential to exacerbate the threat*

It discusses each relevant potential indirect impact in detail and outlines how the Plan addresses it.

Please refer to Chapter 15 for a detailed discussion and analysis of indirect impacts and mitigation measures included in the Plan. It is critical to read Chapter 15 in order to understand the conclusions reached in this section.

31.14.3 RELEVANT POTENTIAL INDIRECT IMPACTS

The Conservation Advice identifies a range of threats to the TEC. Where these threats are present in the Strategic Assessment Area and have the potential to be exacerbated under the Plan, the Plan includes management strategies to

mitigate their impacts. As outlined in Chapter 15 (Section 15.5 and Attachment A), the following potential indirect impacts (identified as threats in the Conservation Advice) are considered relevant to implementation of the Plan:

- Inappropriate fire regimes
- Weed invasion
- Inappropriate habitat disturbance
- Changes to hydrology
- Diseases, pathogens, and dieback
- Invasive fauna

Climate change is also a relevant threat to the ecological community. The extent to which the Plan has considered adaptation to climate change impacts is addressed in Chapter 41.

Impacts from logging and inappropriate grazing were also identified in the Conservation Advice as key threats. However, neither of these are considered relevant to implementation of the Plan as the Plan is unlikely to exacerbate these risks across the Strategic Assessment Area.

The Plan includes commitments to mitigate indirect impacts from urban and industrial development, infrastructure, and intensive plant agriculture (Commitment 5) on TECs, including meeting specific mitigation requirements in accordance with Appendix E of the Plan. Relevant actions under these commitments and specific mitigation measures for this TEC are discussed below for each identified indirect impact.

INAPPROPRIATE FIRE REGIMES

The TEC contains rainforest and mesic plants which are not well-adapted to fire, and the TEC is negatively impacted by fire events. The existing fragmentation of the landscape means that fire events may lead to localised extinctions of the TEC, as recolonisation of a burnt area by neighbouring populations may not be possible (TSSC, 2013).

Increased fire frequency can be caused by:

- Arson and accidental lighting of fires
- Application of fire by authorities to manage fire risk

Increased human activity within the nominated areas increases the risk of arson or accidental fires and may lead to further increases in fire frequency that could impact the TEC. Key risk areas are those that are easily accessible to the public and in close proximity to urban capable land. Bushfire management by authorities is also likely in areas close to new urban capable land. For the TEC this includes the areas in GMAC.

The Plan incorporates a range of general measures to manage the bushfire risk to biodiversity. In summary, these include:

- A commitment (Commitment 17) to manage fire in strategic locations across the Strategic Assessment Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - Consultation with fire management authorities and traditional owners about how best to manage fire and maintain biodiversity values
    - Preparation of a fire management strategy in priority locations that will (amongst other things) provide guidance on fire management to maintain and promote biodiversity values
    - A process to work with delivery partners to implement the fire management strategy
    - Integration of the fire management actions for conservation land identified in the fire management strategy in stewardship agreements and reserve management plans
- Introduction of a SEPP (Strategic Conservation Planning) that will:
    - Set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to managing fire risk
    - Require asset protection zones (APZs) to be wholly within urban capable land. This will ensure the highest intensity bushfire risk mitigation activities occur away from the TEC. While these APZs are designed to

provide a buffer zone between a bushfire hazard and buildings or other infrastructure that need to be protected, they will also act as a protective buffer for the bushland areas from the sorts of activities within the urban capable land and transport corridors that might increase fire frequency or changes to natural fire regimes

The package of measures in the Plan is expected to adequately manage the risk to the TEC from altered fire regimes as a result of development. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- APZs for fire management are required to be located within urban capable land which will reduce the risk of fire mitigation activities impacting the TEC
- Fire management authorities will be engaged to ensure they understand the requirements of the TEC and incorporate them in their fire management practices. This will include specific fire management approaches for conservation areas

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of fire.

WEED INVASION

The TEC is threatened with invasion and competition by weeds. Notable weeds which threaten this TEC include Lantana (*Lantana camara*) and African Olive (*Olea europa* subsp. *cuspidata*). These weeds are already present in the Cumberland subregion and threaten the TEC (DSEWPC, 2012b).

The TEC is most susceptible to the threat of weeds from development under the Plan where new urban development or transport corridors occur adjacent to the TEC and/or fragments patches of the TEC into smaller patches and introduces edge effects. Key risk areas include the central portion of GMAC where it occurs adjacent to urban capable land.

The Plan incorporates a range of general measures to manage the risk posed by weed invasion to biodiversity. In summary, these include:

- A commitment (Commitment 15) to manage priority weeds in strategic locations in the Cumberland subregion to reduce threats to land secured within the Strategic Conservation Area. This includes a number of actions, of which the following are the most relevant to the outcome for the TEC:
    - Preparation of a Weed Control Strategy, and entering into written agreements with delivery partners to implement the weed control program
    - Integration of weed control actions for conservation land into biodiversity stewardship agreements and reserve management plans
    - Provision of grants to relevant stakeholders to reduce weeds in the following locations: on public land adjoining or near conservation land, and on Aboriginal-owned land adjoining or near to conservation land
- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement weed control measures, including:
    - Submitting a weed eradication and management plan with development applications for subdivisions, outlining weed control measures during and after construction
    - Undertaking subdivision design and earthworks to minimise environmental weed spread, and require the inclusion of measures to eradicate weeds in accordance with relevant council weed policies
    - Managing and eradicating Weeds of National Significance and weeds on the National Environmental Alert List under the National Weeds Strategy. The proponent is to refer to NSW Weed Wise for current weed identification and management approaches
- Introduction of a SEPP (Strategic Conservation Planning) that will set out development controls to avoid and minimise impacts of future development on biodiversity values in avoided land and the SCA. The SEPP requires the consent authority to be satisfied that the development is managed to avoid adverse impacts to biodiversity values prior to granting approval. This would include consideration of risks to biodiversity values relating to the spread of weeds

The package of measures in the Plan is expected to adequately manage the risk posed to the TEC from weed invasion. This is because:

- Avoided land and the SCA will be protected under the SEPP (Strategic Conservation Planning)
- The Plan provides for a landscape scale approach to managing weeds through the development and implementation of a weed management strategy. This includes the land to be protected under the conservation program for the TEC
- There will be a range of planning controls to minimise the potential spread of weeds during and after construction

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of weeds.

INAPPROPRIATE HABITAT DISTURBANCE

Inappropriate habitat disturbance is identified in the Conservation Advice as a threat to the TEC. This relates to a wide range of different mechanisms for disturbance including:

- Dumping of rubbish and garden waste which can directly impact areas of the TEC as well as facilitate increases in weeds (see above) and pollutants
- Inappropriate recreational activities such as ad hoc track building and trail bike use which can directly impact areas of the TEC and facilitate processes such as erosion
- Removal of wood which changes the structure and habitat features of the TEC
- Inadvertent disturbance during construction which has the potential to directly impact the TEC outside approved development areas

Each of these mechanisms have the potential to alter the structure and floristic composition of the TEC.

Inappropriate habitat disturbance within the Strategic Assessment Area may increase due to development within the nominated areas. Occurrences of the TEC considered most at risk are those within GMAC.

The Plan incorporates a range of general measures to mitigate the risks associated with inappropriate habitat disturbance for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area to minimise any potential inadvertent disturbance during construction. This includes measures such as temporary fencing to protect areas with high biodiversity value, and ensuring that parking, and equipment and laydown areas will be located away from land with biodiversity values
- Active management of land secured for conservation through the Plan which will address any issues associated with inappropriate habitat disturbance in those locations
- A commitment (Commitment 26) to implement a compliance program to ensure compliance with the Plan and conditions of approval. This will include funding for at least three council-based compliance officers to ensure compliance with the conservation program. These officers will work closely with council rangers to monitor illegal dumping and vegetation clearing
- A commitment (Commitment 20) that will provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation. This process will ideally help the local community understand and appreciate the biodiversity values that occur nearby, and potentially reduce the level of disturbance to natural areas

The package of measures in the Plan is expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development. This is because:

- Development controls will be put in place to address potential impacts associated with construction
- Conservation lands will be actively managed which will address disturbance in those areas
- There will be funded compliance with a focus on minimising habitat disturbance
- A program of education for the community will be run to help them understand the biodiversity values they live near

These controls are consistent with a number of priority conservation actions in the Conservation Advice about the management of disturbance.

CHANGES TO HYDROLOGY

The creation of hard surfaces associated with urban capable land and transport corridors results in changes to the hydrology of surrounding areas. The main threat to the TEC associated with altered hydrology is increased runoff into patches of the TEC carrying high nutrient and sediment loads, as well as weed seeds or propagules. This can both encourage weed invasion and cause erosion.

The TEC is most susceptible to the threat of increased runoff from development under the Plan where new urban capable land occurs adjacent (and upstream or upslope) to the TEC. Key risk areas are those in GMAC. The TEC is not threatened by transport projects because it does not occur within the vicinity of any of the transport corridors.

The Plan incorporates a range of general measures to mitigate the risks associated with changes to hydrology for the TEC. In summary, these include:

- Incorporation of development controls into DCPs for each nominated area that will require proponents undertaking development to implement measures to manage hydrological impacts, including in relation to:
    - Water cycle management. For example:
        - Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles
        - Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise urban water run-off and sediment and pollutants to waterways
    - Water quality. For example, stormwater systems must be constructed and maintained to achieve EES water quality targets
    - Soil erosion and sedimentation. For example:
        - Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development
        - Soil and Water Management Plans must be prepared in accordance with Managing Urban Stormwater (Landcom, 2004) and submitted with each subdivision development application

The package of measures in the Plan is expected to adequately manage the risk to the TEC from changes to hydrology because development controls in urban areas will be put in place to ensure development is designed, constructed, and operated in a way that avoids and minimises any potential impacts to the TEC.

DISEASES, PATHOGENS, AND DIEBACK

TECs are potentially susceptible to a range of diseases, pathogens, and dieback which can substantially affect their long-term viability. Recognised threats include myrtle rust.

Development under the Plan may increase the risk of the spread of infection/disease. This is primarily related to:

- Soil transportation on contaminated footwear, vehicles, and machinery, and in residential garden establishment
- Increased site visitation rates
- Earthworks and activities conducted during construction
- Increased surface water runoff

The Plan incorporates a range of general measures to manage the risks associated with diseases, pathogens, and dieback. In summary, these include:

- A commitment (Commitment 18) to support new or existing programs to control key diseases affecting threatened species and ecological communities in the Cumberland subregion. This will include:
    - Consulting with researchers, government agencies and other delivery partners to identify programs that contribute to the management of disease and dieback in the Cumberland subregion
    - Entering into written agreements with delivery partners to implement priority disease control programs

- Incorporation of development controls into DCPs for each nominated area to require the preparation of Construction Environmental Management Plans (CEMP) that must set out the measures methods to protect the environment during construction, including best practice site hygiene protocols to minimise spread of *Phytophthora* and Myrtle Rust

The package of measures in the Plan is expected to adequately manage the risk to the TEC from diseases, pathogens, and dieback because:

- It supports a landscape scale approach to the issue across the Cumberland subregion
- It will ensure appropriate controls during construction

INVASIVE FAUNA

TECs can be threatened by introduced animals and aggressive native species. These species include:

- Domestic species such as cats and dogs which are related to urban development
- Pest species such as foxes, rats, house mice, and rabbits, which are primarily related to agricultural development
- Aggressive bird species which compete for resources

Collectively, these animals can lead to declines in biodiversity through:

- Predation
- Damage to vegetation and soils
- Competition for resources

Existing land use within the nominated areas and surrounding region (which includes residential and rural residential areas, and farming) means that these issues are already present in the Strategic Assessment Area and are unlikely to pose a novel threat to the TEC.

However, the extent of proposed new urban development under the Plan means that the threats associated with cats and dogs are likely to be exacerbated. It is likely that there will be an increase in the number of domestic cats and dogs in the local area, which, in turn, may lead to an increase in feral cat and wild dog numbers. The main areas of concern relate to new urban development in GMAC.

In relation to aggressive bird species, the two main drivers for increasing the threat within the TEC are:

- Fragmentation of habitat which creates greater edge effects and facilitates access by aggressive bird species. As outlined above in the analysis of direct impacts, the Plan is considered unlikely to lead to any notable fragmentation to the TEC and as such is not considered an issue
- Habitat disturbance through inappropriate land management which can change the structure of the TEC and facilitate access by aggressive bird species. As outlined above in relation to inappropriate habitat disturbance, the Plan includes a package of measures which are expected to adequately manage the risk to the TEC from inappropriate habitat disturbance as a result of development

In relation to the residual risks associated with invasive fauna, the Plan incorporates a range of general measures to manage the risks. In summary, these include:

- A commitment (Commitment 16) to manage priority pest animals in strategic locations in the Cumberland subregion to reduce threats to land protected in the Strategic Conservation Area. This includes a number of actions with the most relevant to the outcome for the TEC being:
    - The establishment of a pest animal working group to guide the implementation of pest animal control activities under the Plan
    - Preparation of a Pest Animal Control Implementation Strategy
    - A process to enter into written agreements with delivery partners to implement the pest animal control program
    - Integration of pest control actions for conservation lands into biodiversity stewardship agreements and reserve management plans
- Incorporation of development controls into DCPs for each nominated area that will:

- Ensure that domestic animals are appropriately contained at urban/bushland interfaces
- Require property boundaries to have appropriate fencing to contain domestic animals within the landholders' property
- Require appropriate management and control of pest animals relevant to development sites

POTENTIAL ADDITIONAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE AND TUNNELS

This section considers the potential additional impacts to the TEC from essential infrastructure and tunnels. Please refer to the following chapters for details about these development types and the predicted outcomes for matters protected by the EPBC Act:

- *Chapter 36 – Summary of transport program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with tunnels*
- *Chapter 37 – Summary of urban program impacts which includes an analysis of the potential impacts on EPBC Act protected matters associated with essential infrastructure outside the urban capable land (but still within the nominated areas)*

In addition to predicted impacts within the urban capable land and transport corridors, there is the potential for impacts to the TEC to occur due to development of essential infrastructure within the avoided lands of GMAC.

The TEC does not occur within the vicinity of the tunnel footprints for transport and is therefore not at risk of additional impacts from tunnels.

31.14.4 POTENTIAL IMPACTS FROM ESSENTIAL INFRASTRUCTURE

Areas of the TEC occur within the avoided lands of GMAC (15.2 ha). Of the 15.2 ha, 2.1 ha is in good (intact) condition. Impacts to the TEC are possible where it occurs within land avoided for biodiversity purposes (10.5 ha). The likelihood of impact is reduced where the TEC occurs in riparian corridors or steep slopes (4.7 ha).

The Plan includes a number of general measures to protect TECs from impacts associated with essential infrastructure, which are described below.

As outlined in Part 2 and Chapter 37, essential infrastructure may be undertaken on avoided land if consistent with the requirements of the Plan. The Plan specifies that:

- Every effort should be made to ensure that essential infrastructure development is limited to urban capable land
- Where essential infrastructure is proposed on avoided land:
  - It must comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
  - It must meet the commitments for avoidance (Commitments 2.1 and 2.2), including limiting cumulative direct impacts for certain TECs

The Cumberland Plain Conservation Plan Guidelines for Infrastructure Development will include development controls that apply to essential infrastructure on avoided land to ensure consistency with the requirements of the Plan. The guideline states that essential infrastructure development must:

- Avoid and minimise impacts to biodiversity values and specific TECs and species, including koala habitat and corridors
- Identify and implement mitigation measures to address indirect impacts on biodiversity values, including installing and maintaining the integrity of koala exclusion fencing
- Offset any impacts in accordance with the BAM and BC Act

In addition, proposed essential infrastructure on avoided land may require approval under the BC Act and if so, will be required to apply the BAM, which includes:

- On-ground surveys to determine the biodiversity values within the potential development area
- Measures to avoid impacts to the species through development design
- Measures to mitigate any potential indirect impacts
- Measures to offset any residual impacts in accordance with the requirements of the BAM

In addition to these general measures, the Plan includes a species-specific mitigation measure to protect the TEC from impacts from essential infrastructure:

- Commitment 2.1, which states to "limit the total cumulative direct impacts within avoided lands to Western Sydney Dry Rainforest and Moist Woodland on Shale over the life of the Plan to no more than 0.3 ha in GMAC"

It is not expected that substantial impacts to the species will occur as a result of essential infrastructure, and that any impacts that did occur would be adequately mitigated and offset. See Section 37.6 in Chapter 37 for more details.

LIKELY EFFECTS OF IMPLEMENTATION OF THE PLAN ON THE LONG-TERM VIABILITY OF THE TEC

This section considers the likely effects of implementation of the Plan on the long-term viability of the TEC. The analysis has regard for the guidance in the Conservation Advice (there is no Recovery Plan for the TEC), and draws on the analysis of avoidance, direct impacts and offsets, and indirect impacts and mitigation presented above.

Where applicable, this section also identifies any relevant Threat Abatement Plans. The general consistency of the Plan with Threat Abatement Plans is discussed in detail in Section 15.9 of Chapter 15.

31.14.5 IMPLICATIONS FOR LONG-TERM VIABILITY

Implementation of the Plan is not expected to negatively influence the long-term viability of the TEC for the following key reasons:

- There will be no direct impacts to the TEC
- Potential indirect impacts have been analysed and determine to be adequately managed and mitigated through a number of commitments and actions in the Plan
- Potential impacts to the TEC from essential infrastructure will be limited through Commitment 2.1

31.14.6 CONSISTENCY WITH RECOVERY PLAN

There is no recovery plan for the TEC.

31.14.7 KEY THREATENING PROCESSES AND CONSISTENCY WITH THREAT ABATEMENT PLANS

Relevant Key Threatening Processes (KTPs) and any of their associated Threat Abatement Plans (TAPs) have been identified in Table 31-26 where they relate to:

- The potential direct impacts of the Plan, or
- The relevant indirect impacts

The Plan is not inconsistent with any of the relevant TAPs. Please refer to Section 15.9 of Chapter 15 for a detailed discussion of each TAP and the relationship of the Plan.

Table 31-26: Key Threatening Processes and relevant Threat Abatement Plans for Western Sydney Dry Rainforest and Moist Woodland on Shale

KEY THREATENING PROCESS	RELEVANT THREAT ABATEMENT PLAN
Land clearance	There is no relevant TAP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	There is no relevant TAP
Predation by feral cats	Threat abatement plan for predation by feral cats (DoE, 2015g)

DATA TABLES

This section sets out the data tables for occurrence, avoidance, and direct impacts. Cross references to the tables are provided throughout the text above.

Table 31-27: Occurrence of Western Sydney Dry Rainforest and Moist Woodland on Shale in the Strategic Assessment Area

	SAA TOTAL	WITHIN PROTECTED LANDS
TOTAL TEC MAPPING (ha)	**968.1**	**145.2**
Intact	801.8	111.6
Thinned	166.3	33.6
Scattered Trees	0.0	0.0
Higher Viability TEC	664.0	92.6

Table 31-28: Avoidance of impacts to Western Sydney Dry Rainforest and Moist Woodland on Shale within the nominated areas

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL TEC IN NOMINATED AREA (ha)	**0.0**	**16.2**	**0.0**	**2.4**	**18.6**
Intact	0.0	2.2	0.0	2.4	4.6
Higher Viability TEC	0.0	0.0	0.0	2.4	2.4
TEC WITHIN EXCLUDED LANDS (ha)	0.0	1.0	0.0	2.4	3.3
TEC WITHOUT EXCLUDED LANDS (ha)	**0.0**	**15.2**	**0.0**	**0.0**	**15.2**
AVOIDANCE FOR BIODIVERSITY PURPOSE (ha)	0.0	10.5	0.0	0.0	10.5
Intact	0.0	1.4	0.0	0.0	1.4
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR BIODIVERSITY PURPOSE (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**69.1**	**N/A**	**0.0**	**69.1**
AVOIDANCE FOR OTHER REASONS (ha)	0.0	4.7	0.0	0.0	4.7
Intact	0.0	0.7	0.0	0.0	0.7
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0
AVOIDANCE FOR OTHER REASONS (% TEC WITHOUT EXCLUDED LANDS)	**N/A**	**30.6**	**N/A**	**0.0**	**30.6**
TOTAL AVOIDANCE (ha)	0.0	15.2	0.0	0.0	15.2
Intact	0.0	2.1	0.0	0.0	2.1
Higher Viability TEC	0.0	0.0	0.0	0.0	0.0

	WILTON	GMAC	WSA	GPEC	TOTAL IN NOMINATED AREAS
TOTAL AVOIDANCE (% TEC WITHOUT EXCLUDED LANDS)	N/A	99.7	N/A	0.0	99.7

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CUMBERLAND PLAIN ASSESSMENT REPORT

PART 6A: ATTACHMENT

ATTACHMENT A - KOALA TERMINOLOGY

ATTACHMENT B - DETAILED BACKGROUND TO KOALAS IN THE STRATEGIC ASSESSMENT AREA

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	James Shepherd, Callan Wharfe, Rebecca Dwyer (Biosis) Darren James (DAJ Environmental)
CONTENT:	Natasha Buckingham, Peter Hemphill (Open Lines) Darren James (DAJ Environmental)
REVIEWED BY:	
OPEN LINES:	Peter Hemphill (Open Lines)
ACCREDITED ASSESSOR:	N/A
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DATE:	2021

Part 6A Attachment Contents

Part 6A Attachment List of Figures

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A. Koala terminology

There are many terms used for mapping Koala habitat and understanding Koala ecology. For clarification, Table A-1 lists the terms used in this report.

Table A-1: Koala terminology used in this report

Term	Meaning
Blue Mountains Koala population	This refers to Koalas within the vicinity of the Blue Mountains, which is the closest Koala population to the WSA and GPEC.
Census population size	The total number of Koalas in a population
Connectivity	The degree of continuity and linkage among areas of vegetation. Greater connectivity increases potential gene flow across a landscape
Effective population size	The size of an idealised population (a population which varies in genotype frequencies only due to in the population census size), that would result in the degree of inbreeding and alteration in variance of frequencies observed in the population of interest. This can indicate the number of breeding individuals and degree of genetic diversity of the species
Food tree	Species of tree whose leaves are consumed by Koalas. Koala food trees can generally be considered to be those of the following genus: *Eucalyptus*, *Angophora, Corymbia, Lophostemon* and *Melaleuca*
Genetic diversity	The degree of variation of genes and genetic information of species in a specific area. This includes the genetic differences among individuals in a population
Habitat critical to the survival	Koala habitat that is considered to be important for the species' long-term survival and recovery. The *EPBC Act referral guidelines for the vulnerable Koala* (DoE, 2014) outlines the methodology by which this habitat is identified
Habitat tree	Species of trees which are utilised by Koalas, either as a food source, as a source of refuge or shelter, or to facilitate movement of Koalas through the landscape
Important habitat	Referred to in the Threatened Biodiversity Data Collection and comprises the species polygons for the BAM process. For this project important habitat is comprised of primary, secondary, and tertiary corridors
Inbreeding depression	The decrease in survival and reproduction in naturally outbreeding species caused by inbreeding (mating with genetically similar individuals). Inbreeding may negatively affect fecundity, gamete production and parental capabilities
Koala habitat	Habitat which is suitable for use by Koalas for the purposes of one or more of the following activities: feeding, resting, breeding and/or dispersal between different areas
Koala habitat is comprised of:	
• **High quality habitat**	Defined as the best habitat with the capacity to support higher densities of Koalas
• **Moderate quality habitat**	Defined as lower quality habitat with the capacity to support lower numbers of Koalas
• **Low quality habitat**	Defined as the lowest quality habitat areas, potentially used for movement through the landscape between higher quality areas
Koala metapopulation	A group of Koala populations or sub-populations connected by dispersal
Koala population	A group of Koalas which interbreed and are demographically, genetically, and/or spatially separated from other groups of Koalas

Term	Meaning
Movement corridors	Areas of habitat (often but not always linear) which facilitate the movement and dispersal of Koalas between habitat patches which would otherwise be disconnected
Movement corridors are comprised of:	
• **Primary corridors**	Defined as connected areas of principal habitat (and associated supporting habitat) that provide for ecological function of a population
• **Secondary corridors**	Defined as corridor areas that become narrow to less than 50 metres wide, or that are not connected at both ends
• **Tertiary corridors**	Smaller corridor areas that are not connected at the landscape level
Protected Koala habitat	Koala habitat that has been included in the Plan's Strategic Conservation Area and/or the avoided land. It includes some areas of cleared land that may be restored to enhance koala corridors and habitat
Principal habitat	Comprises contiguous areas of high-quality habitat of sufficient size to support the home ranges of male Koalas
Shelter tree	Species of tree (typically with a dense canopy) which is not used as a Koala feed tree, which Koalas are known to utilise for shelter (particularly during hot periods)
Southern Sydney Koala population	This refers to Koalas within the vicinity of Wilton and GMAC, and includes Koalas from the Campbelltown/Wollondilly/Southern Highlands localities
Supporting habitat	The remaining areas of suitable habitat and vegetation structure that are outside principal habitat. Comprises scattered trees peripheral to and outside of identified Koala movement corridors
Viable population	A self-supporting population with sufficient numbers and genetic variety among healthy individuals and breeding pairs that are well enough distributed to ensure a high probability of survival despite the foreseeable effects of demographic, environmental and genetic events, and of natural catastrophes

B. Detailed background to Koalas in the Strategic Assessment Area

This attachment provides detailed information about Koala populations and ecology in the Strategic Assessment Area. It provides:

- A general background to the species
- An overview of the process of identifying Koala populations in the Cumberland subregion (and vicinity)
- Detailed information about the Koalas and Koala habitat which occurs within and near to Wilton and GMAC
- Relevant information about the Koalas and Koala habitat which occurs near the GPEC and WSA

SPECIES BACKGROUND

Koalas are arboreal marsupials that are distributed within coastal and inland regions of eastern Australia, from South Australia to northern Queensland.

MORPHOLOGY

Although Koalas are recognised as a single species, they have significant differences in morphology and behaviour across the extent of their range (Houlden, Costello et al., 1999). For instance, southern (Victorian) Koalas are on average 80 per cent larger (mean male body weight of 11.8kg) than northern (Queensland) Koalas (mean male body weight of 6.8kg) (Black, Price et al., 2014). There are also obvious variations in body form (including skull shape and fur colour) between northern Koalas and southern Koalas (Black, Price et al., 2014). These differences are the result of adaptions of Koalas to their local environment, which changes significantly between the northernmost and southernmost extent of the species' range.

FEEDING

Koalas are specialist folivores, meaning that they eat leaves and are highly selective in their choice of diet. They are known to eat the leaves of over 100 *Eucalyptus* species and over 30 non-*Eucalyptus* species (including genera such as *Angophora* and *Corymbia*) (OEH, 2018).

However, local Koala populations typically tend to select their diet from only a small number of trees in their local area, with the preferred tree species varying between populations . McAlpine et al. (2008) proposes that Koalas may select their preferred trees through preferences for certain leaf nutrients (rather than tree species *per se*), and that leaf nutrients may vary between trees of the same species growing in different locations and under different conditions. This may explain why a certain tree species are used by Koalas in some locations but not in others.

Overall, Koalas typically preference trees growing on fertile soils, as fertile soils result in higher leaf nutrient content in trees.

SOCIAL INTERACTIONS

Koalas are territorial animals which exist in complex social networks. Ellis, Melzer & Bercovitch (2009) proposes that Koala habitat use is akin to a checkerboard model, where the ranges of Koalas overlap, yet where individual trees are rarely shared by different Koalas.

Males are more prone to dispersion, whereas female Koalas tend to remain close to natal sites (Houlden, Costello et al., 1999). Male ranges typically tend to be significantly larger than female ranges. The average size of a Koala's home range varies significantly between populations and between different areas and habitats. For example, some home ranges have been recorded to be 10-15 ha, whereas others have been recorded to be as large as 500 ha (Office of the NSW Chief Scientist & Engineer, 2016).

Reported densities of Koala populations also significantly vary between different habitats, ranging between 0.006/ha in the South East Forests of NSW to >8/ha in north-eastern Victoria (Close, Ward et al., 2017).

The differences in morphology, habitat preferences and behaviours between populations across the species' range means that research results of individual Koala populations may not be applicable to other populations. This means that local

research is often required to determine the specific habitat requirements and conservation needs of any particular local population (McAlpine, Rhodes et al., 2008).

POPULATION NUMBERS AND TRENDS

Koalas had already undergone a series of population bottlenecks prior to European arrival (likely as a result of glacial/interglacial cycles). They therefore already had low genetic diversity prior to the impacts of European activities on the population (Black, Price et al., 2014). The number and density of Koalas in Australia prior to European settlement is unknown, although it is likely that Aboriginal hunting and dingo predation pressures combined to keep Koala populations low (Close, Ward et al., 2017; Tsangaras, Avila-Arcos et al., 2012).

Given uncertainty regarding the number of Koalas originally present in Australia prior to European arrival, determining long-term population trends of the species across its range is difficult. This challenge is further complicated by the cryptic nature of the species (particularly within low-density populations; see for example (Close, Ward et al., 2017)), which makes accurate survey and estimation of current population numbers difficult.

Adams-Hoskings et al. (2016) estimated the numbers and trends of Koala populations across Australia (as of 2012), shown in Table B-1. The spatial distribution of Koala population trends across Australia (as of 2012) is indicated in Figure B-1, sourced from McAlpine et al. (2015). It is noted that both studies acknowledge the presence of varying degrees (and sometimes significant levels) of uncertainty with regards to the accuracy of knowledge of the distribution and trends of Koala populations.

Table B-1: State and national Koala population sizes and trends for 2012, aggregated from bioregional estimates. Adapted from (Adams-Hosking, McBride et al., 2016)

	Queensland	New South Wales	Victoria	South Australia	National Total
Mean Population	79,000	36,000	183,000	33,000	331,000
Population Range	~33,000 - 153,000	~14,000 - 73,000	~77,000 - 327,000	~19,000 - 51,000	~144,000 - 605,000
Mean Population Change (per cent)*	-53	-26	-14	-3	-24

* Mean population change is based on the largest population change in any three-generation period, that is the past three Koala generations (from 15-21 years ago) to the future three Koala generation (15-21 years into the future).

A recent report (Lane, Wallis et al., 2020) examined more recent population trends for Koalas in NSW, and sought to quantify the effects of the 2019-20 fires on Koalas in the State. This report found substantial pre-fire declines in the NSW Koalas. Between 2001-2018 (the last three Koala generations), the NSW Koala population declined by a minimum of 28.52 per cent up to a possible 65.95 per cent. The report suggests declines are more likely to have occurred towards the upper estimate.

The most dramatic declines occurring in the far western NSW populations (such as the Pilliga population, which was once the largest NSW Koala population to the west of the Great Dividing Range, yet is currently thought to be functionally extinct). It is thought that climate change and associated drought and heatwaves are a major cause for observed pre-fire declines and eastward range contractions of the species in the State (Lane, Wallis et al., 2020).

It is further estimated that the 2019-20 fires would have resulted in the death of 6,382 koalas across NSW, equivalent to 15 per cent of the total pre-fire Koala population, although this estimate is considered to be conservative and the true loss is likely to be greater (Lane, Wallis et al., 2020).

In 2020, a parliamentary inquiry into the current status of Koala populations and habitat in NSW found that (NSW Legislative Council, 2020):

- Following the 2019-2020 bushfires and the general trend of population decline, the estimated number of 36,000 Koalas in NSW is now outdated and unreliable
- Given the current trajectory of Koala populations in NSW, without government intervention the Koala will become extinct in NSW before 2050

THREATS

Koala populations have been declining as a result of a diverse number of threats, including (McAlpine, Lunney et al., 2015; OEH, 2017):

- Habitat loss
- Habitat modification and fragmentation
- Predation from domestic and feral dogs
- Vehicle strike
- Fire (particularly increased fire intensity which burns the crown of trees)
- Disease (particularly *Chlamydia*)
- Heat stress through drought and heatwaves
- Climate change (which increases drought and heatwaves, but also alters habitat quality)

The presence and prevalence of each threat varies spatially and temporally across the range of the species, and Koala populations are often simultaneously under pressure from multiple threats (Rhodes, Ng et al., 2011). Conservation actions to protect Koala populations should therefore seek to address a suite of threats present for each population, as conservation actions which only target a single threat where multiple threats are present are unlikely to be adequate to safeguard a Koala population (Rhodes, Ng et al., 2011).

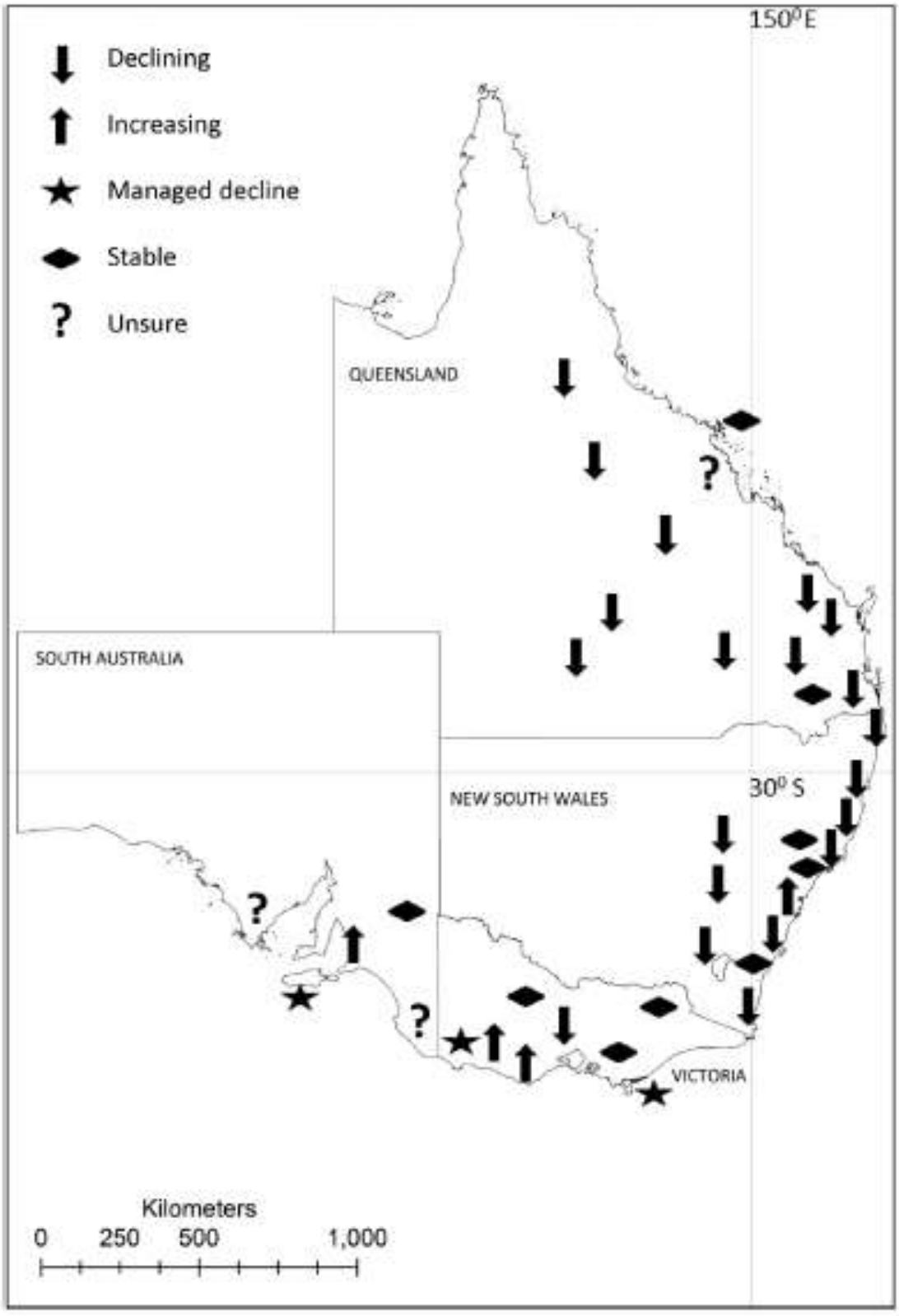

Figure B-1: Koala regional population trend synthesis map as of 2012 (Clive McAlpine, Lunney et al., 2015).

IDENTIFYING KOALA POPULATIONS

Literature indicates that different Koala populations may have different habitat requirements and different threats, and therefore appropriate management of Koalas must be targeted to the specific needs of each population (McAlpine, Rhodes et al., 2008). To effectively conserve Koalas within and near the proposed nominated areas, identification and delineation of the characteristics and distributions of local Koala populations is essential.

Koalas are known to exist in the region surrounding Sydney, in wooded areas to the west and south of the main urban areas. Delineation of Koala populations within these regions was undertaken through examination of five different data sources, including:

- Genetic analyses
- Koala record distribution and landscape analysis
- Koala record tracking
- Koala *Chlamydia* distribution
- Koala population trends

The results of each data source were then compiled and analysed to determine the likely distribution and connectivity of Koala populations. The following provides an overview of the assessment process and findings.

GENETIC ANALYSES

Lee et al. (2010) undertook genetic analysis of Koala populations to the west and south of Sydney, and determined that there were three genetically-separate Koala populations:

- South Sydney - which encompassed an area from Heathcote to the Campbelltown region, and had low genetic diversity which indicated a recent population bottleneck event
- Southern Tablelands - which was abruptly genetically distinct from the Heathcote/Campbelltown population, indicating the presence of barrier/s to gene flow between the populations despite physical proximity. The nature of genetic differentiation between the two populations was such that it was likely that any barriers to gene flow between these populations were a recent, not historic, landscape feature. Note that Lee et al. (2010) does not provide detailed information on the sampling point locations used to identify the Southern Tablelands population, and therefore it is unknown whether this population incorporates Koalas from the Southern Highlands or not
- Blue Mountains - which was genetically distinct from both the South Sydney and Southern Tablelands population, and had comparatively higher genetic diversity

Kjeldsen et al. (2019) undertook further genetic analyses on a wide range of Koala populations, including the Blue Mountains, Campbelltown and Southern Highlands Koala populations. Results of this study indicated that:

- Genetic admixture is occurring between the Campbelltown and Southern Highlands Koala populations. Genetic admixture occurs when previously isolated populations begin interbreeding
- The Blue Mountains Koala population is one of the most genetically diverse Koala populations in Australia

KOALA RECORD DISTRIBUTION AND LANDSCAPE ANALYSIS

The NSW BioNet database was accessed on 17 October 2020, to view the distribution of Koala records across Sydney and the wider region. The data was also cleaned or subject to expert review to ensure all data points were valid. The results are shown in Map 30-14. Note that a high density of sightings does not necessarily indicate a high density of Koalas yet may instead be indicative of areas where high human presence and activity leads to increased chances of wildlife sightings.

Map 30-14 indicates a largely continuous presence of Koalas, from north of Campbelltown through to the Southern Highlands. The continuity of Koala records suggests that Koalas are present throughout this region, and therefore there is a high likelihood that Koalas within the Campbelltown locality would be connected to Koalas within the Southern Highlands and beyond. It is further noted that there is an absence of any significant landscape features (e.g. large waterbodies, urban areas, major roads with wildlife fencing) between the Campbelltown locality and the Southern Highlands which would have the capacity to entirely block Koala movements between the two areas.

There are known Koala records in the Blue Mountains, particularly in the locality of Kurrajong. There are comparatively fewer records of Koalas in the region between the Blue Mountains and the Campbelltown/Southern Highlands region, suggesting that there may not be large populations of Koalas within these areas. Therefore, it is likely that the Blue Mountains Koalas and the Koalas within the Campbelltown/Southern Highlands localities comprise separate populations.

KOALA TRACKING RESEARCH

Recent research has been conducted through the Saving Our Species program administered by EES. As part of this research, Koalas have been tracked from Appin through to bushland south of Picton Road (Saving Our Species, 2019). These tracking records indicate that Koalas are able to successfully cross Appin Road and Picton Road, and therefore that the Campbelltown Koalas (to the north of Appin Road) and the Southern Highlands Koalas (to the south of Picton Road) currently have some degree of contact with each other through migration (Saving Our Species, 2019).

KOALA CHLAMYDIA DISTRIBUTION

Chlamydia is a genus of bacteria from the family *Chlamydiaceae*. Infection of Koalas with *Chlamydia* can lead to the development of a range of illnesses such as conjunctivitis, genital tract infection and urinary tract infection (Jackson, White et al., 1999). The range of illnesses caused by infection with *Chlamydia* is collectively referred to as Chlamydiosis. It is noted that a Koala which is infected with *Chlamydia* does not always present clinical symptoms of disease.

There are multiple species of *Chlamydia*, of which two are known to infect Koala populations within Australia (Jackson, White et al., 1999). The first of these is *C. pseumoniae*, whilst the second is *C. pecorum* (Jackson, White et al., 1999). Of these two species, *C. pecorum* is more pathogenic, as (Jackson, White et al., 1999):

- Infection with *C. pecorum* is more likely to result in clinical expression of disease
- When clinical expression occurs, *C. pecorum* is more likely to result in severe disease symptoms than *C. pseumoniae*

The Koalas within the Campbelltown locality are recognised as being important for conservation purposes as the Koalas are free of *Chlamydia* (Western Sydney University, 2017). It is likely that (to date) the population has been protected from contracting *Chlamydia* due to isolation from neighbouring populations (Western Sydney University, 2017).

Recent research has been undertaken through the Saving Our Species program to test for the presence of *Chlamydia* and Chlamydiosis within Koalas in the Campbelltown, Wollondilly and Southern Highlands localities using genetic analysis (Saving Our Species, 2019). Results of this research are as follows (Saving Our Species, 2019):

- Koalas within the Southern Highlands are infected with *C. pecorum*, and display clinical symptoms of the disease Chlamydiosis
- Koalas within the Wollondilly locality are infected with *C. pecorum*, yet do not display clinical symptoms of the disease
- Koalas within the Campbelltown locality (within the area bounded by Appin Road to the south and to the west) are not infected with *Chlamydia*

KOALA POPULATION TRENDS

There is a long history of Koala occupation within the Campbelltown locality (Biolink, 2016). The Koala population is known to be recovering from a near extinction event, which may have been caused by hunting pressures associated with the fur trade, a severe outbreak of disease in the 1920s, or some combination of the two (Lee, Zenger et al., 2010). For a number of years, Koalas were extremely rare in the locality, with very few records occurring prior to the 1980's (Biolink, 2016).

Research undertaken by Biolink (2016) and Biolink (2018) within the Campbelltown City Council Local Government Area has indicated that the Koala population is currently recovering, a trend which is evidenced through increases in the area of habitat utilised by Koalas on an ongoing basis.

There is also evidence that Koalas within the Southern Highlands underwent a near extinction event in the early 1920's, with reliable sightings of Koalas only reoccurring from the 1970's onwards. The population is since thought to have continued its recovery trend, based on historic reports and contemporary reports of increases in sightings, contemporary increases in roadkill occurrences, and from the results of spotlighting surveys conducted in the region (Saving Our Species, 2019; Tilley & Uebel, 1990).

RESULTS AND DELINEATION OF KOALA POPULATIONS WITHIN THE SYDNEY REGION

Genetic analyses have consistently identified the Blue Mountains Koalas as being genetically distinct from the Koala populations within the Southern Tablelands/Southern Highlands/Campbelltown localities (Kjeldsen, Raadsma et al., 2019; Lee, Zenger et al., 2010). Therefore, it is considered that the Blue Mountains Koalas belong to a different ecological population to the Koalas within Southern Tablelands/Southern Highlands/Campbelltown localities. Whilst there may be some degree of dispersal of Koalas between these two areas, the rate of dispersal is likely to be low. The Blue Mountains Koala population is recognised to be an important population for conservation due to its unusually high genetic diversity (Kjeldsen, Raadsma et al., 2019).

Delineation of populations within the Southern Tablelands/Southern Highlands/Campbelltown localities is more complicated. Genetic analysis indicates the following sequence of events has occurred for Koalas within these regions:

- The Koala populations would have originally been well connected (prior to European arrival) (Lee, Zenger et al., 2010)
- There had been a recent (post-European) introduction of some form of barrier which prevented gene flow between the Koalas in the Southern Tablelands and the Koalas in the Campbelltown locality, resulting in genetic differences between these two populations (Lee, Zenger et al., 2010)
- Even more recently, the Koalas within the Southern Highlands and the Campbelltown locality have begun to show signs of genetic mixing again, indicating that these populations are once again connected (Kjeldsen, Raadsma et al., 2019)

The landscape between the Campbelltown and Southern Highlands Koalas consists of largely continuous bushland intersected by several roads with moderate to high traffic densities (Picton Road and Appin Road). It is known that Koalas are able to successfully cross both of these roads. Therefore, there is an apparent absence of any significant landscape barrier which would effectively separate Campbelltown and Southern Highlands Koalas.

It is known that Koalas within the Campbelltown and Southern Highlands localities have previously undergone significant population decline, yet it is understood that both populations are currently in recovery. It is therefore hypothesised that the two Koala populations became separated as a result of contractions in Koala habitat occupancy, and that recent re-connection of the two Koala populations has occurred as a result of the recovery of both populations.

The historical and current distribution of *Chlamydia* supports this hypothesis. The Campbelltown Koala population has long been recognised as being *Chlamydia*-free, a feature which is likely to be the result of the isolation of the Campbelltown Koalas from neighbouring Koala populations (Western Sydney University, 2017). However, recent research has found the presence of *Chlamydia* as far north as Appin, indicating that the infection may be spreading further north into areas which had previously been *Chlamydia*-free (Saving Our Species, 2019).

The results of this analysis have therefore identified two Koala populations for the purposes of assessment within the vicinity of the proposed nominated areas. These populations are identified as:

- Southern Sydney Koala population – this refers to Koalas within the vicinity of Wilton and GMAC, and includes Koalas from the Campbelltown/Wollondilly/Southern Highlands localities
- Blue Mountains Koala population – this refers to Koalas within the vicinity of the Blue Mountains, which is the closest Koala population to the WSA and GPEC

The following sections provide an overview of the characteristics of each population.

SOUTHERN SYDNEY KOALA POPULATION

DELINEATION OF STUDY AREA

As discussed above, the ecological boundaries of Koala populations in the vicinity of Wilton and GMAC are unclear. It is possible that all Koalas within this vicinity are increasingly becoming connected into one large population, which extends north and south beyond the potential areas of impact associated with the proposed development.

Therefore, the study area for this population has been confined to areas of Koala habitat within proximity to the nominated areas, which have potential to be either directly or indirectly impacted by the proposed development.

HABITAT PREFERENCES AND USAGE

The Southern Sydney Koala population exhibits a well-documented preference for vegetation growing on Wianamatta shale soils over Hawkesbury sandstone soils, as a result of the higher nutrient content of shales (DPIE, 2019; Phillips & Callaghan, 2000; Ward, 2002). Ward (2002) found that Koalas were in better condition and bred more successfully on Wianamatta shale soils, while EES (DPIE, 2019) found a higher density of preferred tree species, and a higher density of observed Koalas, on Wianamatta shale soils. However, Koalas are still known to utilise Hawkesbury sandstone habitats, and can successfully breed in these habitats (Ward, 2002). It is noted that there are few Koala records from Narrabeen shales in the region (Ward, 2002), but this is a very infrequent substrate in the region and mostly found deep in the inaccessible and flooded gorges.

A number of studies have aimed to identify preferred habitat tree species utilised by the Southern Sydney Koala population, the results of which are shown in Table B-2. Koalas have also exhibited preference for trees with greater diameter at breast height (DBH) (Phillips & Callaghan, 2000; Ward, 2002).

Table B-2: Tree species preferred by the Southern Sydney Koala population

Source	Preferred Tree Species
(DPIE, 2019)	*Eucalyptus punctata, E. globoidea, E. pilularis, E. longifolia, E. tereticornis, E. paniculata, Acacia decurrens*
(Ward, 2002)	*Eucalyptus punctata, E. globoidea, E. pilularis, E. agglomerata, E. capitellata, E. eugenioides, E. piperita, Syncarpia glomulifera**
(Sluiter, Close et al., 2001)	*Eucalyptus punctata, E. agglomerata, Corymbia gummifera*
(Phillips & Callaghan, 2000)	*Eucalyptus punctata***, *E. agglomerata***

* Shelter tree.

** Preferences only exhibited when tree growing on shale soil.

Of all of the identified preferred habitat trees, grey gum (*Eucalyptus punctata*) is the only species which is consistent across each study. Further, *E. punctata* was identified as a preferred habitat tree for every tracked Koala within the study conducted by (DPIE, 2019), whereas other species were not consistently identified as a preference by all Koalas. Analysis of Koala faecal pellets also indicated that *E. punctata* accounted for a major proportion of Koala diet for three Koalas in the Campbelltown locality, with *E. punctata* accounting for between 66-92 per cent of leaf cuticle fragments in faecal matter (Sluiter, Close et al., 2001).

However, Koala habitat usage patterns are not solely determined by tree species and soil type, but also by a wide range of factors including Koala social interactions and age, in addition to temporal (e.g. seasonal) influences on tree nutritional values (Ellis, Melzer et al., 2009; Ramsay, 1999). For example, Ramsay (1999) found that juvenile Koalas at Nowendoc exhibited different tree preferences to their mothers and that there were seasonal effects upon tree nutrient and anti-nutrient contents, whilst Ellis et al. (2009) found that Koalas rarely re-use the same tree twice or share trees used by other Koalas and that social interactions play a significant role in influencing Koala habitat usage. Therefore, the observed variations in preferred tree species utilised by Koalas may be the result of differences in the wider range of factors which influence tree selection.

HABITAT DISTRIBUTION AND CONNECTIVITY

A range of assessments have been undertaken to assess the key characteristics, quality, distribution and connectivity of Koala habitat within the Plan Area. These assessments include:

- **Species-distribution model:** This provides information on habitat availability and distribution across the Cumberland subregion
- **Corridor habitat happing:** This provides information on habitat availability, distribution, characteristics and connectivity within and near to the four
- **GAPCLoSR:** This is a GIS-based analysis which provides information on habitat connectivity
- **Habitat critical to the survival of the species:** This provides information on the availability and distribution of habitat critical to the survival of the Koala, in accordance with the EPBC referral guidelines

Details of the methods for each assessment is provided in Part 3.

KOALA HOME RANGE AND DENSITY ESTIMATES

A number of studies have sought to identify the densities and home range sizes of Koalas within the Southern Sydney population (see Table B-3).

Table B-3: Densities and ranges of Koalas within the Southern Sydney Koala population

Source	Koala Density (Koalas/ha)	Female Range (ha)	Male Range (ha)
(DPIE, 2019)	0.078 (within high quality habitat)	Average: 38 n = 3	Average: 114 n=8
	0.017 (within non high-quality habitat)		
	0.052 (overall average across full study area)		
(Ward, 2002)	0.035 ± 0.087 (using a transect method)	MCP* Range^: 28 - 129 MCP Midpoint: 79 90% Harmonic Mean** Range: 12 - 62 90% Harmonic Mean Midpoint: 37 60% Harmonic Mean Range: 5 - 25 60% Harmonic Mean Midpoint: 15 n = 6. It is noted that only 3 female adult Koalas had sufficient fixes to reach the asymptote in home range size.	MCP Range^: 38 - 387 MCP Midpoint: 213 90% Harmonic Mean Range: 12 - 165 90% Harmonic Mean Midpoint: 88.5 60% Harmonic Mean Range: 6 - 72 60% Harmonic Mean Midpoint: 39 n = 5. It is noted that no male adult Koalas had sufficient fixes to reach the asymptote in home range size.
	0.049 (using a home range method)		

^ Range data refers to adult ranges only (females ≥ 3 years old, males ≥ 4 years old) and has been rounded to the nearest hectare.

* Minimum Convex Polygon refers to the maximum area in which the Koala is observed and includes areas which are rarely used by the Koala.

** Harmonic Mean calculates the probability of the Koala being present within a given area. Therefore, the 90 per cent Harmonic Mean provides the range of the Koala within which the animal is present 90 per cent of the time, whilst the 60 per cent Harmonic Mean provides the range of the Koala within which the animal is present 60 per cent of the time.

KOALA POPULATION SIZE ESTIMATES

The assessment area examined within this report is similar in size and distribution to the study area examined by EES (DPIE, 2019).

In their assessment, EES (DPIE, 2019) calculated the potential population size of Koalas within the assessment area via the following method:

Koala Population Size = Koala Density (Koalas/ha) x Area of Available Habitat (ha)

Given an average recorded density of 0.052 Koalas/ha and a mapped habitat area of 8,293 ha within their assessment area, EES (DPIE, 2019) calculated that there was a potential Koala population size of up to 433 Koalas. This is a useful approximation for use in this assessment.

It is noted that calculating the potential size of the Koala population through extrapolation from observed Koala densities and mapped areas of Koala habitat relies upon the following assumptions:

- The reported density of Koalas in each habitat type is accurate (the accuracy of measurements for this parameter have potential to be influenced by field survey techniques, survey timing, survey longevity and sample size)
- All areas of available Koala habitat are occupied by Koalas
- The observed densities of Koalas within each habitat type are in equilibrium (i.e. the population is neither increasing nor decreasing in density)

The size of the Koala population estimated by EES (DPIE, 2019) is therefore subject to some degree of uncertainty.

KOALA POPULATION TRENDS

As discussed above, the Koala populations within the Campbelltown and Southern Highlands localities are thought to be expanding (Phillips, 2016; Saving Our Species, 2019; Tilley & Uebel, 1990).

Within the Campbelltown locality specifically, is noted that part of the Koala habitat expansion has occurred through Koalas inhabiting areas further to the west, towards and across Appin Road (Biolink, 2018). Recent survey work conducted by Biolink (Biolink, 2017) confirmed the presence of Koalas along the Nepean River, and found that the Campbelltown Koalas are in contact with the Nepean Koalas. It may be that the increasing westward trend in habitat occupancy of the Campbelltown Koalas may either indicate, or be the result of, strengthened connections with the Nepean Koalas.

POPULATION GENETIC DIVERSITY AND RESILIENCE

Low genetic diversity of a population has the potential to decrease the resilience of the population, through increasing risks associated with factors such as:

- Decreased biological fitness of individual Koalas as a result of inbreeding (known as inbreeding depression)
- Increased vulnerability to environmental change
- Increased vulnerability to threats such as disease

Genetic diversity is measured here as the effective population size (Ne), which is a calculated metric reflecting the population's genetic characteristics. Note that effective population size is distinct from the census population size (Nc), which refers to the total number of Koalas within the population. Available literature in population genetics suggests that an effective population size of between 50 and 100 is typically recommended as an estimate of required genetic diversity to ensure population viability, although it is recognised that such estimates are generalised metrics which may not be applicable for all species (Frankham, Bradshaw et al., 2014).

It is noted that Koalas are thought to have had low genetic diversity prior to European arrival (Tsangaras, Avila-Arcos et al., 2012), indicating that low genetic diversity may be a normal feature of healthy Koala populations. It is further recognised that some of the most successful Koala populations within Australia (which have such large population sizes that they are subject to managed population reduction measures) have very low genetic diversity as a result of strong historic population bottleneck events (McAlpine, Lunney et al., 2015). Therefore, it may be that Koalas have some degree of resilience to low rates of genetic diversity.

Lee et al. (2010) found that the Southern Sydney Koala population had an effective population size of Ne = 16-21, which indicates that the population had a very low genetic diversity and has been subject to a recent population bottleneck event. More recent analysis conducted by Kjeldsen et al. (2019) indicates that genetic mixing has recently begun to occur between Koalas in the Campbelltown and Southern Highlands localities, which would be contributing to increasing the genetic diversity within each of these populations.

Overall, it is noted that Koalas within the Campbelltown and Southern Highlands localities are currently experiencing population expansion (Biolink, 2018; Saving Our Species, 2019), despite low genetic diversity.

Therefore, whilst it is recognised that the Koalas of Southern Sydney have low genetic diversity, it is considered that this feature of the population is unlikely to pose a significant threat to the population's ongoing recovery, and that other threats (such as habitat loss, disease, vehicle strikes and dog predation) are likely to pose more significant challenges to the population.

EXISTING KEY THREATS TO SOUTHERN SYDNEY KOALA POPULATION

Currently, the key threats to the Southern Sydney Koala population (based on documented threats to the population within the Campbelltown locality) include (Phillips, 2016):

- Vehicle strike
- Wildfire
- Dog predation
- Habitat loss

The rates and distribution of Koala roadkill events have been analysed through an examination of available roadkill records within BioNet (as at October 2020). The distribution of roadkill records in the vicinity of Wilton and GMAC are shown in Map 30-18. It is noted that the true number of roadkill Koalas is likely to be greater than the number of records, as not all roadkill occurrences would necessarily be recorded. Therefore, the true number and rate of Koala roadkill occurrences is unknown. However, the records nonetheless provide insight into trends in the rate and distribution of roadkill events in the locality.

Vehicle strikes of Koalas are becoming more common within the Campbelltown and Wollondilly LGAs. The increasing rates of vehicle strike are correlated with a rapid increase in traffic density within the locality, particularly on Picton Road and Appin Road (DPIE, 2019). The increasing trend in traffic density, and corresponding increase in Koala mortality rates, is likely to continue with further development without the implementation of appropriate mitigation measures (DPIE, 2019).

Further, a number of roadkill hotspots have been identified, where a hotspot is defined as a location with greater than four roadkill Koalas within a 2 km stretch of road (DPIE, 2019). Roadkill hotspots tend to occur where a major road intersects a primary Koala corridor, often near the headwaters of a watercourse. Roadkill hotspots are known to occur at the following locations (DPIE, 2019):

- Picton Road between Cordeaux Dam and Wilton
- Macarthur Drive
- Eastern end of Wilton Road
- Appin Road between Appin and Campbelltown
- Hume Highway at the Bargo exit

The rates of Koala mortalities from the remaining key threats to the population (wildfires, dog predation and habitat loss) are currently unknown. Estimating the severity of these threats is difficult, such threats are typically not highly visible (e.g. dog attack from roaming dogs in bushland) and operate over long timescales (e.g. habitat loss) or in a stochastic manner (e.g. bushfires). It is therefore difficult to identify the prevalence and severity of each threat to the viability of the population as a whole, and subsequently it is difficult to determine how investment in conservation funding to address each threat should be prioritised.

It is noted that the area occupied by the Southern Sydney Koala population was largely unburnt in the 2019/20 bushfires, and subsequently this population was not substantially impacted. This increases the importance of the Southern Sydney Koalas as a source population to enable recolonisation of surrounding habitat areas which were more heavily impacted. However, the population remains vulnerable to the threat of future fires, particularly as prolonged absence of fire allows larger fuel loads to develop.

Nonetheless, it is noted that Rhodes et al. (2011) found that, where multiple threats are present in a Koala population, addressing only a single threat is unlikely to achieve the desired result of protecting a Koala population from decline. Therefore, Rhodes et al. (2011) recommend implementation of a range of strategies to target and reduce multiple threats, as focusing on a single, key threat is unlikely to be effective.

BLUE MOUNTAINS KOALA POPULATION

This section provides an overview of the Blue Mountains Koala population, which is the closest Koala population to GPEC and WSA, and the source population for dispersing Koalas which may enter the nominated areas.

HABITAT AVAILABLE WITHIN GPEC AND WSA

An assessment of Koala habitat availability and quality within GPEC and WSA has been conducted through analysis of the following landscape features:

- Habitat mapping
- Consideration of threatening processes
- Consideration of distribution of Koala records

Each of these matters is considered in detail below.

HABITAT MAPPING WITHIN GPEC AND WSA

Three methods of mapping have been conducted to determine the availability and importance of Koala habitat within the GPEC and WSA.

The first method, known as a Species Distribution Model (SDM), did not find any areas of potential Koala habitat within either the GPEC or WSA. The results of the SDM mapping are presented in Map 30-14.

The second method, known as corridor mapping, found only scattered areas of supporting Koala habitat within the nominated areas. The results of the corridor mapping are presented in Map 30-15 and Map 30-16.

The third method, known as habitat critical to the survival mapping, did not map any habitat critical in the nominated areas.

Overall, none of the mapping methods identified the presence of important habitat within either nominated area. Further detail regarding the methodology for preparing the above mapping methods is presented in Part 3.

CONSIDERATION OF THREATENING PROCESSES

GPEC already contains large areas of existing urban development. Urban environments pose significant threats to Koalas, through factors including high road and traffic densities, high densities of predators such as domestic dogs, landscape hazards such as swimming pools and barriers to movement such as fences.

Whilst Koalas may occasionally occur within areas of vegetation within GPEC, it is considered unlikely that a breeding and persisting population of Koalas would be able to permanently reside in habitat within GPEC, as it is considered likely that the mortality rates of Koalas due to the high threat pressures would be greater than the breeding rate. Therefore, it is probable that habitat currently available within GPEC constitutes 'sink habitat'.

WSA does not currently have such a high density of urban development, and therefore is less likely to have threat densities which are as significant as those in GPEC. However, it is noted that the scarcity of native vegetation within the nominated area would require Koalas to cross large areas of open habitat whilst traversing between vegetation, which would increase the vulnerability of Koalas to threats such as predation by dogs.

Overall, it is considered that significant threat pressures would be present within both nominated areas.

CONSIDERATION OF KOALA RECORD DISTRIBUTION

The BioNet record database has been examined to determine the likelihood that Koalas are present within GPEC and WSA. It is noted that there are high human population densities in both areas, particularly within GPEC, and therefore an absence of records would be likely to accurately reflect an absence of Koalas (as opposed to an absence of surveys).

There are no records of Koalas within WSA Area. Three records occur within GPEC, including:

- One record dated from 1990 in Blackett
- One record dated from 2018 in Oxley Park
- One record dated from 2018 in the North St Marys locality

A small number of Koala records also occur in semi-rural localities to the north of GPEC, as follows:

- One record is dated from 1984 in the Londonderry locality

- One record is dated from 2006 and located in the Metro offset site near Colebee
- Three records are dated from 2018 and located to the west of Shanes Park

Further Koala records are located to the west of the two nominated areas, within and in proximity to areas of remnant vegetation associated with the eastern boundary of the Blue Mountains.

Whilst a small number of Koala records occur within and in the vicinity of the GPEC and WSA, the scarcity of these records, and the length of time between sightings, suggests that Koalas are extremely rare within the locality, and that it is very unlikely that there is a persistent population in the locality. Instead, it is more likely that Koala sightings within these localities are of dispersing individuals travelling between areas of more suitable habitat.

Summary

Koala habitat mapping, consideration of threatening processes and Koala BioNet records all suggest that:

- It is very unlikely that suitable Koala habitat is present within either GPEC or WSA
- It is likely that any Koalas which are present within the two are dispersing between areas of more suitable habitat

It is therefore considered that any Koalas within the GPEC or WSA would likely constitute individuals which have dispersed from the Blue Mountains Koala population, as this is the closest habitat area which is known to support a self-sustaining and expanding population from which Koalas are known to disperse.

OVERVIEW OF THE BLUE MOUNTAINS KOALA POPULATION

Compared to the Southern Sydney Koala population, comparatively little is known about the Blue Mountains Koala population. The majority of research in this area has been conducted through the 'Blue Mountains Koala Project', which is run by the non-profit conservation organisation Science for Wildlife (Leigh, pers. comm. 2019).

Koala populations are known to occur in the following localities (Leigh, 2019):

- South east Wollemi National Park to the Hawkesbury LGA
- Kangara-Boyd National Park to the Megalong Valley
- Lower Blue Mountains
- Newnes Plateau
- Potentially the Kedumba Valley

It was previously thought that habitat within the Blue Mountains would only support low densities of Koalas as the majority of habitat is sandstone-based. However, research in two study areas (south east Wollemi National Park to the Hawkesbury LGA, and Kangara-Boyd National Park to the Megalong Valley) found large numbers of koalas occurring in medium densities. Further, although previous modelling suggests that Koalas are unlikely to occur above 800 m elevation on low quality soils, Koalas in Kangara-Boyd National Park have been observed living at over 1,100 m elevation on low quality soils (Leigh, 2019).

It is also recognised that the Blue Mountains are likely to become more important habitat for Koalas in the future, offering climate refugia from climate change and protection from continuing human development in surrounding areas. Overall, habitat within the Blue Mountains is considered to be very important for the persistence of Koalas (Leigh, 2019).

The Blue Mountains Koalas are important for conservation purposes as it has the highest recorded levels of genetic diversity of any Koala population in Australia (Kjeldsen, Raadsma et al., 2019). Further, prior to the 2019-20 fire season, Koala populations in the following localities were thought to be expanding (Leigh, 2019):

- South east Wollemi National Park to the Hawkesbury LGA
- Kangara-Boyd National Park to the Megalong Valley (it is noted that the Kangara population is *Chlamydia* - free)
- Lower Blue Mountains

The primary threats for Koalas within the Blue Mountains are considered to be disease and fire. Habitat fragmentation is not considered to be a major threat for Koala populations in these localities given that the majority of habitat occurs in protected areas (NSW Legislative Council, 2020).

The Blue Mountains were substantially impacted by the 2019/20 fire season, with 80 per cent of the total Greater Blue Mountains World Heritage Area occurring within the fire ground. In February 2020, it was reported that a number of important Koala study sites had 75 to 100 per cent of their area impacted by fire. While a small number of Koalas were evacuated from these areas and re-released following the fire season, it is unknown how many Koalas remain within these areas, or what the current population trajectory is (NSW Legislative Council, 2020).

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CUMBERLAND PLAIN ASSESSMENT REPORT

PART 6B: STRATEGIC ASSESSMENT REPORT

CHAPTER 32 – MIGRATORY SPECIES IMPACT ASSESSMENT

CHAPTER 33 – RAMSAR IMPACT ASSESSMENT

CHAPTER 34 – WORLD AND NATIONAL HERITAGE IMPACT ASSESSMENT

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CHAPTER 36 – SUMMARY OF TRANSPORT PROGRAM IMPACTS

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CHAPTER 38 – CUMULATIVE IMPACT ASSESSMENT

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	James Shepherd, Callan Wharfe, Rebecca Dwyer (Biosis) Darren James (DAJ Environmental)
CONTENT:	John Horan, Natasha Buckingham, Stephanie Binks, Kimberly Spragg, Tom Holden, Heather Tolley, Peter Hemphill, Christa Shen, Heidi Birkby (Open Lines)
REVIEWED BY:	
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DATE:	2021

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32 Migratory species impact assessment

This Chapter assesses the potential impacts to migratory species from the Plan.

The Strategic Assessment Area supports a number of migratory bird species that are protected under the EPBC Act. There are two key policy statements that apply to these species:

- The *Draft Referral guideline for 14 migratory birds listed under the EPBC Act* (DoE, 2015). Potential impacts to species relating to this guideline are assessed in Section 32.1. Assessment of migratory birds in this section is also supported by guidance material from the *Significant Impact Guidelines 1.1* (DoE, 2013b)
- The *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoEE, 2017). Potential impacts to species relating to this guideline are assessed in Section 32.2

There are no other listed migratory species that are relevant to the assessment.

32.1 MIGRATORY BIRDS

Nine species listed in the migratory bird referral guidelines (DoE, 2015) have been observed within the Strategic Assessment Area. These species have large areas of important habitat in Australia, of which less than 1 per cent will be impacted by the Plan (NSW NPWS, 2002).

Potential direct and indirect impacts to the nine species as a result of the Plan are considered to be negligible.

Only one of the species (White-throated Needletail) has been observed in ecologically significant numbers in the Cumberland subregion. This species is almost exclusively aerial and found over a wide range of habitats including extensively modified and urban areas. Development under the Plan is considered unlikely to disrupt this species' use of the Strategic Assessment Area.

This section sets out:

- The regulatory context for assessing impacts to migratory birds
- The approach to the impact assessment
- Baseline information about migratory birds in the Strategic Assessment Area
- Analysis of the potential impacts
- An overview of relevant conservation measures
- Evaluation of the outcome for migratory birds

32.1.1 REGULATORY CONTEXT

This section assesses impacts to the species discussed in the *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE, 2015). The section also outlines approval considerations under the EPBC Act.

REFERRAL GUIDELINES

The guidelines relate to site-by-site assessments under the EPBC Act (Parts 7-9) and set out three pathways for significant impacts to migratory birds:

- Impacts to habitat: Substantial modification of important habitat, or
- Impacts to individuals: Serious disruption of an ecologically significant proportion of a population, or
- Establishment of invasive species that is harmful to the migratory species in an area of important habitat for the migratory species

Only one pathway needs to be met to be considered a significant impact.

The migratory bird referral guidelines provide definitions of "important habitat" for each species, in addition to thresholds to define a "substantial modification" and an "ecologically significant proportion" of each species' habitat or population.

Substantial modification of important habitat is defined using a threshold of 1 per cent of the species' total habitat in Australia. A threshold of 0.1 per cent of the species' total population in Australia is used to require proponents to collect further information on the species' presence, including surveys.

Similarly, an ecologically significant proportion of a population is defined as 1 per cent of the species' total population, with a 0.1 per cent threshold triggering a requirement for additional information and surveys. This threshold is based on the number of individuals from a given species that use the relevant area over a year.

With regards to the introduction of invasive species in important habitat for migratory birds, the migratory bird referral guidelines are unclear about the scale of impact associated with introduced species which is required to trigger a significant impact. To resolve this, assessment of impacts from invasive species draws on guidance provided in the Significant Impact Guidelines 1.1.

EPBC ACT APPROVAL CONSIDERATIONS

Section 146L of the EPBC Act sets out the approval considerations in relation to migratory species. In summary, the outcomes of the Plan must not be inconsistent with any of the international agreements relating to migratory species. Of relevance to migratory birds are:

- The Bonn Convention (or the Convention on the Conservation of Migratory Species)
- The bilateral agreements for the conservation of migratory birds between the Government of Australia and the Government of Japan (JAMBA), the Government of China (CAMBA), and the Government of the Republic of Korea (ROKAMBA)

The *Wildlife Conservation Plan For Migratory Shorebirds* (DoEE, 2015) provides a useful summary of Australia's commitments under these agreements. The key obligations (of relevance to this assessment) which cut across the various agreements in different forms are for Australia to:

- Conserve and where possible restore habitats
- Mitigate and manage threats to migratory birds

It is also noted in the Wildlife Conservation Plan that the EPBC Act is the key piece of legislation which gives effect to Australia's international obligations. Following the process and meeting the requirements of the EPBC Act implicitly means that those obligations will be met.

32.1.2 APPROACH TO IMPACT ASSESSMENT

The following sections outline the assessment methodology used to assess impacts to habitat and individuals, and impacts associated with the establishment of harmful invasive species in migratory species habitat.

IMPACTS TO HABITAT AND INDIVIDUALS

The assessment drew on the concepts of substantial modification of habitat and ecologically significant proportions of a population set out in the migratory bird referral guidelines. It was based on available desktop information and used the 1 per cent threshold for impacts to habitat and impacts to individuals rather than the 0.1 per cent threshold. This is an appropriate threshold given the geographic scale and strategic nature of the assessment; noting the 0.1 per cent thresholds for additional surveys are based on site-by-site assessments.

The assessment considered two questions for each impact pathway (see Table 32-1).

Table 32-1: Steps for identifying significant impacts

Steps	Impacts to habitat	Impacts to individuals
Step one	Do the urban capable land and major transport corridors contain over 1 per cent of important habitat for the species, as identified in the migratory bird referral guidelines?	Do the urban capable land and major transport corridors support over 1 per cent of the population of the species in Australia, as identified in the migratory bird referral guidelines?

Steps	Impacts to habitat	Impacts to individuals
Step two	If so, will the classes of action modify, destroy, or isolate the relevant habitat?	If so, will the classes of action disrupt the lifecycle of the relevant population?

The steps for each impact pathway are discussed further below.

Impacts to habitat

Table 2 of the migratory bird referral guidelines provides definitions of important habitat, which occur as written descriptions of habitat features used by each migratory bird. The consulting team has identified all PCTs that correspond with the descriptions of important habitat set out in the migratory bird referral guidelines, which has been used to assess the distribution of important habitat within the Strategic Assessment Area. Given the general nature of habitat descriptions provided in the migratory bird referral guidelines and the large number of PCTs which contain potentially suitable habitat features, this mapping approach is considered to be precautionary.

Step 1 compared the impacts to the PCTs associated with important habitat within the urban capable land and major transport corridors against the thresholds set out in the migratory bird referral guidelines (DoE, 2015).

The impact analysis showed that potential impacts would not exceed the 1 per cent thresholds set out in guidelines for any of the species, so it was not necessary to apply Step 2.

Impacts to individuals

Step 1 drew on observation records from Birdlife Australia, the Atlas of Living Australia, and BioNet Atlas. These records reflect observations as well as organised surveys. The analysis used a conservative estimate of individuals based on the total recorded sightings of each species per year across the Cumberland subregion.

Some of the species are more prevalent in Australia during the summer. To ensure that all the birds that are recorded in a summer season are counted together, the analysis combined records between the 1st of July and the 30th of June the following year. For example, the Atlas of Living Australia contains 210 Fork-tailed Swift records in the Cumberland subregion between July 1st, 1982 and June 30th, 1983. Most of these are over the 1982-83 summer and are recorded in this analysis as occurring in 1982-83.

The impact analysis showed that only one species (White-throated Needletail) is present in the Strategic Assessment Area in ecologically significant numbers. For this species, Step 2 was applied to consider the extent and type of impacts to foraging and roosting habitat to determine whether the Plan is likely to disturb an ecologically significant proportion of the population.

IMPACTS FROM INTRODUCTION OR ESTABLISHMENT OF INVASIVE SPECIES IN IMPORTANT HABITAT

The migratory bird guidelines state that "*An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will... result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species*."

The migratory bird referral guidelines do not provide sufficient guidance with regards to what scale of impact is required to trigger assessment as a significant impact with regards to invasive species. Therefore, the assessment of impacts from invasive species draws on guidance from the Significant Impact Guidelines 1.1.

The *Significant impact guidelines 1.1* (DoE, 2013b) define important habitat as habitat which meets one of the following criteria:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining

The impacts from introduction or establishment of invasive species in important habitat has therefore been assessed with regards to the habitat definition provided in the Significant Impact Guidelines 1.1.

APPROACH TO EPBC ACT APPROVAL CONSIDERATIONS

Regulatory requirements were considered at the end of the assessment by drawing together the results of the impact analysis, examination of the benefits of the conservation measures in the Plan and reviewing any specific requirements for migratory species.

32.1.3 MIGRATORY BIRDS IN THE STRATEGIC ASSESSMENT AREA

Nine species covered by the migratory bird referral guidelines have been observed within the Strategic Assessment Area. The species and their habitat and population thresholds are listed in Table 32-2.

Table 32-2: Migratory birds and impact thresholds in the Strategic Assessment Area

Common name	Scientific name	1% threshold for impacts to habitat	1% threshold for impacts to individuals (individuals)
Oriental Cuckoo, Himalayan Cuckoo	*Cuculus saturatus*	250,000 ha	10,000
Fork-tailed Swift	*Apus pacificus*	*	1,000
Rufous Fantail Southern	*Rhipidura rufifrons rufifrons*	2,600 ha	1,100
Satin Flycatcher	*Myiagra cyanoleuca*	4,400 ha	1,700
Black-faced Monarch	*Monarcha melanopsis*	865 ha	465
White-throated Needletail+	*Hirundapus caudacutus*	*	100
Spectacled Monarch Southern	*Symposiachrus trivirgatus*	1,300 ha	410
Osprey	*Pandion haliaetus*	840 km of coastline	240
Yellow Wagtail	*Motacilla flava*	*	10,000

* No thresholds are available for these species due to a lack of knowledge or rarity

+ The White-throated Needletail is also listed as a vulnerable species and is assessed both in this chapter as a migratory species, and in Chapter 30 as a threatened species

32.1.4 IMPACT ANALYSIS

This section considers the impacts to each species in Table 32-2 using the approach described above.

IMPACTS TO HABITAT

The total area of impacts to native vegetation within the urban capable land and major transport corridors is 1,753.6 ha. This is well below the threshold for Oriental Cuckoo (250,000 ha) and Satin Flycatcher (4,400 ha). There is no coastline in the Strategic Assessment Area, but 135 km of potential Osprey habitat exists along the Nepean and Hawkesbury Rivers within the Strategic Assessment Area. This is also well below the threshold for substantial modification of important habitat for Osprey (840 km of coastline).

The Fork-tailed Swift, White-throated Needletail and Yellow Wagtail do not have thresholds for substantial modification of important habitat. The guidelines note that roosting habitat for White-throated Needletail is poorly understood and may be a constraint on the species. This will be considered below.

This leaves three species to consider:

- Rufous Fantail Southern
- Black Faced Monarch
- Spectacled Monarch Southern

The guidelines describe important habitat for each of these species. Table 32-3 gives these descriptions, along with the corresponding PCTs that could be impacted by the Plan, and the extent of potential impacts to those PCTs.

Table 32-3 shows that the potential impacts to the three species are well below the thresholds for substantial modification of important habitat.

The Plan will not substantially modify, destroy or isolate an area of important habitat for any of the migratory birds listed in the guidelines.

Table 32-3: Important habitat and potential impacts for three migratory bird species

Species (threshold in ha)	Important habitat	Corresponding PCTs within the urban capable land and major transport corridors	Extent of potential impacts (ha)*
Rufous Fantail Southern (2,600)	Moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands.	724, 725, 781, 830, 835, 849, 850, 889, 1181, 1395, 1800	1,753.6
Black Faced Monarch (865)	Wet forest specialist, found mainly in rainforest and wet sclerophyll forest, especially in sheltered gullies and slopes with a dense understorey of ferns and/or shrubs.	830, 835, 1800	212.2
Spectacled Monarch Southern (1,300)	Dense vegetation, mainly in rainforest but also in moist forest or wet sclerophyll and occasionally in other dense vegetation such as mangroves, drier forest, and woodlands.	724, 725, 781, 830, 835, 883, 1800	362.3

* Impact calculations exclude impacts to derived native grasslands, as all three species require forests, woodlands, or dense vegetation

IMPACTS TO INDIVIDUALS

Ecologically significant proportions of populations

Atlas of Living Australia, Birdlife Australia and BioNet Atlas records for each species were aggregated over 12-month periods starting from July 1st each year since 1979-80. Prior to 1979-80, sightings were recorded sporadically and in small numbers that are not helpful for this analysis.

For each 12-month period, the total number of sightings was defined as the largest number of records for that period from either the Atlas of Living Australia, Birdlife Australia, or BioNet Atlas data sets.

Table 32-4 sets out the total number of records for each species for the ten 12-month periods with the highest numbers of records since 1980. It also provides the year in which those sightings were made.

Table 32-4: Years with the largest number of records of migratory birds in the Cumberland subregion since 1980

	Ranked year of highest number of records (number of individuals (year))									
Species	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**	**Seventh**	**Eighth**	**Ninth**	**Tenth**
Fork-tailed Swift	250 (1985-86)	210 (1982-83)	158 (2016-17)	52 (2017-18)	15 (2006-07)	12 (2003-04)	8 (2012-13)	8 (2012-13)	7 (2013-14)	7 (1981-82)
Oriental Cuckoo	1 (2015-16)	1 (2013-14)	1 (2009-10)	Species only recorded in three years						
White-throated Needletail	2576 (2016-17)	2208 (2012-13)	1472 (2017-18)	884 (2015-16)	739 (2014-15)	676 (2011-12)	644 (2013-14)	593 (2010-11)	356 (2009-10)	233 (1986-87)

	Ranked year of highest number of records (number of individuals (year))									
Species	**First**	**Second**	**Third**	**Fourth**	**Fifth**	**Sixth**	**Seventh**	**Eighth**	**Ninth**	**Tenth**
Black-faced Monarch	53 (2016-17)	20 (2013-14)	17 (2014-15)	14 (2017-18)	12 (2011-12)	11 (2015-16)	11 (2012-13)	5 (2005-06)	4 (2010-11)	4 (2003-04)
Yellow Wagtail	2 (2016-17)	2 (2012-13)	Species only recorded in two years							
Satin Flycatcher	26 (2014-15)	10 (2012-13)	9 (2013-14)	8 (2011-12)	6 (2016-17)	5 (2017-18)	4 (2003-04)	3 (2004-05)	3 (1997-98)	2 (1983-84)
Osprey	16 (2013-14)	12 (2012-13)	9 (2010-11)	5 (2017-18)	5 (2014-15)	3 (2016-17)	3 (2015-16)	2 (2003-04)	1 (2004-05)	1 (1989-90)
Rufous Fantail Southern	137 (2016-17)	84 (2017-18)	48 (2016-15)	48 (2013-14)	44 (2014-15)	39 (2012-13)	39 (2011-12)	14 (2010-11)	13 (2009-10)	8 (2000-01)
Spectacled Monarch Southern	1 (1986-87)	Species only recorded in one year								

All of the species in Table 32-4 are well below the thresholds for ecologically significant populations except for the White-throated Needletail. The threshold for this species is 100 birds, and it has been recorded in flocks of up to 300 individuals, with over 2,000 records per year in two years. Based on this data, it has been assumed that an ecologically significant proportion of its population uses the Strategic Assessment Area.

For the other species, the records are sufficiently low across the entire Cumberland subregion that it is unlikely that the urban capable land or major transport corridors support an ecologically significant proportion of their populations.

Potential Impacts to the White-throated Needletail

The White-throated Needletail is a large swift. It has two subspecies, of which only one (*Hirundapus caudacutus caudacutus)* occurs in Australia. This subspecies breeds in northeast Asia (from central Siberia through to Northern China, Sakhalin and Japan) and migrates to Australia for the non-breeding season (DoEE, 2018b).

There is limited information on the ecology of this species. In Australia, it is often found in large flocks of hundreds or thousands of birds. It is widespread in eastern and south-eastern Australia. The species is an insect feeder and is almost exclusively aerial in Australia. It occurs over a wide range of habitats, ranging from heavily treed forests to open habitats such as farmland, heathland or mud flats. There is limited data on total population and population trends in Australia, but there is some evidence that the population and area of occupancy is in decline (DoEE, 2018b).

It is not threatened in NSW and is listed as vulnerable under the EPBC Act. A detailed impact assessment of the White-throated Needletail as a threatened species is provided in Section 30.17 of Chapter 30. That assessment found the species was at no risk of direct impacts, and implementation of the Plan would not influence the long-term viability of the species.

Impacts to foraging habitat

The species has been observed foraging over a wide range of habitats. The Atlas of Living Australia, Birdlife Australia and BioNet Atlas contain numerous records in or above heavily modified and urban environments. The species is aerial while foraging and is often observed in areas of updraughts (e.g. above cliffs, ridges, and dunes, in the smoke of bushfires, in whirlwinds, or along the edges of low pressure systems) (TSSC, 2019).

The species appears to prefer certain geographic and meteorological conditions, rather than relying on particular kinds of vegetation. It is unlikely that modification of habitat from the Plan will substantially alter the species' use of the

Strategic Assessment Area or the urban capable land and major transport corridors. There are no anticipated impacts to foraging habitat from the Plan.

Impacts to roosting habitat

There are limited records of the White-throated Needletail roosting and it was previously thought that the species was exclusively aerial in Australia. Records now suggest that the species roosts in tall trees and may prefer roosting sites on ridgelines. There is some evidence that the species uses traditional roosting sites although there are no records of these sites in the Cumberland subregion.

The species is wide-ranging and not known to roost within the Strategic Assessment Area. The Plan will conserve large areas of high-quality woodland, which will ensure the species has continued access to potential roosting sites within the Cumberland subregion. There is a low risk of impacts to roosting habitat from the Plan.

Summary of impacts to the White-throated Needletail

The Plan is unlikely to disrupt foraging within the Cumberland subregion. It is possible that roosting sites may be present within the urban capable land and major transport corridors, but there are no records of this and the risk of loss of roosting habitat is low. The Plan will ensure the conservation of high-quality woodland which will provide continued access to potential roosting habitat within the Strategic Assessment Area. The Plan will not seriously disrupt the lifecycle of the proportion of the White-throated Needletail population that frequents the Cumberland subregion.

IMPACTS FROM INTRODUCTION OR ESTABLISHMENT OF INVASIVE SPECIES IN IMPORTANT HABITAT

The migratory bird referral guidelines identify introduced species that present key threats to some of the migratory bird species. A migratory species can be significantly impacted under the guidelines if one of the relevant introduced species becomes established in an area of important habitat as a result of an action. Four of the species known to occur within the Cumberland subregion have key threats listed in the guidelines (see Table 32-5).

Table 32-5: Invasive species harmful to migratory species in the Strategic Assessment Area

Species	Invasive species harmful to the migratory species
Osprey	Any introduced species that causes a large reduction in fish stocks
Black-faced Monarch	Black Rat (*Rattus rattus*) Vines that invade riparian habitats
Spectacled Monarch	Black Rat (*Rattus rattus*) Vines that invade riparian habitats
Rufous Fantail	Black Rat (*Rattus rattus*) Vines that invade riparian habitats

Impacts associated with introduced species are only significant if they occur within important habitat for the relevant migratory species. As noted above, with regards to the assessment of impacts relating to invasive species, the important habitat has been defined in this section based on the definition provided in the Significant Impact Guidelines 1.1.

There is no important habitat for any of the four migratory species in Table 32-5 within the Cumberland subregion, because:

- None of the habitat in the Strategic Assessment Area is of critical importance to Osprey, Black-faced Monarch, Spectacled Monarch, or Rufous Fantail at particular life stages
- The Cumberland subregion is not at the limit of any of these species' range
- None of these species are present in ecologically significant proportions (as shown in Table 32-4)
- There is no evidence that the populations of Osprey, Black-faced Monarch, Spectacled Monarch, or Rufous Fantail are in decline within the Strategic Assessment Area. Table 32-4 shows:
    - An increase in observations of Osprey and Black-faced Monarch within the Strategic Assessment Area since 2010

- Only one record of Spectacled Monarch in the Cumberland subregion (from 1986-87) which is inadequate to establish a population trend
- Numerous observations (over 200 birds in two 12-month periods) of Rufous Fantail in 1982-83 and 1985-86, but these seem anomalous and the species has been observed in increasing numbers in the last 10 years

The Plan includes a range of commitments and actions to minimise and avoid indirect impacts, including from introduced species (see Chapter 15 for details). The populations of Osprey, Black-faced Monarch, Spectacled Monarch and Rufous Fantail using the Strategic Assessment Area are small, and the region is of limited importance for these species. The management measures for indirect impacts are considered sufficient to minimise the risk of these impacts to migratory birds within the Strategic Assessment Area.

32.1.5 CONSERVATION MEASURES THAT WILL BENEFIT MIGRATORY BIRDS

The Plan includes a range of commitments that will benefit the migratory birds discussed in this section. The Plan will set aside for conservation a minimum of 5,325 ha of native vegetation with a focus on large, well connected, high quality patches. This will protect foraging and passage habitat for these species within the Cumberland subregion.

32.1.6 EVALUATION OF THE OUTCOME FOR MIGRATORY BIRDS

As outlined in Section 32.1.1, the outcomes of the Plan must not be inconsistent with any of the international agreements relating to migratory species. The key obligations (of relevance to this assessment) which cut across the various agreements in different forms are for Australia to:

- Conserve and where possible restore habitats
- Mitigate and manage threats to migratory birds

The Plan is not inconsistent with these obligations:

- The potential impacts to the nine species listed in the guidelines are below the thresholds for substantial modification of important habitat for all species
- Only the White-throated Needletail is present in the Strategic Assessment Area in ecologically significant numbers. The species is known to forage above a wide range of habitats and is unlikely to be disrupted or displaced by development. There are no known roosting sites within the Cumberland subregion, and the commitments and actions in the Plan will protect potential roosting sites and other vegetation to benefit the species

32.2 MIGRATORY SHOREBIRDS

Thirty-seven species of migratory shorebirds regularly visit Australia during their non-breeding season (from the Austral spring to autumn). The majority of those breed in the northern hemisphere and use the East Asian-Australasian Flyway which stretches from Siberia and Alaska, through east and south-east Asia, to Australia and New Zealand. They depend upon a range of sites along the flyway for breeding, staging, feeding, and roosting. In Australia, coastal and freshwater wetlands provide important habitat (DoEE, 2015).

Twenty-one of these species have been recorded within the Cumberland subregion. Two of those have been recorded at a site level in important numbers. They are the Sharp-tailed Sandpiper and Latham's Snipe.

Potential impacts to migratory shorebirds as a result of the Plan are considered to be negligible. No important habitat will be lost, and the risk of indirect impacts such as degradation of habitat and disturbance of birds is considered to be low.

This section sets out:

- The regulatory context for assessing impacts to migratory shorebirds
- The approach to the impact assessment
- Baseline information about migratory shorebirds in the Strategic Assessment Area
- Analysis of the potential impacts
- An overall conclusion

32.2.1 REGULATORY CONTEXT

GUIDELINES

The *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoEE, 2017) provide guidance about how the EPBC Act applies to that group of species. They are designed to be read in conjunction with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DoE, 2013b).

Impact pathways

The guidelines set out four pathways by which impacts can be significant to migratory shorebirds:

- Loss of important habitat
- Degradation of important habitat leading to a substantial reduction in migratory shorebird numbers
- Increased disturbance within important habitat leading to a substantial reduction in migratory shorebird numbers
- Direct mortality of birds leading to a substantial reduction in migratory shorebird numbers

Definition of important habitat

Important habitat for migratory shorebirds is a key concept outlined in the guidelines. It relates to three of the impact pathways.

Important habitats are sites that meet one or more of the following criteria:

- Habitat that is already identified as internationally important
- Habitat that regularly supports 0.1 per cent of the flyway population of a single species of migratory shorebird. Estimates of the flyway populations for each of the species is provided in the *Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species* (Hansen, Fuller et al., 2016)
- Habitat that regularly supports 2,000 migratory shorebirds, or
- Habitat that regularly supports 15 migratory shorebird species (DoEE, 2017)

There are different criteria for identifying important habitat for Latham's snipe (*Gallinago harwickii*). This is because this species does not typically aggregate in large flocks and uses different habitat to the other species discussed in the migratory shorebird guidelines. Important habitat for Latham's snipe is:

- Any area that has been previously identified as internationally important for the species, or

- Any area that supports at least 18 individuals of the species (DoEE, 2017)

Avoiding and/or mitigating impacts

The guidelines also outline a set of general measures to avoid and/or mitigate impacts to shorebirds. Measures include:

- Making every effort to avoid habitat loss
- Ensuring habitat is not degraded through the introduction of exotic species; changes to hydrology or water quality (including toxic inflows); fragmentation of habitat or exposure to litter or pollutants; and exposure of acid sulphate soils
- Mitigating against the impacts of disturbance
- Considerations around direct mortality to shorebirds
- Consideration of climate change

WILDLIFE CONSERVATION PLAN FOR MIGRATORY SHOREBIRDS

The Wildlife Conservation Plan for Migratory Shorebirds (DoEE, 2015) provides a framework to guide the conservation of migratory shorebirds in Australia. It:

- Summarises Australia's commitments to migratory shorebirds under international conventions and agreements
- Outlines national actions to support shorebird conservation

The Wildlife Conservation Plan is consistent with the EPBC Act referral guidelines. Particularly in relation to the definition of important habitat and the discussion of threats.

EPBC ACT APPROVAL CONSIDERATIONS

Migratory species

Section 146L of the EPBC Act sets out the approval considerations in relation to migratory species. In summary, the outcomes of the Plan must not be inconsistent with any of the international agreements relating to migratory species. Of relevance to migratory shorebirds are:

- The Bonn Convention (or the Convention on the Conservation of Migratory Species)
- The bilateral agreements for the conservation of migratory birds between the Government of Australia and the Government of Japan (JAMBA), the Government of China (CAMBA), and the Government of the Republic of Korea (ROKAMBA)

The Wildlife Conservation Plan (DoEE, 2015) provides a useful summary of Australia's commitments under these agreements. The key obligations (of relevance to this assessment) which cut across the various agreements in different forms are for Australia to:

- Conserve and where possible restore habitats
- Mitigate and manage threats to shorebirds

It is also noted in the Wildlife Conservation Plan that the EPBC Act is the key piece of legislation which gives effect to Australia's international obligations. Following the process and meeting the requirements of the EPBC Act implicitly means that those obligations will be met.

Threatened species

A number of the migratory shorebirds are also listed as threatened. These species are addressed both in this chapter as a migratory species, and in Chapter 30 as threatened species.

32.2.2 APPROACH TO IMPACT ASSESSMENT

This assessment primarily draws on the concepts presented in the migratory shorebird guidelines and is based on:

- Development of baseline information, which includes:
  - Compilation of available records for shorebird species

  - Habitat mapping (including the identification of important habitat) across the Cumberland subregion
- Analysis of potential direct and indirect impacts with a focus on:
  - The four potential impact pathways set out in the Guidelines
  - The general measures to avoid and/or mitigate impacts to shorebirds set out in the Guidelines
- Consideration of regulatory requirements for migratory and (where relevant) threatened species

BASELINE INFORMATION

Compilation of records

Records were compiled from the Birdlife Australia database and the EES BioNet database. This is considered to be the most complete data for shorebirds in the Cumberland subregion.

Approach to habitat mapping within the Cumberland subregion

Habitat mapping was undertaken broadly in accordance with the approach outlined in the EPBC guidelines. However, the method applied was amended to reflect the landscape scale nature of the project, and was more precautionary than required under the EPBC guidelines to ensure that no important habitat sites were missed (see 'limitations in the baseline data' below).

The process involved the following steps:

Step 1: Analysis of records across the Cumberland subregion

Records were compiled and examined across the whole of the Cumberland subregion. The initial step considered the subregion as a single habitat unit to determine which species exceeded the thresholds for important habitat across the whole area (i.e. which species occur in numbers greater than the threshold when records are summed across the whole subregion).

Step 2: Identification of important migratory shorebird habitat sites

The spatial distribution of records was then assessed to identify the individual wetland and waterbody (or wetland mosaic) where the thresholds were exceeded at a site level. Each wetland that was identified as important for migratory shorebirds had its boundary marked and a 250-metre buffer applied. This buffer distance is consistent with the guidelines which suggest buffer distances ranging from 165 to 255 m to mitigate against disturbance (DoEE, 2017).

For ephemeral wetlands the threshold was considered across every year where records were held.

For permanent wetlands, the guidelines suggest considering the last five years. The approach taken for this assessment was to look at records for the last 20 years for sites that were thought to be permanent. This acknowledges the uncertainty in determining if habitat sites are permanent or ephemeral across the Strategic Assessment Area.

Step 3: Identification of potential migratory shorebird habitat

The remaining potential migratory shorebird habitat in the subregion was determined based on the presence of suitable wetlands throughout the landscape that exceed 1.5 ha in area. This 1.5 ha threshold was used as a proxy for the minimum disturbance distance for shorebirds of 150 m.

Wetland mapping layers were interrogated from the Directory of Important Wetlands (DoEE, 2018a) and the LPI topographical data Hydro Area layer (LPI, 2016) to identify areas of potential habitat.

Limitations in the baseline data

The data used in the habitat mapping is the best available across the Cumberland subregion. It incorporates:

- Historical records from both BioNet and Birdlife Australia
- Wetland and waterbody mapping from DAWE and LPI

However, there has not been a systematic survey for migratory shorebirds across the subregion and it is likely that shorebirds visit a number of sites where there are no records.

To address uncertainty in the data a precautionary approach was taken. This involved:

- Considering the whole of the Cumberland subregion to determine what species occurred in numbers greater than the important habitat thresholds when their records were summed for all sites
- Mapping potential habitat using wetland and waterway mapping

APPROACH TO ANALYSING IMPACTS

Direct and indirect impacts were assessed by considering the four impact pathways identified in the guidelines.

The potential loss of important habitat was calculated by:

- Intersecting the urban capable land and major transport corridors with the habitat mapping
- Considering potential changes to hydrology, water quality or vegetation structural changes near important habitat sites

Potential degradation and disturbance within important habitat, and potential direct mortality of migratory shorebirds were assessed through:

1. Identifying the activities under the Plan that may lead to these impacts
2. Considering how those activities are proposed to be managed under the Plan (noting that Chapter 15 provides a detailed description and analysis of how indirect impacts will be managed)
3. Analysing the residual risk to important habitat and shorebirds

APPROACH TO EPBC ACT APPROVAL CONSIDERATIONS

Regulatory requirements were considered at the end of the assessment by drawing together the results of the impact analysis, examination of the benefits of the conservation measures in the Plan and reviewing any specific requirements for migratory and (where relevant) threatened species.

32.2.3 MIGRATORY SHOREBIRDS IN THE STRATEGIC ASSESSMENT AREA

Migratory shorebirds are found at a number of sites within and adjacent to the Strategic Assessment Area during their seasonal occurrence in the southern hemisphere. Site usage varies based on the extent and quality of habitat.

This section provides:

- An overview on the migratory shorebirds recorded in the Cumberland subregion
- An overview of habitat in the subregion
- Site profiles for important habitat

MIGRATORY SHOREBIRDS RECORDED IN THE CUMBERLAND SUBREGION

A total of 21 species have been recorded across the Cumberland subregion (see Table 32-7). Of these:

- Four have been recorded in numbers that exceed the thresholds for important habitat when the subregion is considered as a single habitat unit. They are Sharp-tailed Sandpiper, Latham's Snipe, Black-tailed Godwit, and Bar-tailed Godwit
- Two have exceeded thresholds for important habitat at the individual site level. They are Sharp-tailed Sandpiper and Latham's Snipe
- Five are also listed as threatened species under the EPBC Act. They are Bar-tailed Godwit (vulnerable), Curlew Sandpiper (critically endangered), Eastern Curlew (critically endangered), and Red Knot (endangered)

OVERVIEW OF SHOREBIRD HABITAT

A total of 11 important sites occur for migratory shorebirds across the subregion (see Map 32-1). None of these sites will be directly impacted by development under the Plan.

Table 32-6: Summary of migratory shorebird habitat sites

Habitat type	Number of sites	Total area of habitat (ha)
Important habitat within the Strategic Assessment Area	5	182.3
Important habitat within the broader Cumberland subregion	6	54.5
TOTAL	**11**	**236.8**

The important habitat sites can be broadly placed into five groups based on their location:

- Sites in the Strategic Assessment Area:
  - Sites 7, 9, 17 and 21 all occur near to the Hawkesbury River in the north of the Strategic Assessment Area
  - Site 19 occurs in the Mt Annan Botanic Gardens to the west of GMAC
- Sites outside the Strategic Assessment Area in the broader Cumberland subregion:
  - Sites 1 and 11 occur in the Marsden Park North Precinct of the existing North West Growth Area
  - Sites 3, 13 and 15 all occur within the vicinity of Sydney Olympic Park
  - Site 5 occurs outside in the suburb of Panania

It is important to note that important migratory shorebird habitat has been mapped for use in BAM assessments under the NSW BC Act. No important migratory shorebird habitat has been identified within the Strategic Assessment Area.

A number of sites are subject to existing management (e.g. as a nature reserve). The section below provides a profile for each site.

Table 32-7: List of migratory shorebird species occurring within the Cumberland subregion (species in excess of important habitat thresholds = blue, threatened species = bold)

Common name	Scientific name	EPBC Act listing status	0.1% flyway population threshold (Hansen, Fuller et al., 2016)	Species exceeds 0.1% across the whole Strategic Assessment Area?	Number of individual sites exceeding the 0.1% flyway population threshold	Sites where key^ species have been recorded
Bar-tailed Godwit	***Limosa lapponica***	**Migratory Vulnerable[#]**	**325**	**Yes**	**0**	**9, 13, 15**
Black-tailed Godwit	*Limosa limosa*	Migratory	160	Yes	0	7, 9, 13, 21
Common Greenshank	*Tringa nebularia*	Migratory	110	No	0	1, 3, 7, 9, 13, 21
Common Sandpiper	*Actitis hypoleucos*	Migratory	190	No	0	9, 13, 17
Curlew Sandpiper	***Calidris ferruginea***	**Migratory Critically Endangered**	**90**	**No**	**0**	**1, 3, 7, 9, 13, 21**
Double-banded Plover	*Charadrius bicinctus*	Migratory	19	No	0	1, 3, 7, 11, 21
Eastern Curlew	***Numenius madagascariensis***	**Migratory Critically Endangered**	**35**	**No**	**0**	**13**
Greater Sand-plover	***Charadrius leschenaultii***	**Migratory Vulnerable**	**200**	**No**	**0**	**3**
Grey Plover	*Pluvialis squatarola*	Migratory	80	No	0	3, 21
Latham's Snipe	*Gallinago hardwickii*	Migratory	18*	Yes	3	1, 3, 7, 9, 11, 13, 15, 17, 19, 21
Little Curlew	*Numenius minutus*	Migratory	110	No	0	7, 9, 21
Long-toed Stint	*Calidris subminuta*	Migratory	230	No	0	7, 9, 21
Marsh Sandpiper	*Tringa stagnatilis*	Migratory	130	No	0	3, 7, 9, 13, 21
Pacific Golden Plover	*Pluvialis fulva*	Migratory	120	No	0	3, 7, 9, 13, 15, 21
Pectoral Sandpiper	*Calidris melanotos*	Migratory	1,220	No	0	1, 3, 7, 9, 21

Common name	Scientific name	EPBC Act listing status	0.1% flyway population threshold (Hansen, Fuller et al., 2016)	Species exceeds 0.1% across the whole Strategic Assessment Area?	Number of individual sites exceeding the 0.1% flyway population threshold	Sites where key^ species have been recorded
Red Knot	***Calidris canutus***	**Migratory Endangered**	**110**	**No**	**0**	**13**
Red-necked Stint	*Calidris ruficollis*	Migratory	475	No	0	1, 3, 7, 9, 13
Ruddy Turnstone	*Arenaria interpres*	Migratory	30	No	0	1, 3
Ruff	*Philomachus pugnax*	Migratory	25	No	0	3, 7, 9, 21
Sharp-tailed Sandpiper	*Calidris cuminate*	Migratory	85	Yes	8	1, 3, 7, 9, 11, 13, 15, 21
Wood Sandpiper	*Tringa glareola*	Migratory	130	No	0	1, 3, 9, 21

^ For species occurring in excess of important habitat thresholds and/or threatened species

Two subspecies of *L. lapponica* regularly occur in Australia. In the non-breeding season, *L. l. bauera* (listed as migratory and vulnerable) occurs along the north and east coasts of Australia (TSSC, 2016a). *L. l. menzbieri* (listed as migratory and critically endangered) on the other hand occurs predominately in Western Australia (TSSC, 2016b) and is not considered likely to occur in the Cumberland subregion.

* For Latham's Snipe important habitat is defined based on the presence of 18 birds rather than the 0.1 per cent threshold which is 30 individuals

SITE PROFILES FOR IMPORTANT HABITAT

Profiles for each of the eleven important habitat sites within the Cumberland subregion are provided below.

Site 1

SITE DETAILS	
Site ID number:	1
Site name:	Old Riverstone Meatworks ponds
Location:	Outside the Strategic Assessment Area within the broader Cumberland subregion
Approximate distance to nearest development area:	5.7 km
Important habitat for:	Sharp-tailed Sandpiper (187 birds recorded in 2005)
Total species recorded:	9
Area of important habitat:	8.1 ha
Area with buffer:	57.1 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Site 1 is comprised of a group of former wastewater ponds associated with the old Riverstone Meatworks in the Marsden Park North Precinct of the existing North West Growth Area. The site is currently surrounded by farmland to the West, North and East; and low density development to the South. The Precinct is in the process of being rezoned and options are being explored for re-creating shorebird habitat in the vicinity before removing the old ponds (DPE, 2018).	

Site 3

SITE DETAILS	
Site ID number:	3
Site name:	Mason Park Wetlands
Location:	Outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion
Approximate distance to nearest development area:	25.5 km
Important habitat for:	Sharp-tailed Sandpiper (120 birds recorded in 2004; 150 in 2005; 112 in 2007; and 100 in 2009)
Total species recorded:	8
Area of important habitat:	7.8 ha
Area with buffer:	60.2 ha
DESCRIPTION & LANDSCAPE CONTEXT	
The Mason Park Wetlands occur near to Sydney Olympic Park. The wetlands are bounded by Saleyards and Powells Creeks, and used to form part of the once extensive estuarine environment of the Parramatta River. They contain remnant salt marsh communities and are recognised for their habitat value for migratory shorebirds (AECOM, 2010).	

Site 5

SITE DETAILS	
Site ID number:	5
Site name:	N/A
Location:	Outside the Strategic Assessment Area within the broader Cumberland subregion
Approximate distance to nearest development area:	8.1 km
Important habitat for:	Latham's Snipe (50 birds recorded in 1983)
Total species recorded:	1
Area of important habitat:	3.7 ha
Area with buffer:	45.1 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Site 5 is an unnamed ephemeral water body. It occurs approximately 500 m from the Georges River and is not connected to any other waterways.	

Site 7

SITE DETAILS	
Site ID number:	7
Site name:	Bushell's Lagoon
Location:	In the north of the Strategic Assessment Area, to the north of the Hawkesbury River
Approximate distance to nearest development area:	17.4 km
Important habitat for:	Sharp-tailed Sandpiper (100 birds recorded in 2002)
Total species recorded:	12
Area of important habitat:	118.1
Area with buffer:	317.2
DESCRIPTION & LANDSCAPE CONTEXT	
Bushell's Lagoon is a natural, ephemeral water body that occurs on the floodplain of the Hawkesbury River. It is connected to a number of first order streams. The wetland is surrounded by farm land.	

Site 9

SITE DETAILS	
Site ID number:	9
Site name:	Pitt Town Lagoon
Location:	In the north of the Strategic Assessment Area, to the east of the Hawkesbury River
Approximate distance to nearest development area:	14.5 km
Important habitat for:	Sharp-tailed Sandpiper (183 birds recorded in 2005; 1,000 in 2006; 261 in 2009; 100 in 2013)
Total species recorded:	15

Area of important habitat:	39.6 ha
Area with buffer:	130.5 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Pitt Town lagoon is part of the Pitt Town Nature Reserve and is managed by NSW National Parks. The site is mostly surrounded by farmland and flows into the Hawkesbury River to the north. The site is recognised for its habitat value for migratory shorebirds (NSW NPWS, 2000).	

Site 11

SITE DETAILS	
Site ID number:	11
Site name:	N/A
Location:	Outside the Strategic Assessment Area within the broader Cumberland subregion
Approximate distance to nearest development area:	5.6 km
Important habitat for:	Sharp-tailed Sandpiper (187 birds in 2012)
Total species recorded:	4
Area of important habitat:	0.9 ha
Area with buffer:	30 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Site 11 is a grassy area in a developed area of the Riverstone Precinct of the existing North West Growth Area. The site appears unlikely to provide suitable long-term habitat for migratory shorebirds, but was identified as important based on the number and accuracy of available records.	

Site 13

SITE DETAILS	
Site ID number:	13
Site name:	Wanngal Wetland
Location:	Outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion
Approximate distance to nearest development area:	24 km
Important habitat for:	Sharp-tailed Sandpiper
Total species recorded:	12
Area of important habitat:	32.1 ha
Area with buffer:	117.7 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Wanngal Wetland is part of the Newington Nature Reserve within Sydney Olympic Park. It is part of a highly modified estuarine wetland system. The site contains a range of important ecological values and contains significant areas of remnant saltmarsh and mangroves in excellent condition. It is recognised for its habitat value for migratory shorebirds (NPWS, 2003).	

Site 15

SITE DETAILS	
Site ID number:	15
Site name:	N/A
Location:	Outside the Strategic Assessment Area on the eastern edge of the Cumberland subregion
Approximate distance to nearest development area:	24.5 km
Important habitat for:	Sharp-tailed Sandpiper (202 birds recorded in 2012)
Total species recorded:	4
Area of important habitat:	2 ha
Area with buffer:	38 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Site 15 is located within the Sydney Olympic Park precinct. It occurs adjacent to Brickpit Park and is an ephemeral waterbody that is not connected to other waterways.	

Site 17

SITE DETAILS	
Site ID number:	17
Site name:	Yarramundi Lagoon
Location:	In the north of the Strategic Assessment Area, to the east of the confluence of the Grose and Nepean Rivers
Approximate distance to nearest development area:	12.7 km
Important habitat for:	Latham's Snipe (counts for the species not available, however, multiple records occur for 2002, 2003 and 2004 – taking a precautionary approach the site has been identified as important)
Total species recorded:	1
Area of important habitat:	10.3 ha
Area with buffer:	102.4 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Yarramundi Lagoon is a linear shaped wetland that occurs in the active floodplain of the Hawkesbury – Nepean River (LandArc, 2007). The site is surrounded by farmland and is connected to the Hawkesbury River to the north through a chain of first order streams and small wetlands.	

Site 19

SITE DETAILS	
Site ID number:	19
Site name:	N/A
Location:	In the south of the Strategic Assessment Area, to the west of GMAC

Approximate distance to nearest development area:	1.4 km NB: The edge of this site overlaps with the tunnel footprint for a major transport corridor. However, this development will be sub-surface
Important habitat for:	Latham's Snipe (species has multiple records across a number of years – taking a precautionary approach the site has been identified as important)
Total species recorded:	2
Area of important habitat:	0.2 ha
Area with buffer:	26.1 ha
DESCRIPTION & LANDSCAPE CONTEXT	
Site 19 is a small wetland that occurs in the Mt Annan Botanic Gardens. It is part of a chain of managed ponds that drains north towards Annan Creek.	

Site 21

SITE DETAILS	
Site ID number:	21
Site name:	McGraths Hill Wetland
Location:	In the north of the Strategic Assessment Area, to the south of the Hawkesbury River
Approximate distance to nearest development area:	11.9 km
Important habitat for:	Sharp-tailed Sandpiper (276 birds recorded in 1982)
Total species recorded:	13
Area of important habitat:	14.1 ha
Area with buffer:	77.4 ha
DESCRIPTION & LANDSCAPE CONTEXT	
McGraths Hill Wetland is part of an effluent reuse and wetland project (associated with a sewerage treatment plant). The site occurs on a floodplain and drains into Wianamatta (South Creek) and ultimately into the Hawkesbury River.	

32.2.4 IMPACT ANALYSIS

This section considers the potential impacts to migratory shorebirds against the four impact pathways identified in the EPBC referral guidelines (DoEE, 2017). It also provides a brief consideration of climate change and an evaluation of the outcomes for shorebirds as listed migratory species.

LOSS OF IMPORTANT HABITAT

As outlined in the guidelines (DoEE, 2017), loss of important habitat can occur through either:

- Direct loss: e.g. through clearing, inundation, infilling or draining
- Indirect loss: e.g. through changes to hydrology, water quality, or vegetation structural changes near roosting areas

Direct loss

There will be no direct loss of important habitat (or habitat buffers) due to development under the Plan. No important habitat areas occur closer than 1.4 km from the urban capable land or surface development of major transport corridors, and the majority of important sites are significantly further away.

Indirect loss

Changes to hydrology and water quality

Urban development and transport have the potential to lead to changes to hydrology and water quality. This is related to a range of factors but includes:

- Potential disruption to natural water flows
- The increase of hard surfaces leading to increased runoff
- Potential introduction of a range of contaminants that may affect water quality (e.g. nutrients, chemicals)

Migratory shorebird habitat that would be at risk of these effects are sites that are:

- In close proximity to development areas
- Hydrologically well connected (e.g. downstream) to development areas

None of the important habitat sites meet these criteria. Table 32-8 provides an analysis of the risk to each site due to potential changes in hydrology and water quality. Sites are grouped according to their general location in the Cumberland subregion. The risk of impacts is low in all cases.

Table 32-8: Risk of hydrology or water quality changes to important migratory shorebird habitat sites

Sites	Risk of impacts due to changes in hydrology and water quality
Sites within the Strategic Assessment Area:	
Sites 7, 9, 17 and 21	These sites occur in the north of the Strategic Assessment Area on (or close to) the floodplain of the Hawkesbury River. The broad area is downstream of much of the western third of the Cumberland subregion which includes all or part of the four nominated areas and major transport corridors. The sites are relatively distant from the nearest development (more than 12 km). They would not be immediately influenced by any potential changes to hydrology or water quality. They are also subject to a range of existing influences such as: • Water extraction • Nutrient and chemical inputs from adjacent farmland • Sewerage treatment While broadly downstream of development, they are not considered to be well connected because: • They occur upstream of the Hawkesbury River on the floodplain • They are relatively distant from the development Risks to these sites is considered to be low.
Site 19	This site occurs in the Mt Annan Botanic Gardens to the west of GMAC. It is part of a managed series of ponds. The area is not hydrologically connected to the development in GMAC where the water flows to the east. Risks to this site are considered to be low.
Sites outside the Strategic Assessment Area in the broader Cumberland subregion:	
Sites 1 and 11	These sites occur within or near to existing development in the Marsden Park North Precinct of the existing North West Growth Area (outside the Strategic Assessment Area). Site 1 is comprised of wastewater ponds at the old Riverstone Meatworks. The Precinct is in the process of being rezoned and options are being explored for re-creating shorebird habitat in the vicinity before removing the old ponds (DPE, 2018). Site 11 appears unlikely to provide suitable long-term habitat for migratory shorebirds (it is a grassy area surrounded by development), but was identified as important based on the number and accuracy of available records. Risks to these sites are considered to be low.

Sites	Risk of impacts due to changes in hydrology and water quality
Sites 3, 13 and 15	These sites all occur within or close to Sydney Olympic Park on the eastern edge of the Cumberland subregion. The area is approximately 20 km from the nearest development and not connected hydrologically. Risks to these sites are considered to be low.
Site 5	Site 5 occurs outside the Strategic Assessment Area in the suburb of Panania. It is an unnamed ephemeral water body that occurs approximately 500 m from the Georges River. The site is not connected to any other waterways and risks are considered to be low.

While the risk of impacts due to changes in hydrology and water quality are low, the Plan includes a commitment to mitigate indirect impacts from development (Commitment 5), which will ensure that development is planned and managed to address the environmental risks from these impacts.

A Development Control Plan (DCP) will be prepared for each nominated area by either the Department (in the case of Department led precincts) or by the relevant councils in collaboration with the Department. DCPs are non-legally binding planning policies that provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act.

DCPs will incorporate several types of development controls, including a broader set of development controls that address indirect impacts on environmental values generally. These type of controls are commonly implemented by planning authorities through the development application process to manage indirect impacts on environmental values, such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic. Examples of these types of controls that are included in the draft Wilton DCP are provided in Table 32-9.

A detailed description of the process to implement these development controls in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

It is considered that these broader set of development controls and the process to implement them described in Chapter 15 further reduce the risk of potential impacts to important migratory shorebird habitat sites.

Table 32-9: Commonly implemented development controls relevant to managing hydrology/water quality impacts

Control type	Summary of example control in draft Wilton DCP
Water cycle management	• Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles • Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise run-off and sediment and pollutants to waterways
Water quality	• Stormwater systems must be constructed/maintained to achieve EES water quality targets
Soil erosion and sedimentation	• Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development • Soil and Water Management Plans must be prepared in accordance with *Managing Urban Stormwater* (Landcom, 2004) and included in development applications
Disturbance to saline soils	• Salinity Management Plans must be prepared in accordance with the *Western Sydney Salinity Code of Practice 2004* (WSROC, 2004) and included in development applications
Contaminated soils	• Development is to be in accordance with the *Contaminated Land Management Act 1997* and *State Environmental Planning Policy 55 – Remediation of Land* • Development applications must be accompanied by a Stage 1 Preliminary Site Investigation. Where this identifies potential site contamination, a Stage 2 detailed site investigation must be prepared • A Remediation Action Plan (RAP) must be prepared for areas identified as contaminated land in the Stage 2 Site Investigation

Changes to vegetation structure

Changes to vegetation structure can arise from factors such as increased vegetation cover or encroachment of buildings (DoEE, 2017). This may be possible at sites that are in close proximity to development.

Given the distance of important habitat to development, the risks of changes to vegetation structure are considered to be low.

DEGRADATION OF IMPORTANT HABITAT LEADING TO A SUBSTANTIAL REDUCTION IN MIGRATORY SHOREBIRD NUMBERS

The guidelines (DoEE, 2017) set out examples of the types of activities that can lead to degradation of important habitat. They include:

- Activities occurring in coastal or estuarine environments. For example:
  - Substantial loss of marine or estuarine vegetation
  - Invasion of intertidal mudflats by weeds
  - Exposure of acid sulphate soils
- Water pollution and changes to the water regime

Activities in coastal or estuarine environments

No development under the Plan will occur in coastal or estuarine environments.

Of the eleven important habitat sites, none are coastal and three occur within or close to estuarine areas. The three that occur within or close to estuarine areas are the three sites in proximity to Sydney Olympic Park. All of the sites are subject to existing management and will not be influenced by development under the Plan.

Risks from activities in coastal or estuarine environments are nil.

Water pollution and changes to the water regime

Potential water pollution and changes to the water regime are similar issues to those discussed above in relation to hydrology and water quality.

The risks to all sites are considered to be low because:

- They are generally distant to development
- No sites are hydrologically well connected
- There are commitments and actions in the Plan to manage and control environmental risks from indirect impacts

INCREASED DISTURBANCE WITHIN IMPORTANT HABITAT LEADING TO A SUBSTANTIAL REDUCTION IN MIGRATORY SHOREBIRD NUMBERS

As outlined in the guidelines (DoEE, 2017), increased disturbance to migratory shorebirds is a key threat within Australia. It may occur through:

- Construction activities (e.g. demolition)
- Residential and recreational activities such as four-wheel-driving, jet- and water-skiing, power boating, fishing, walking, windsurfing, kite-surfing, walking dogs, noise, and night-lighting

Migratory shorebird habitat that would be at risk of these effects are sites that are:

- In close proximity to development areas
- Publicly accessible for recreation (particularly where this is not managed to protect shorebirds)
- Adjacent to recreation areas (e.g. waterways used for boating etc)

Table 32-10 provides an analysis of the risk to each site due to potential increases in disturbance. Sites are grouped according to their general location in the Cumberland subregion. The risk of impacts is low in all cases.

Table 32-10: Risk of increased disturbance within important habitat leading to impacts to migratory shorebirds

Sites	Risk of impacts due to increased disturbance
Sites within the Strategic Assessment Area:	
Sites 7, 9, 17 and 21	These sites occur in the north of the Strategic Assessment Area on (or close to) the floodplain of the Hawkesbury River. ***Proximity to development*** The sites are relatively distant from the nearest development (more than 12 km). They would not be immediately influenced by disturbance from activities under the Plan. ***Accessibility*** It is considered unlikely that development under the Plan will lead to a significant increase in access and use of the sites: • Sites 7 and 17 are surrounded by farmland and while likely subject to a current level of disturbance, their distance from the nominated areas and landscape context make it unlikely that development under the Plan will lead to increased disturbance • Site 9 is part of the Pitt Town Nature Reserve and is managed by NSW National Parks. Access is managed and increased disturbance is considered unlikely • Site 21 is part of an effluent reuse facility. Increased disturbance is considered unlikely ***Proximity to recreation areas*** None of the sites occur within proximity to high intensity recreational areas. They are either: • Surrounded by farm land (Sites 7 and 17) • Part of a nature reserve where access and use is managed (Site 9) • Part of an effluent reuse facility (Site 21) ***Overall risks*** The overall risks to these sites from increased disturbance are considered to be low.
Site 19	This site occurs in the Mt Annan Botanic Gardens to the west of GMAC. It is part of a managed series of ponds. ***Proximity to development*** This site is the closest to a development area under the Plan (approximately 1.4 km from GMAC). However, it is sufficiently distant to ensure that it would not be immediately influenced by disturbance from activities under the Plan. ***Accessibility*** The area is currently accessible as part of the Botanic Gardens. It is possible that visitation will increase as the population of Western Sydney increases. However, dog walking, which is one of the key causes of disturbance, is prohibited in the gardens. It is considered unlikely that disturbance to shorebirds will significantly increase. ***Proximity to recreation areas*** The site does not occur within proximity to high intensity recreational areas. ***Overall risks*** The overall risks to these sites from increased disturbance are considered to be low.
Sites outside the Strategic Assessment Area in the broader Cumberland subregion:	
Sites 1 and 11	These sites occur within or near to existing development in the Marsden Park North Precinct of the existing North West Growth Area (outside the Strategic Assessment Area). Site 1 is comprised of wastewater ponds at the old Riverstone Meatworks. The Precinct is in the process of being rezoned and options are being explored for re-creating shorebird habitat in the vicinity before removing the old ponds (DPE, 2018). Site 11 appears unlikely to provide suitable long-term habitat for migratory shorebirds (it is a grassy area surrounded by development), but was identified as important based on the number and accuracy of available records.

Sites	Risk of impacts due to increased disturbance
	Risks to these sites are considered to be low.
Sites 3, 13 and 15	These sites all occur within or close to Sydney Olympic Park on the eastern edge of the Cumberland subregion. ***Proximity to development*** The sites are approximately 20 km from the nearest development and would not be immediately influenced by disturbance from activities under the Plan. ***Accessibility*** The sites are currently accessible as part of the Sydney Olympic Park. However, access is managed, and the area is already subject to significant visitation. It is considered unlikely that disturbance to shorebirds will significantly increase. ***Proximity to recreation areas*** The sites do not occur within proximity to high intensity recreational areas. ***Overall risks*** The overall risks to these sites from increased disturbance are considered to be low.
Site 5	Site 5 is an unnamed ephemeral water body that occurs outside the Strategic Assessment Area in the suburb of Panania. ***Proximity to development*** The site is approximately 8.1 km from the nearest development and would not be immediately influenced by disturbance from activities under the Plan. ***Accessibility*** The site is currently accessible. However, it is bordered by a range of disturbed areas and recreational opportunities appear to be limited. Given that it occurs in an existing suburb, it is considered unlikely that disturbance to shorebirds will significantly increase due to development under the Plan. ***Proximity to recreation areas*** The site does not occur within proximity to high intensity recreational areas. ***Overall risks*** The overall risks to this site from increased disturbance are considered to be low.

DIRECT MORTALITY OF BIRDS LEADING TO A SUBSTANTIAL REDUCTION IN MIGRATORY SHOREBIRD NUMBERS

As outlined in the guidelines (DoEE, 2017), direct mortality of birds may results from activities relating to:

- Bird strike due to:
  - Development of wind farms in migration or movement pathways
  - Aeroplanes or fixed structures such as towers with support cables
- Inappropriate waste management and chemical or oils spills

Bird strike

Development under the Plan does not relate to windfarms, aeroplanes, or large fixed structures with support cables. Risks of significant bird strike due to the development are considered to be low.

Inappropriate waste management and chemical or oils spills

Potential impacts due to inappropriate waste management and chemical or oils spills are similar issues to those discussed above in relation to hydrology and water quality.

The risks to all sites are considered to be low because:

- They are generally distant to development
- No sites are hydrologically well connected

- The Plan includes a commitment to mitigate indirect impacts from development (Commitment 5). As described above and detailed in Chapter 15, Section 15.6.1, DCPs will be prepared for each nominated area that will include a broad set of development controls to manage indirect impacts on environmental values generally. Controls relating to pollution management are commonly incorporated into DCPs by planning authorities as part of these broad set of controls, and these measures will further reduce the risk of pollution affecting shorebirds

Risks associated with these causes of direct mortality are considered to be low.

CONSIDERATION OF CLIMATE CHANGE

The guidelines (DoEE, 2017) suggest that "areas landward of important shorebird habitat areas should be maintained in an undeveloped state to allow the natural coastal processes of erosion and accretion to respond to possible rising sea levels".

None of the important habitat sites in the Cumberland subregion occur in coastal areas and consideration of climate change in this context is not considered relevant.

Chapter 41 of the report describes how the Plan more broadly has considered the extent to which it facilitates adaptation to climate change for MNES, including consideration of any particularly vulnerable matters.

EVALUATION OF THE OUTCOME FOR MIGRATORY SHOREBIRDS

As outlined in Section 32.2.1, the outcomes of the Plan must not be inconsistent with any of the international agreements relating to migratory species. The key obligations (of relevance to this assessment) which cut across the various agreements in different forms are for Australia to:

- Conserve and where possible restore habitats
- Mitigate and manage threats to shorebirds

The Plan is not inconsistent with these obligations. There will be:

- No direct impacts to important habitat
- Low to negligible risks of indirect impacts to important habitat
- Commitments and actions in the Plan to manage and control threats to shorebirds from development

32.2.5 CONCLUSION

Potential impacts to migratory shorebirds as a result of the Plan are considered to be negligible. No important habitat will be lost, and the risk of indirect impacts such as degradation of habitat and disturbance of birds is considered to be low.

The outcomes of the Plan for these species meets the regulatory requirements for listed migratory and (where relevant) threatened species under the EPBC Act.

33 Ramsar impact assessment

33.1 INTRODUCTION

While there are no Ramsar sites in the Strategic Assessment Area, the Towra Point Nature Reserve occurs downstream in the Botany Bay Catchment.

This Chapter sets out:

- Australia's international conservation obligations with regards to Towra Point Nature Reserve
- A general description of the Towra Point Nature Reserve
- The Ramsar listing criteria
- A summary of the ecological character of the site
- Analysis of the potential direct, indirect, and facilitated impacts
- An assessment of how the Plan addresses obligations under the Ramsar convention

The analysis shows that an impact to the ecological character of the Towra Point Nature Reserve is not expected as a result of implementation of the Plan. There will be no direct impacts and potential indirect impacts will be adequately mitigated.

Attachment A sets out more detail about the ecological character of the site.

Potential cumulative impacts to Towra Point Nature Reserve are considered in Chapter 38.

33.2 INTERNATIONAL AGREEMENTS AND OBLIGATIONS TO PROTECT TOWRA POINT

Australia is party to a number of international agreements and treaties which require protection of significant wetlands and habitat for migratory birds. These include (DECCW & SMCMA, 2010):

- The Ramsar Convention on Wetlands
- The Convention on the Conservation of Migratory Species of Wild Animals (Bonn)
- The Japan - Australia Migratory Bird Agreement (JAMBA)
- The China - Australia Migratory Bird Agreement (CAMBA)
- The Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)
- The East Asian - Australasian Flyway Partnership (EAAFP)

The Ramsar Convention aims to prevent the degradation and loss of important wetlands across the globe through requiring implementation of appropriate site management and conservation principles. Section 33.7 discusses how obligations under the Ramsar Convention have been addressed.

The Bonn Convention is an environmental treaty of the United Nations and aims to conserve migratory species within their migratory ranges. The Bonn convention is the only global convention which specialises in the conservation of migratory species, their habitats and migration routes. As of 1 November 2019, there were 130 Parties to the Convention.

JAMBA, Bonn, CAMBA and ROKAMBA are bilateral agreements which provide for protection of migratory birds and their important habitats.

The EAAFP is an informal and voluntary initiative which aims to protect migratory waterbirds and their habitats. Members of EAAFP include countries, intergovernmental agencies, NGOs, and the international business sector.

33.3 GENERAL DESCRIPTION OF TOWRA POINT NATURE RESERVE

Towra Point Nature Reserve has an area of 603.7 ha, located on the southern shore of Botany Bay opposite Sydney Kingsford Smith International Airport. The site is approximately 16 km from the centre of Sydney, within the Sutherland Shire local government area (see Figure 33-1).

Towra Point Nature Reserve is an estuarine wetland complex. It is the largest of its type in the Sydney region and supports vegetation types that are regionally significant, including around 40 per cent of the remaining mangrove communities and 60 per cent of the remaining saltmarsh communities in Sydney. It is also an important link for migratory shorebirds on the East Asian-Australasian Flyway, supporting 30 out of 80 species of birds listed under international bilateral agreements (JAMBA, CAMBA, ROKAMBA). The site is comprised of the following eight wetland types:

- 'Marine subtidal aquatic beds', including significant areas of seagrass meadows within and adjacent to the Towra Point Nature Reserve
- 'Sand, shingle or pebble shores', including the itinerant sand spits and islands around Towra Point that are continually changing as a result of sand movement. These areas provide important habitat for shorebirds. They include Towra Spit Island, formed in 1991 from the tip of Towra Point when it became separated by a channel. Since its formation, it has been recognised as the second most important nesting site in NSW for the little tern
- 'Estuarine waters'. Those that surround Towra Point include Botany Bay, Georges River, Cooks River, Woolooware Bay, Quibray Bay and Weeney Bay. Approximately 1,400 ha of these surrounding waters have been designated as the Towra Point Aquatic Reserve
- 'Intertidal mud, sand or salt flats', including 156 (low tide) ha of muddy sand flats that extend along the shoreline from mean low water spring to mean high water spring tides. These areas are high in organic matter and provide rich feeding grounds for many shorebirds
- 'Intertidal marshes', including around 134 ha of saltmarsh within and adjacent to Towra Point Nature Reserve, which occurs on the landward side of adjacent areas of mangrove. The saltmarsh at Towra Point is one of the largest stands in NSW
- 'Intertidal forested wetlands', supporting a significant 385 ha of mangrove within and adjacent to Towra Point Nature Reserve
- 'Coastal brackish lagoons' and 'Coastal freshwater lagoons'. There are three named lagoons at Towra Point including Towra Lagoon, Mirrormere and Weedy Pond, and at least three unnamed lagoons that have no ecological information. All lagoons meet the definition of Sydney Freshwater Wetlands – an endangered ecological community in NSW

The Towra Point Nature Reserve is in the Botany Bay catchment which covers 1,165 km^2 and supports a population of approximately 2 million people (OEH, 2012; SMCMA, 2011). The Georges and Cooks Rivers and their tributaries flow into Botany Bay.

The entire Ramsar site lies within the boundary of the Towra Point Nature Reserve which is managed by the NSW National Parks and Wildlife Service (OEH, 2012). The site is also adjacent to the Towra Point Aquatic Reserve (see Figure 33-2) which is an important nursery area for fish and invertebrates, provides important habitat for migratory seabirds and is rich in marine biodiversity.

Figure 33-1 shows the Ramsar site within the context of its upstream catchment. The data for the catchment was downloaded from the Australian Government Department of Agriculture, Water and Environment spatial data viewer (http://www.environment.gov.au/fed/catalog/main/home.page). The data layer was derived using:

- "Each of the Ramsar Wetland site's boundaries
- A 10 km buffer area to each site, clipped to 3km where the buffer area extends seawards from the coast
- A catchment for each site from an upstream trace process using the Australian Hydrological Geospatial Fabric (Geofabric) features and relationships
- A multi-ring buffer, intersect and erase process to divide the catchment into distance bands from the Ramsar site"

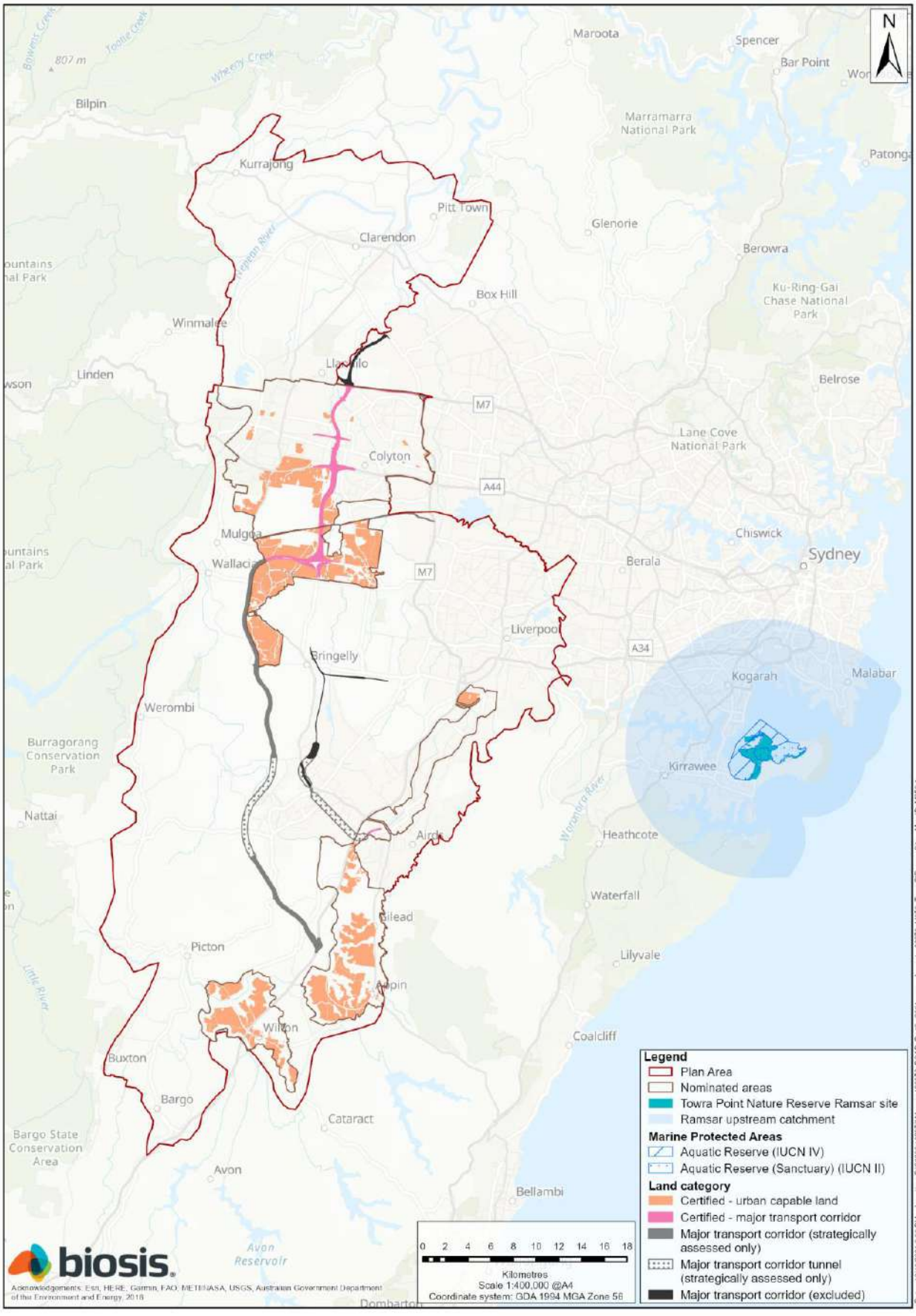

Figure 33-1: Map of Towra Point Nature Reserve Ramsar site in the Sydney Basin Bioregion

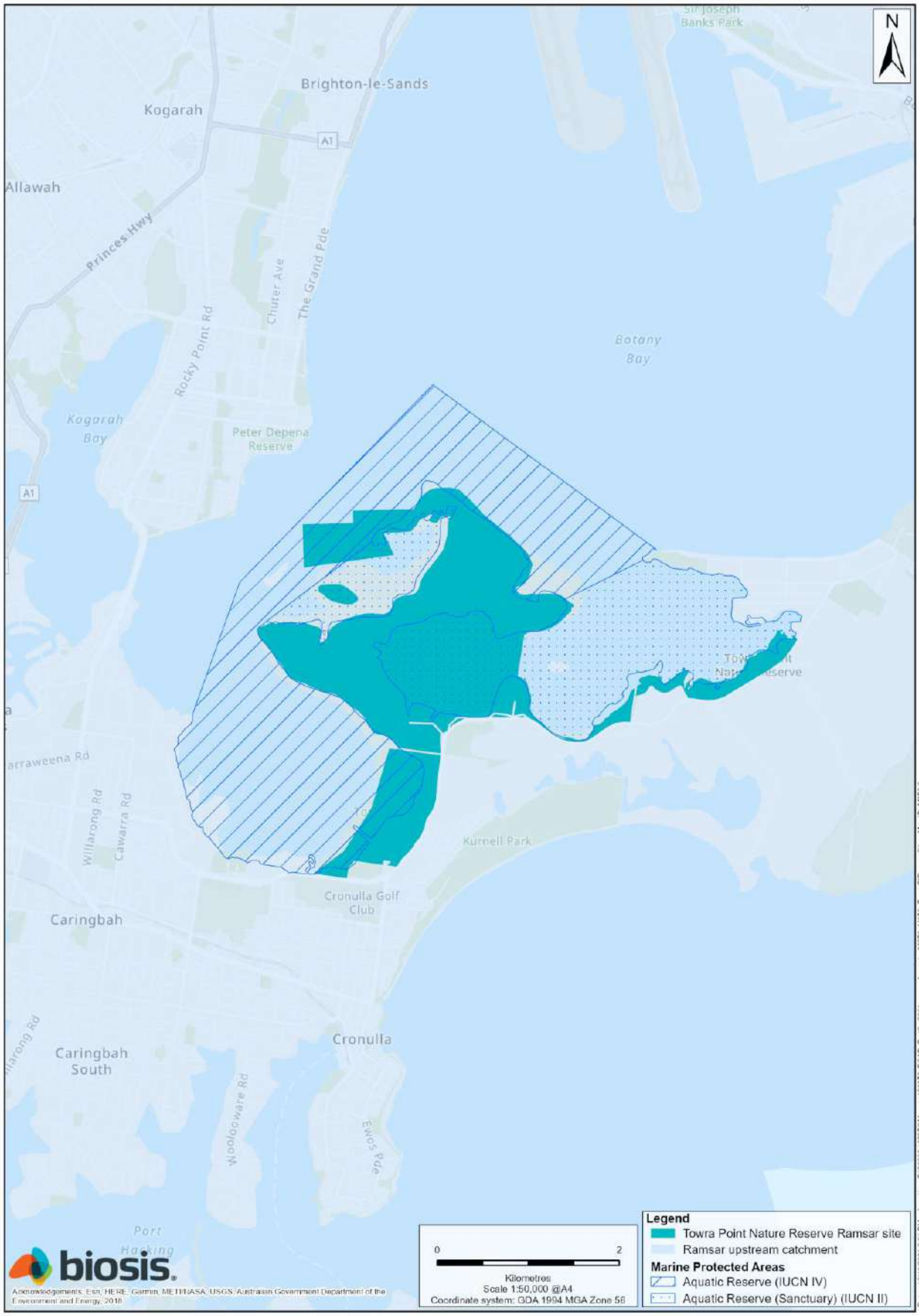

Figure 33-2: Site map of Towra Point Nature Reserve Ramsar site

33.4 RAMSAR LISTING CRITERIA

Towra Point Nature Reserve was listed as a Wetland of International Importance under the Ramsar Convention in February 1984. For a wetland to be designated as a Ramsar site it must satisfy one or more of the Ramsar listing criterion. Towra Point Nature Reserve is considered to meet criteria 2, 3, 4 and 8 (see Table 33-1). Note that these criteria have changed since the original listing in 1984 due to administrative changes.

Table 33-1: Criteria for Ramsar listing

Criterion	Justification
2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities	It supports three EPBC Act listed threatened species • Grey-headed flying fox (*Pteropus poliocephalus*) • Magenta lilly pilly (*Syzygium paniculatum*) • Green and golden bell frog (*Litoria aurea)*
3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region	In 1993 Botany Bay was recognised as one of the four most important migratory wading bird sites in NSW. Towra Spit Island was recognised as the second most important breeding area in NSW for the little tern *(Sterna albifrons)* (NSW NPWS, 2001) Towra Point is home to seagrass beds, mangrove and saltmarsh communities that provide critical habitat for juvenile fish and crustaceans (DECCW & SMCMA, 2010) The site also provides critical links for ecological connectivity and supports species that are uncommon elsewhere in the Sydney region (DECCW & SMCMA, 2010)
4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions	Towra Point provides habitat for species of juvenile fish and crustaceans at a vulnerable stage in their life cycle. Such as the common silver biddy *(Gerres ovatus)*, yellow fin bream *(Acanthopagrus australis)*, flat-tailed mullet *(Liza argentea)*, and luderick *(Girella tricuspidata)* Migratory shorebirds use Towra Point as a critical stopover on migratory routes from Korea, Japan, China, Russia, Siberia and Alaska during September to April (DECCW & SMCMA, 2010)
8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend	The site provides habitat and food sources for at least 25 species of fish of economic importance. The seagrass, mangroves, and saltmarshes provide important habitat for protection for juvenile and migratory fish as well as food sources (DECCW & SMCMA, 2010)

By designating Towra Point Nature Reserve as a Ramsar site, Australia is obligated to establish and implement a management framework that aims to conserve the wetland and ensure its wise use. 'Wise use' under the Convention is broadly defined as maintaining the 'ecological character' of the wetland.

Ecological character is defined under the Ramsar Convention as the combination of the ecosystem components, processes, benefits and services that characterise the wetland at a given point in time (Ramsar Convention, 2005). It provides a baseline description of the wetland at the time of listing and often incorporates limits of acceptable change (LAC). LACs are the "range of variation in the components, processes and benefits or services that can occur without causing a change in the ecological character of the site" (DEWHA, 2008).

Ecological character is also the main element for the consideration of significant impacts under the EPBC Act. The significant impact guidelines (DoE, 2013b) state that:

> *An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:*
>
> - *areas of the wetland being destroyed or substantially modified*
> - *a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland*
> - *the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected*
> - *a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or*
> - *an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.*

This assessment uses these guidelines to discuss the potential impacts to the Towra Point Nature Reserve.

33.5 SUMMARY OF THE ECOLOGICAL CHARACTER OF THE SITE

The Ecological Character Description (ECD) for Towra Point was developed retrospectively in 2010 (DECCW & SMCMA, 2010). It identifies in detail the critical components, processes, services and benefits of the site, along with the limits of acceptable change.

Table 33-2 provides a high-level summary of the ecological character of the site and Attachment A provides more detail.

Table 33-2: High level summary of the ecological character of Towra Point

Component of ecological character	Key points	Limits of acceptable change (LAC)
Components and processes		
Geomorphology	• Towra Point was formed as a result of dynamic wind, wave, and tidal processes over time; in particular, from the dynamic movement of marine sand from Botany Bay and fluvial mud from the Georges River • Since its listing, a range of factors (anthropogenic and natural) have altered its geomorphology. Notably, sediment connecting Towra Spit Island to the mainland was dredged in 2004 and needs to continuously be managed to maintain the ecological value of the Island • The wetland is low lying and the flora and fauna reflect their tolerance to salt water • The sedimentation processes of erosion and accretion facilitate the movement and colonisation of vegetation. They also create mudflats that provide favourable habitat for migratory birds and mangroves	• The LAC for geomorphology is the same as those set for the little tern because the spit is an important breeding and roosting habitat for migratory birds (including the little tern) • The LAC is the 'successful annual breeding in one out of every two years' of the little tern
Hydrology	• The site is part of a dynamic system and relies on the hydrological processes of tides, wave action, and groundwater • Anthropogenic changes (before and after listing) have affected tidal movements and wave action • The site is situated on the Botany Bay Sand Aquifer that extends from Centennial Park in the north, to Botany Bay and Kurnell Peninsula in the south, and west to Rockdale • The area around the wetland provides an important point of recharge for the aquifer	• Limits of acceptable change for groundwater are determined by the relevant water quality guidelines (ANZECC & ARMCANZ, 2000, 2018)

Physiochemical environment	• At Towra Point the physiochemical environment determines water quality, which is vital for sustaining the diverse range of flora and fauna
	• The key components of the physiochemical environment at Towra Point are:
	  ○ Salinity
	  ○ Nutrients
	  ○ Heavy metals
	  ○ Turbidity
		• Water quality guidelines for marine water have been used to determine limits of acceptable change for the physiochemical environment (ANZECC & ARMCANZ, 2000, 2018)

Component of ecological character	Key points	Limits of acceptable change (LAC)

Biota	• Towra Point supports a number of regionally significant flora that occur as distinct vegetation zones across the wetland. Critical components include:
	  ○ Seagrass
	  ○ Mangroves
	  ○ Saltmarsh
	  ○ Substantial areas of terrestrial vegetation
	• Towra Point is one of the last remaining wetlands of its type in the Sydney region and provides important habitat for a number of threatened and migratory species. Fauna species present at the site include:
	  ○ Macro-invertebrates
	  ○ Fish
	  ○ Reptiles and amphibians (including the Green and Golden Bell Frog)
	  ○ Mammals (including the Grey-headed Flying Fox)
	  ○ Birds (189 species, important habitat for migratory shorebirds, important site for the Little Tern (*Sternula albifrons*))
		• LACs have been developed (where possible) for vegetation and a range of specific species

Climate	• Climate exists as an ecosystem regulator and plays an important role in maintaining equilibrium • The flora and fauna at Towra Point have adapted to the temperate climate of the region. Climate change and anthropogenic changes around Botany Bay are altering the intensity of climatic parameters	• Parameters for climate cannot be managed at a local scale. It has therefore been identified that LACs cannot be set for climate for Towra Point Nature Reserve Ramsar site
Services and benefits		

Provisioning services	• Provisioning services include:
	  ○ Fisheries production
	  ○ Trophic relay (transfer of energy and nutrients to different parts of the estuary)
		• N/A

Regulating services	• Regulating services of Towra Point Ramsar site include:
	  ○ Maintenance of hydrological regimes
	  ○ Shoreline stabilisation and storm protection
	  ○ Biological control of pests and disease
	  ○ Pollution control
		• N/A

Component of ecological character	Key points	Limits of acceptable change (LAC)

Cultural services	• Cultural services of Towra Point Ramsar site include:
	  ○ Recreation and tourism
	  ○ Science and education
	  ○ Aesthetic amenity
	  ○ Aboriginal heritage
	  ○ Non-Aboriginal heritage
		• N/A

Supporting services	• Supporting services of Towra Point Ramsar site include:
	  ○ Hydrological processes
	  ○ Food webs
	  ○ Physical habitat
	  ○ Nutrient cycling
	  ○ Primary production
	  ○ Sediment trapping and stabilisation
	  ○ Biodiversity
	  ○ Special ecological, physical or geomorphic features
	  ○ Threatened wetland species, habitats and ecosystems
	  ○ Priority wetland species
	  ○ Ecological connectivity
		• N/A

33.6 ANALYSIS OF POTENTIAL IMPACTS

33.6.1 DIRECT IMPACTS

Towra Point Nature Reserve is located outside the Strategic Assessment Area. The Ramsar site is approximately 23 km from the nearest nominated area (see Figure 33-1) and the Plan will not result in any direct impacts on the site.

33.6.2 INDIRECT OR FACILITATED IMPACTS

The Plan has the potential to cause the following indirect and facilitated impacts on Towra Point Nature Reserve:

- Reduction in surface water quality and changes to surface water flows due to run-off from urban and industrial, infrastructure, and transport development in the upstream catchment
- Potential changes to the ecological character of the reserve from increased recreational use from increased populations in Western Sydney facilitated by the urban development

POTENTIAL CHANGES TO SURFACE WATER FLOWS AND REDUCTION IN WATER QUALITY

Nature, extent and duration of indirect impacts

Towra Point Nature Reserve is located in the Botany Bay catchment, which comprises four major sub-catchments:

- Direct to Botany Bay (this incorporates the minor sub-catchment of South Botany Bay, which would most directly influence Towra Point Nature Reserve)
- Cooks River
- Georges River
- Woronora River

A small part of the Strategic Assessment Area is located within the Georges River sub-catchment. Water quality within Towra Point Nature Reserve may be affected by the development through:

- Urban development within a part of GMAC that overlaps with the Georges River sub-catchment (170 ha)
- Major transport corridors that occur within the Georges River sub-catchment (9 ha)

Towra Point Nature Reserve is also connected to the Botany Sand Aquifer, which extends from Centennial Park to Botany Bay and Kurnell Peninsula. The development occurs outside this area and is unlikely to impact on this aquifer.

Potential impacts to surface water quality may occur due to construction activities and an increased extent of urban land. Construction activities have the potential to impact water quality entering the Georges River and its tributaries for the duration of construction through the following pathways:

- Soil disturbance as part of construction activities may lead to an increase in erosion and runoff which would mean more sediments and nutrients entering the system
- Introduction of contaminants as a result of spillage or improper use and disposal of hazardous substances

Urban development may affect water quality entering the Georges River as a result of:

- Disruption to natural flows and processes
- Increase of hard surfaces leading to an increased volume of water entering downstream waterways
- Introduction of contaminants into surface water, such as nutrients, sediment, and other pollutants

The components, processes, services, and benefits of the ecological character of the Towra Point Nature Reserve that may be affected by these indirect impacts are identified in Table 33-4 and Table 33-5.

The exact location and timing of construction activities within GMAC are not known at this time, which means the nature and extent and duration of possible changes to water quality entering the Georges River cannot be quantified. However, there are a number of factors which substantially reduce the level of risk to the ecological character of Towra Point Nature Reserve from construction and a change in land use. These include:

- Distance of the development to Towra Point: GMAC is approximately 23 km from Towra Point. This distance provides a buffer to potential impacts relating to an increase in water flows and will reduce any sediment load and level of nutrients and contaminants reaching Towra Point
- Well flushed nature of the wetland: Towra Point is part of a tide-dominated estuarine system. Tidal movement means that suspended solids can only reside in the bay for a short time, leading to a well flushed water body and relatively high water quality
- Vegetated buffers on all riparian corridors: the development has avoided riparian corridors (see Chapter 14). This riparian vegetation will minimise direct runoff into waterways and act as a sink for nutrients and sediments

Commitments to address indirect impacts

Urban and industrial development

The Plan includes a commitment to mitigate indirect impacts from urban and industrial development (Commitment 5).

A Development Control Plan (DCP) will be prepared for each nominated area by either the Department (in the case of Department led precincts) or by the relevant councils in collaboration with the Department.

DCPs are non-legally binding planning policies that provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act.

DCPs for each nominated area will be prepared in accordance with:

- A DCP template prepared by the Department to support implementation of the Plan
- Standard format for DCPs and a set of model provisions that apply across NSW
- Any processes and guidelines for preparing DCPs specific to each council
- Current best practice standards, guidelines or targets (e.g. water quality standards for urban runoff)

DCPs will incorporate several types of development controls (see Chapter 15, Section 15.6.1), including a broader set of controls that address indirect impacts on environmental values generally. These controls are commonly implemented by planning authorities through the development application process to manage indirect impacts on environmental values, on such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic. Examples of these types of controls that are included in the draft Wilton DCP are shown in Table 33-3.

A detailed description of the process to implement these development controls in the nominated areas, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

It is considered that these broader set of development controls and the process to implement them described in Chapter 15 are adequate to mitigate impacts to Towra Point Nature Reserve from urban and industrial development and no additional measures are considered necessary for the protection of the site.

Table 33-3: Commonly implemented development controls relevant to managing indirect impacts on Towra Point

Control type	Summary of example control in draft Wilton DCP
Water cycle management	• Water management measures must comply with council's requirements for detention, drainage, and water sensitive urban design principles • Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise run-off and sediment and pollutants to waterways
Water quality	• Stormwater systems must be constructed/maintained to achieve EES water quality targets
Soil erosion and sedimentation	• Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development

Control type	Summary of example control in draft Wilton DCP
	• Soil and Water Management Plans must be prepared in accordance with *Managing Urban Stormwater* (Landcom, 2004) and included in development applications
Disturbance to saline soils	• Salinity Management Plans must be prepared in accordance with the *Western Sydney Salinity Code of Practice 2004* (WSROC, 2004) and included in development applications
Contaminated soils	• Development is to be in accordance with the *Contaminated Land Management Act 1997* and *State Environmental Planning Policy 55 – Remediation of Land* • Development applications must be accompanied by a Stage 1 Preliminary Site Investigation. Where this identifies potential site contamination, a Stage 2 detailed site investigation must be prepared • A Remediation Action Plan (RAP) must be prepared for areas identified as contaminated land in the Stage 2 Site Investigation

Infrastructure

Commitment 5 also includes mitigation of indirect impacts from infrastructure development.

Infrastructure will be subject to future environmental assessment and approval processes under the EP&A Act at the time the projects are proposed. Infrastructure covering the broad types under the Plan (see Part 2) is subject to different environmental assessment processes. These are summarised in Section 15.6.2.

Commitment 5, Action 2 specifies that mitigation measures will be identified and implement based on the outcomes of the environmental assessment of detailed designs of each infrastructure project in accordance with the requirements of the NSW approval processes under the EP&A Act, as well as published, best practice guidelines.

Public authorities typically incorporate a broad set of mitigation measures through these assessment processes to manage indirect impacts of infrastructure on environmental values generally, including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise, and traffic.

It is considered that Commitment 2 will lead to the identification and implementation of a set of mitigation measures that will adequately manage potential indirect impacts from infrastructure on Towra Point Nature Reserve and no additional measures are considered necessary for the protection of the site.

A detailed description of the processes to implement mitigation measures for infrastructure, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2.

Major transport corridors

The Plan includes a commitment to mitigate indirect impacts within major transport corridors, including the Outer Sydney Orbital and Metro Rail Future Extension tunnel sections (Commitment 6), in accordance with the:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (or equivalent) approval within the nominated areas
- Major transport corridors class of action description and the Biodiversity Assessment Method (BC Act) (or equivalent) outside the nominated areas

Actions under Commitment 6 require Transport for NSW to:

- Assess the impacts on biodiversity values listed under the BC Act (for non-certified major transport corridors) and other environmental values (for certified and non-certified major transport corridors) based on detailed design
- Identify and implement mitigation measures based on the outcomes of environmental assessment of detailed designs in accordance with the SSI (or equivalent) approval process, as well as best practice guidelines
- Apply further mitigation according to the BC Act and BAM (or equivalent) for non-certified major transport corridors (strategically assessed), including the tunnel sections of the corridors
- Report to the Department and executive implementation committee on mitigation measures proposed to manage impacts of each transport project, including proposed techniques, timing, frequency, and responsibility for implementing each measure

Transport for NSW typically incorporates a broad set of mitigation measures through these assessment processes to manage the indirect impacts of transport development on environmental values generally, including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

It is considered that Commitment 6 will lead to the identification and implementation of a set of mitigation measures that will adequately manage potential indirect impacts from the major transport corridors on Towra Point Nature Reserve and no additional measures are considered necessary for the protection of the site.

A detailed description of the processes to implement mitigation measures for the major transport corridors, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.3.

Conclusion

It is considered unlikely that there will be a reduction in surface water quality to a point that there are notable or consequential impacts to the ecological character of the Towra Point Nature Reserve. There are several factors that substantially reduce the potential for water quality impacts from the development on Towra Point and the commitments and processes under the Plan to manage indirect impacts is considered to adequately mitigate any residual risks.

POTENTIAL CHANGES TO ECOLOGICAL CHARACTER FROM INCREASED RECREATIONAL USE

Nature, extent and duration of indirect impacts

The development under the Plan will lead to increased numbers of people in Western Sydney that may result in increased visitation to Towra Point Nature Reserve, which could lead to a degradation of site values.

The components, processes, services, and benefits of the ecological character of the Towra Point Nature Reserve that may be affected by increased recreational use are summarised in Table 33-6.

Existing management of visitor access

Access to Towra Point is restricted by permits. In addition to being listed as a Ramsar site, Towra Point is also a nature reserve. Nature Reserves differ from National Parks as they only allow restricted access. Permits are granted for scientific and educational purposes and are fully supervised.

There are two areas that do not require permits to access. These are Quibray Bay viewing platform and Towra Point day use area. The day use area is restricted to the shoreline of Towra Point beach and is only accessible by boat (OEH, 2012).

Activities associated with visitation to Towra Point beach day use area include:

- Recreational fishing
- Use of Towra Point beach recreational area

These activities have the potential to impact fish stocks as a result of recreational fishing, in addition to beach nesting birds. While Towra Spit Island and other habitats for threatened beach nesting birds do not permit public access, beach nesting birds such as the Little Tern are susceptible to disturbance as a result of human activity in the wider area, including swimmers, boats, fishers and divers (DECC, 2008).

There is a Plan of Management for Towra Point Nature Reserve that sets out a range of management strategies to be implemented by the NSW National Parks and Wildlife Service (NSW NPWS, 2001). The Plan includes a range of measures to manage visitor use and enforce of prohibitions and restrictions on access, including (DECC, 2008):

- Restricting access to areas of threatened species habitat, including Towra Spit Island, which is a significant nesting site for the Little Tern
- Use of signage, brochures, media releases and regular on-site patrols to educate the public regarding the importance of Towra Spit Island
- Implementing temporary beach closures and fencing off large areas around nesting colonies where required
- Provision of day-use access to nearby Towra Beach and shorebird viewing platforms to enable safe public engagement with the wetland while protecting wetland values
- Multiple management measures to raise public awareness of the importance of shorebird conservation

These existing measures to manage potential impacts associated with human visitation to Towra Point Nature Reserve are expected to be adequate to manage potential increases in visitor numbers resulting from the urban development.

Conclusion

The potential risk to the ecological character of Towra Point Nature Reserve as a result of an increased number of visitors is considered minimal. Due to existing high population densities in proximity to Towra Point Nature Reserve, the reserve implements a wide range of ongoing and comprehensive management measures to manage the potential impacts associated with human visitation, and these are expected to adequately address this risk.

33.7 ADDRESSING OBLIGATIONS UNDER THE RAMSAR CONVENTION

To satisfy requirements under section 146J of the EPBC Act, section 4.7 of the ToR requires the Assessment Report to consider the extent to which the impacts of the Plan are consistent with Australia's international obligations, including the Ramsar Convention. The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. This requires international cooperation, policy making, capacity building and technology transfer.

The Plan includes a combination of avoidance and mitigation measures relevant to managing impacts on Towra Point Nature Reserve. As described in Section 33.6.2 and considered further in Chapter 15, the Plan includes commitments to mitigate indirect impacts from development under the Plan (Commitment 5 and Commitment 6).

The Plan also includes an evaluation program (Commitment 25) that provides for public reporting on progress in achieving the commitment and actions, and regular and consistent monitoring and evaluation to inform adaptive management responses. The commitment also includes an action to publish yearly updates over the life of the Plan.

The Ramsar Convention has been considered in the development of the Plan, which includes consideration of avoidance, mitigation, and management measures for Ramsar wetlands. The Plan requires information related to the development to be publicly available to ensure equitable sharing of information and improved knowledge relating to the site.

Impacts to Towra Point Nature Reserve are unlikely and loss of wetlands due to the Plan is not foreseeable. The Plan is not considered to be inconsistent with the Ramsar Convention.

Table 33-4: Components, processes, and services of the ecological character of Towra Point that may be impacted by potential indirect impacts from construction

	Components & processes																					Services & benefits			
Potential indirect impacts	**Geology & morphology**	**Topography & microtopography**	**Sedimentation**	**Tides**	**Wave action**	**Groundwater**	**Salinity**	**Nutrients**	**Heavy metals**	**Turbidity**	**Seagrass**	**Mangroves**	**Saltmarsh**	**Terrestrial vegetation**	**Macro-invertebrates**	**Fish**	**Reptiles & amphibians**	**Mammals**	**Birds**	**Temperature**	**Rainfall**	**Storms**	**Provisioning services**	**Regulating services**	**Cultural services**	**Supporting services**
Soil disturbance	X	X	X	X	X	X	X	✓	✓	✓	✓	X	X	X	X	✓	X	X	✓	X	X	X	✓	✓	✓	✓
Introduction of contaminants	X	X	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	✓	✓	X	X	✓	X	X	X	✓	✓	✓	✓

Key:

No risk of potential impacts:	X
Some risk of potential impacts:	✓

Table 33-5: Components, processes, and services of the ecological character of Towra Point that may be impacted by potential indirect impacts from increase in extent of urban and industrial areas

	Components & processes																					Services & benefits			
Potential indirect impacts	**Geology & morphology**	**Topography & microtopography**	**Sedimentation**	**Tides**	**Wave action**	**Groundwater**	**Salinity**	**Nutrients**	**Heavy metals**	**Turbidity**	**Seagrass**	**Mangroves**	**Saltmarsh**	**Terrestrial vegetation**	**Macro-invertebrates**	**Fish**	**Reptiles & amphibians**	**Mammals**	**Birds**	**Temperature**	**Rainfall**	**Storms**	**Provisioning services**	**Regulating services**	**Cultural services**	**Supporting services**
Loss of vegetation	X	X	X	X	X	X	X	✓	✓	✓	✓	X	X	X	X	✓	X	X	✓	X	X	X	✓	✓	✓	✓
Impervious surfaces	X	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	X	✓	✓	X	X	✓	X	X	X	✓	✓	✓	✓
Sewerage & waste contamination	X	X	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	✓	✓	X	X	✓	X	X	X	✓	✓	✓	✓
Point source spills & accidents	X	X	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	✓	✓	X	X	✓	X	X	X	✓	✓	✓	✓

Key:

No risk of potential impacts:	X
Some risk of potential impacts:	✓

Table 33-6: Components, processes, and services of the ecological character of Towra Point that may be impacted by potential facilitated impacts from increase in visitation

	Components & processes																					Services & benefits			
Potential indirect impacts	**Geology & morphology**	**Topography &**	**Sedimentation**	**Tides**	**Wave action**	**Groundwater**	**Salinity**	**Nutrients**	**Heavy metals**	**Turbidity**	**Seagrass**	**Mangroves**	**Saltmarsh**	**Terrestrial vegetation**	**Macro-invertebrates**	**Fish**	**Reptiles & amphibians**	**Mammals**	**Birds**	**Temperature**	**Rainfall**	**Storms**	**Provisioning services**	**Regulating services**	**Cultural services**	**Supporting services**
Recreational fishing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	X	X	X	X	X	✓	X	X	X
Recreational use of beach	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	X	X	X	X	X	X

Key:

No risk of potential impacts:	X
Some risk of potential impacts:	✓

34 World and National Heritage impact assessment

Fires within Greater Blue Mountains World Heritage Area

NSW experienced extensive bushfires throughout the spring and summer of 2019-20. As of 3rd February 2020, the fires had burnt 5.4 million hectares of land (approximately 7 per cent of NSW). This includes 37 per cent of the national park estate, including 81 per cent of the Greater Blue Mountains World Heritage Area (DPIE, 2020b).

An assessment of the potential impacts of the Plan on the Greater Blue Mountains World Heritage Area in relation to fire is provided in section 34.2.5.

World Heritage and National Heritage sites are Matters of National Environmental Significance (MNES) and are protected under the Commonwealth EPBC Act.

This Chapter assesses the potential impacts to World Heritage and National Heritage sites from urban, transport and agricultural development under the Plan. It sets out:

- The regulatory context for World and/or National Heritage properties
- A discussion of each of the properties listed in Table 34-1, including:
  - An assessment of potential direct, indirect, and facilitated impacts
  - An assessment of the consistency of the Plan with the regulatory requirements for each property

There are three World and/or National Heritage listed sites in or near the Strategic Assessment Area that could potentially be impacted by development under the Plan. Table 34-1 lists these sites and their World Heritage and National Heritage listing status.

The Greater Blue Mountains World Heritage Area is located close to the nominated areas and has been considered in detail. The other heritage sites are further from the urban capable land and major transport corridors and are unlikely to impacted; therefore, these sites have been considered in less detail.

In summary, the direct and indirect impacts to these sites from the Plan are negligible. There is the possibility of facilitated impacts from increased visitor numbers, but visitor impacts are already managed at each site and the existing management arrangements for these sites are considered sufficient to manage this risk.

Table 34-1: World and National Heritage sites in or near the Strategic Assessment Area

Site	World Heritage status	National Heritage status
Greater Blue Mountains World Heritage Area	Listed	Listed
Parramatta Female Factory and Institutions Precinct	-	Listed
Old Government House and Government Domain	Part of Australian Convict Sites listing (one of 11 sites across Australia)	Listed

34.1 REGULATORY CONTEXT

The EPBC Act sets out a range of protections for World Heritage and National Heritage properties. This assessment draws on four components of this regulatory framework:

- The concept of Outstanding Universal Value
- The EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013b)
- EPBC Act Section 146G: Approvals relating to declared World Heritage properties
- EPBC Act Section 146H: Approvals relating to National Heritage places

Each of these components is discussed in detail below.

34.1.1 OUTSTANDING UNIVERSAL VALUE

The concept of Outstanding Universal Value (OUV) is defined in the *Operational Guidelines for the Implementation of the World Heritage Convention* (the Guidelines, (UNESCO, 2017)) as "cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity".

For a World Heritage Property to be considered to have OUV, it must:

- Meet one or more of the ten World Heritage criteria listed in the Guidelines (UNESCO, 2017)
- Meet the conditions of integrity and/or authenticity (noting that authenticity is not relevant to the Greater Blue Mountains Area as a natural area)
- Have an adequate protection and management system

The OUV of a World Heritage Property is articulated in a Statement of Outstanding Universal Value which is typically prepared at the time of inscription. Besides describing the attributes of the property that contribute to its OUV, the Statement of OUV provides the basis for the future protection and management of the property.

34.1.2 SIGNIFICANT IMPACT GUIDELINES 1.1

This assessment draws on key concepts outlined in the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013b) in relation to World and National Heritage. These guidelines describe three pathways for significant impacts to World Heritage properties or National Heritage places.

Actions are likely to have significant impacts if there is a real chance or possibility that they will lead to:

- A loss of one or more World or National Heritage values
- Degradation or damage to one or more World or National Heritage values
- Notable alteration, obscuring, or diminishment of one or more World or National Heritage values

These concepts have been used to discuss the potential likelihood and severity of impacts to OUV. The World or National Heritage values for each site will be identified in the relevant section.

34.1.3 APPROVALS RELATING TO DECLARED WORLD HERITAGE PROPERTIES

Section 146G of the EPBC Act sets out the approval considerations in relation to World Heritage properties. It requires the outcomes of the Plan to not be inconsistent with any of:

- Australia's obligations under the World Heritage Convention
- The Australian World Heritage management principles
- A management plan for a World Heritage property that falls under the Sections 316 or 321 of the EPBC Act

The strategic assessment process is consistent with the requirements for public consultation and environmental impact assessment in the Australian World Heritage management principles.

The Australian World Heritage management principles set out requirements for public consultation in the management of and assessment of the possibility of significant impacts to World Heritage properties. These requirements are consistent with the strategic assessment process.

The World Heritage Convention sets out a broad range of obligations to recognise and protect World Heritage properties and cooperate internationally for the ongoing preservation. As outlined below, the potential impacts to World Heritage properties from the Plan are acceptable, and the Plan is not inconsistent with these obligations.

34.1.4 APPROVALS RELATING TO NATIONAL HERITAGE PLACES

Section 146H of the EPBC Act sets out the approval considerations in relation to National Heritage places. It requires the outcomes of the Plan to not be inconsistent with any of:

- The National Heritage management principles
- An agreement to which the Commonwealth is a party in relation to a National Heritage place

- A management plan for a National Heritage place that falls under Sections 324S or 324X of the EPBC Act

The National Heritage management principles relate to the identification, protection, management and use of National Heritage places. The principles are broadly consistent with the strategic assessment process.

A key requirement for approval under the EPBC Act is whether the outcomes of the Plan are inconsistent with any relevant management plans or agreements for each National Heritage place. The relevant plans are discussed in the EPBC Act Approval Considerations section for each property.

34.2 GREATER BLUE MOUNTAINS WORLD HERITAGE AREA

The Greater Blue Mountains World Heritage Area (GBMWHA) is listed as both a World Heritage site and a National Heritage place. It occurs adjacent to the Cumberland subregion (see Figure 34-1).

This section assesses the likely impacts of the proposed development under the Plan on the GBMWHA. It sets out:

- A brief description of the area
- The relevant EPBC Act approval considerations
- The values of the World Heritage area
- The relationship between the Plan and the GBMWHA
- The potential direct, indirect, and facilitated impacts to the values of the GBMWHA associated with the Plan
- Consistency with the Strategic Plan for the World Heritage area
- An evaluation of the adequacy of the outcome

This assessment shows that the only relevant potential impacts to the OUV of the GBMWHA from the Plan are from facilitated impacts. Specifically, the Plan will support population growth near the World Heritage area which may increase the extent and intensity of impacts from visitor use.

The GBMWHA is made up of eight conservation reserves, each of which is protected and managed for conservation. The management plans for these reserves sufficiently address impacts associated with visitor use. Provided these conservation reserves continue to monitor and adaptively manage impacts from visitors over time, the risk of impacts to the OUV of the GBMWHA from the development under the Plan is considered minimal.

34.2.1 DESCRIPTION OF THE GREATER BLUE MOUNTAINS WORLD HERITAGE AREA

The GBMWHA covers 1.03 million ha to the west of the Strategic Assessment Area. It extends between 60 and 180 km inland from central Sydney, between Bowral in the south, and Newcastle and Mudgee to the north (DECC, 2009b).

It contains a deeply incised sandstone plateau with a wide range of forest ecosystems, mallee scrubs, swamps, deep valleys, cliffs, canyons, and rivers. It protects large areas of wilderness and provides habitats for an internationally significant diversity of flora, fauna, and ecological communities. It provides connectivity between coastal ecosystems to the east and the western slopes and is an important north-south corridor (DECC, 2009b).

The park is adjacent to Sydney and urban areas in the Hunter and Central Coast regions. It provides important opportunities for education, recreation, research and access to wilderness (DECC, 2009b).

34.2.2 EPBC ACT APPROVAL CONSIDERATIONS

The Greater Blue Mountains World Heritage Area Strategic Plan (the Strategic Plan) was published in 2009 for the management of the World Heritage property as described by Section 321 of the EPBC Act. The Strategic Plan also acts as a management plan for a National Heritage place under Section 324X of the EPBC Act.

A key consideration for approval of the Plan is that it is not inconsistent with the Strategic Plan. This section sets out the broad objectives of the Strategic Plan and the conditions the Plan must meet to be approvable under the EPBC Act.

OBJECTIVES OF THE STRATEGIC PLAN

The Strategic Plan sets out a range of values that are expressed in the GBMWHA. Some of these are recognised as being Outstanding Universal Values, while others support OUV within the GBMWHA or could potentially be listed in the

future. The Outstanding Universal Values and these supporting values are discussed below. To manage these values, the Strategic Plan lists ten key management issues, each of which has one or more objectives and a range of desired outcomes and management responses. The key management issues and their objectives are provided in Table 34-2.

Table 34-2: Key management issues and objectives for the GBMWHA

Key management issue	Objective
Integrity	• To maintain, and wherever possible, improve the current and future integrity of the GBMWHA
Major impacts	• To reduce the potential for major impacts to adversely affect the integrity of the GBMWHA. Major impacts include mining adjacent to or underlying the GBMWHA, highway construction through the GBMWHA, or other development within or adjacent to the GBMWHA
Biodiversity	• To conserve the GBMWHA's biodiversity and ensure the ecological viability and capacity for ongoing evolution of its World Heritage and other natural values is maintained
Geodiversity	• To protect the GBMWHA's geodiversity
Water catchment protection	• To maintain and improve the water quality and water catchment values of the GBMWHA
Cultural heritage	• To identify, formally recognise and protect the cultural heritage values of the GBMWHA • To manage the GBMWHA jointly with local Indigenous people
Landscape, natural beauty and aesthetic values	• To protect the landscape, natural beauty, and aesthetic values of the GBMWHA
Recreation and visitor use	• To provide for an appropriate range of recreation and visitor use, consistent with the protection of World Heritage and related values
Social and economic issues	• Consistent with the protection of World Heritage and other values, optimise the potential and existing social and economic benefits derived from visitation to the GBMWHA
Education, community participation and consultation	• To encourage community stewardship of the GBMWHA through education, consultation, and the provision of opportunities for community participation in its protection

There are a large number of desired outcomes, many of which are not relevant to implementation of the Plan. Desired outcomes that may be affected by the Plan are discussed individually as appropriate.

TEST FOR APPROVAL

For approval under the EPBC Act, the Plan must not be inconsistent with the Strategic Plan. To achieve this, it must not:

- Prevent the achievement of any of the objectives
- Prevent any of the desired outcomes

These conditions are considered after a discussion of the potential impacts of the Plan.

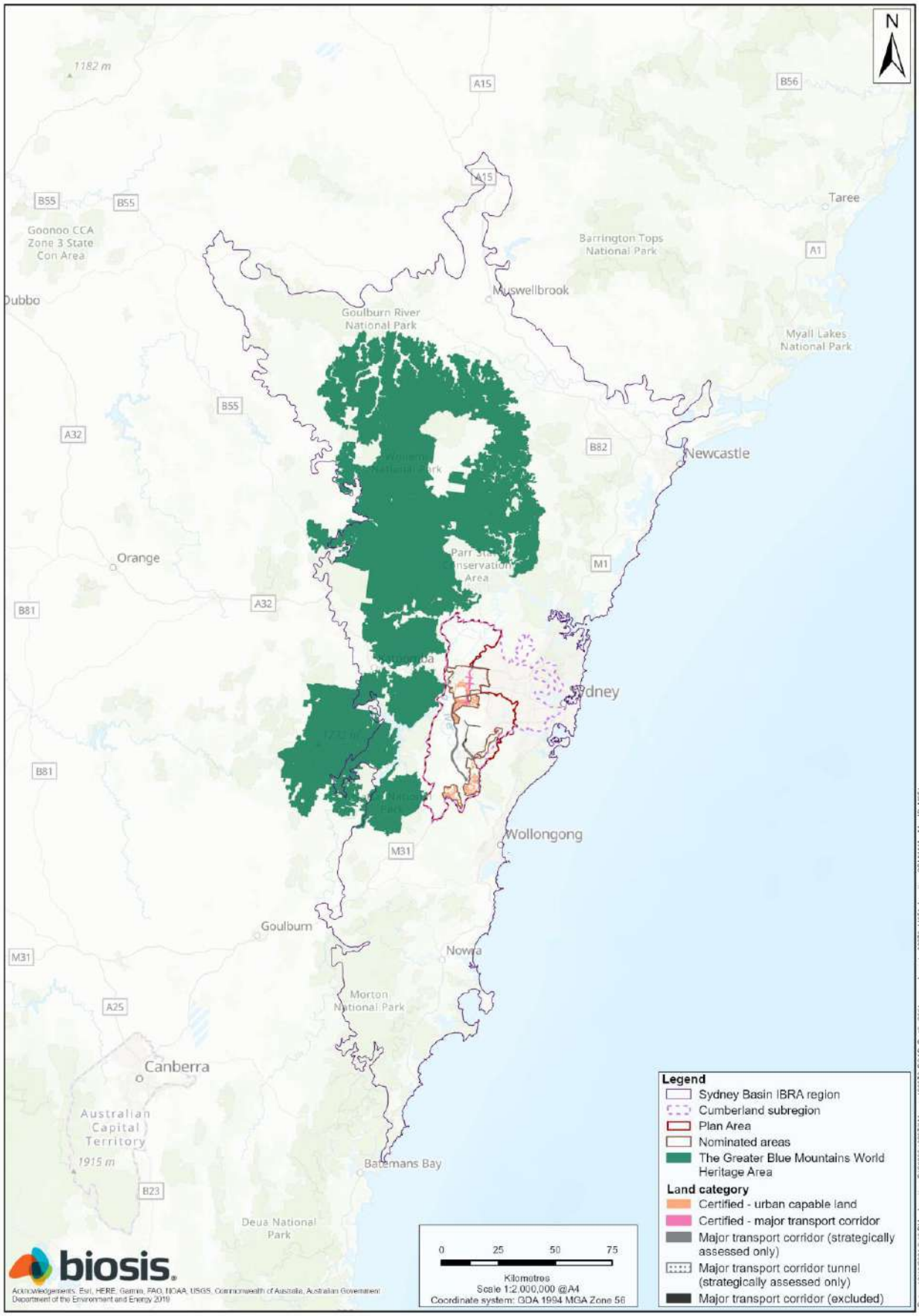

Figure 34-1: The Greater Blue Mountains World Heritage Area

34.2.3 THE VALUES OF THE GREATER BLUE MOUNTAINS WORLD HERITAGE AREA

The GBMWHA is World and National Heritage listed because it contains globally significant examples of eucalyptus evolution and diversification and an outstanding diversity of ecosystems, habitats, and ecological communities.

WORLD HERITAGE LISTING

As a World Heritage Area, the GBMWHA is recognised under the *World Heritage Convention* as having OUV. A Statement of OUV was not prepared for the GBMWHA at the time of inscription. However a retrospective Statement of OUV was adopted by the World Heritage Commission in 2013 (UNESCO, 2018c) and is summarised below.

Criteria and attributes

The GBMWHA meets two criteria for OUV:

- **Criterion (ix):** it is an outstanding example representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals
- **Criterion (x):** it contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation (UNESCO, 2017)

While the precise wording of the listing criteria is periodically updated by UNESCO, the natural heritage criteria that have been met in the GBMWHA reflect ecological and biological processes; and biological diversity including threatened species. The criteria listed in this report are those in the 2017 Operational Guidelines.

The attributes that meet these criteria are discussed in Table 34-3.

Table 34-3: Outstanding Universal Values of the Greater Blue Mountains World Heritage Area

World Heritage listing criteria	Examples of World and National Heritage attributes
Criterion (ix): it is an outstanding example representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals	The GBMWHA has: • Outstanding and representative examples in a relatively small area of the evolution and adaptation of the genus Eucalyptus and eucalypt-dominated vegetation on the Australian continent • Wide and balanced representation of eucalypt habitats including wet and dry sclerophyll forests and mallee heathlands with localised swamps, wetlands, and grassland • Significant examples of eucalypt evolution and diversification • Examples of dynamic processes that cover the full range of interactions between eucalypts, understorey, fauna, environment, and fire • Primitive species of outstanding significance to the evolution of the earth's plant life (e.g. the Wollemi pine *Wollemia nobilis* and the Blue Mountains pine *Pherosphaera fitzgeraldii*) (UNESCO, 2018a)
Criterion (x): it contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	The GBMWHA contains: • An outstanding diversity of habitats, plant communities, species and ecosystems (152 plant families, 484 genera and approximately 1,500 species) • A significant proportion of the Australian continent's biodiversity, especially its scleromorphic flora • Exceptionally high levels of species diversity in the Myrtaceae, Fabaceae, and Proteaceae plant families, including 13 per cent of the world's eucalyptus species • Primitive and relictual species with Gondwanan affinities • Many plants of conservation significance (114 endemic species and 177 threatened species)

World Heritage listing criteria	Examples of World and National Heritage attributes
	• More than 400 vertebrate taxa (of which 40 are threatened) including around one third of Australia's bird species (265 species) • An estimated 120 butterfly and 4,000 moth species and rich cave invertebrate fauna (UNESCO, 2018b)

Integrity

All World Heritage properties are required to meet the conditions of integrity. This is defined by the Guidelines (UNESCO, 2017) as "a measure of the wholeness and intactness of the natural and/or cultural heritage and its attributes". An assessment of the integrity of a property is required to determine the extent to which the property:

- Includes all elements necessary to express its OUV
- Is of adequate size to ensure the complete representation of the features and processes which convey the property's significance
- Suffers from adverse effects of development and/or neglect

The Statement of OUV for the GBMWHA (UNESCO, 2018b) sets out the features of the property that meet these conditions.

- The GBMWHA is of a sufficient size (over 1 million ha) and connectivity to protect its biota and ecosystem processes despite anomalies in its boundary that reduce the protective effect of its size
- Much of the property neighbours State Forests and State Conservation Areas which provide protection to the World Heritage area
- Designated wilderness areas (covering 65 per cent of the property) and closed and protected catchments provide additional protections
- Most of the natural bushland within the property is of high wilderness quality and remains close to pristine
- Plant communities and habitats within the property form a largely undisturbed matrix with little disruption from structures, earthworks, or other human intervention
- The complexity of the property's geological structure, geomorphology and water systems are critical to the evolution of its outstanding biodiversity and require the same level of protection
- The property has a strong and ongoing connection with Aboriginal people from six language groups. Continuation of this custodial relationship is fundamental to the protection of the property's integrity

Protection

All World Heritage properties are required to be adequately protected and managed to ensure that their OUV (including the conditions of integrity at the time of inscription) are sustained or enhanced over time (UNESCO, 2017).

The Guidelines outline the broad level requirements for effective protection and management. This includes:

- Appropriate legislative, regulatory and contractual measures for protection
- Boundaries for effective protection
- Buffer zones
- Appropriate management systems

Finally, the Guidelines provide for the sustainable use of World Heritage Areas where that use does not adversely impact on the OUV of the property.

The GBMWHA is completely contained within the following conservation reserves:

- Blue Mountains National Park
- Gardens of Stone National Park
- Jenolan Caves Karst Conservation Reserve
- Kanangra-Boyd National Park
- Nattai National Park

- Thirlmere Lakes National Park
- Wollemi National Park
- Yengo National Park

Large areas in the southern part of the GBMWHA are within the catchment for Sydney's water. These areas are protected under *Sydney Water Catchment Management Act 1998* that restricts access and acceptable use. This affords an additional level of protection.

All of these reserves are managed by the NSW National Parks and Wildlife Service (UNESCO, 2018b) and are subject to a range of State Government legislation.

In addition to the Strategic Plan, plans of management have been gazetted for the seven national parks listed above and a draft plan of management has been published for the Jenolan Caves Karst Conservation Reserve (UNESCO, 2018b). The plan of management for each conservation reserve is listed in Table 34-4.

Table 34-4: Plans of management for the GBMWHA

Conservation reserve	Plan of management title	Publisher	Year of publication
Blue Mountains National Park	Blue Mountains National Park Plan of Management	DECC	2001
Gardens of Stone National Park	Gardens of Stone National Park Plan of Management	DECC	2009
Kanangra-Boyd National Park	Kanangra-Boyd National Park Plan of Management	NSW NPWS	2001
Nattai National Park	Nattai Reserves Plan of Management	NSW NPWS	2001
Thirlmere Lakes National Park	Thirlmere Lakes National Park Plan of Management	NSW NPWS	1997
Wollemi National Park	Wollemi National Park Plan of Management	NSW NPWS	2001
Yengo National Park	Yengo National Park Finchley Aboriginal Area Plan of Management	DECC	2009
Jenolan Caves Karst Conservation Reserve	Jenolan Karst Conservation Reserve Draft Plan of Management	OEH	2013

NATIONAL HERITAGE LISTING

The GBMWHA meets four criteria for National Heritage listing. It was judged to meet these criteria on the basis of its World Heritage listing. The criteria are:

- **Criterion A Events, Processes** by virtue of meeting World Heritage criteria (ix) and (x)
- **Criterion B Rarity** by virtue of meeting World Heritage criterion (x)
- **Criterion C Research** by virtue of meeting World Heritage criteria (ix) and (x)
- **Criterion D Principal characteristics of a class of places** by virtue of meeting World Heritage criterion (ix) (DoEE, 2019)

The GBMWHA's National Heritage listing is based on its World Heritage status. An assessment of the significance of impacts to the GBMWHA's OUV is considered sufficient to determine the acceptability of impacts to its National Heritage values.

SUPPORTING ATTRIBUTES

The Strategic Plan sets out a number of values that are not recognised as having OUV, but support, complement, or interact with the GBMWHA's World Heritage values. Some of these may be nominated for World Heritage listing in the future. The supporting values described in the Strategic Plan are set out in Table 34-5. Some of these attributes have

already been discussed in the Statement of OUV. Only the attributes that have not already been identified in the World Heritage listing will be considered further below.

Table 34-5: Supporting values of the GBMWHA

Value	Description
Geodiversity and biodiversity	These attributes are discussed in the Statement of OUV
Water catchment	The GBMWHA protects a large number of pristine catchment areas, which make a substantial contribution to water storage for human use as well as water quality and natural flows for the Hawkesbury-Nepean and Goulburn-Hunter river systems
Indigenous values	This attribute is discussed in the Statement of OUV
Historic values	The GBMWHA includes numerous places of historic significance to European settlement of Australia
Recreation and tourism	The GBMWHA provides settings for recreation and tourism that are outstanding and increasingly rare by world standards, adjacent to a major city
Wilderness	This attribute is discussed in the Statement of OUV
Social and economic	The GBMWHA has considerable social and economic value as a tourism destination
Research and education	The variety of ecological communities and landscapes and associated cultural sites makes the GBMWHA ideal for research and educational visits
Scenic and aesthetic	The GBMWHA contains some of the most dramatic scenery in Australia with views of uninterrupted forest wilderness, contrasting forested slopes and cleared valleys, sandstone canyons and pagoda rock formations. The Jenolan Karst Conservation Reserve contains extensive aesthetic caves
Bequest, inspiration, spirituality, and existence	The GBMWHA has value as a unique and important landscape that can be experienced by future generations and contributes to Aboriginal cultural continuity

34.2.4 HOW DEVELOPMENT UNDER THE PLAN RELATES TO THE GBMWHA

The proposed urban capable land and major transport corridors do not occur within or overlap with the GBMWHA.

The western boundary of the Strategic Assessment Area is adjacent to the World Heritage area immediately west of GPEC. The Strategic Assessment Area and the World Heritage area overlap slightly close to the southern end of the Strategic Assessment Area.

GPEC is the nearest nominated area, occurring approximately 1 km from the edge of the World Heritage area, as shown in Figure 34-2. The distance from the GBMWHA to key locations within the urban capable land and major transport corridors is given in Table 34-6.

Table 34-6: Distance between GBMWHA and key locations in the urban capable land and major transport corridors

Location	Distance
Urban capable land in Greater Penrith to Eastern Creek Investigation Area (GPEC)	1 km
Urban capable land in Western Sydney Aerotropolis (WSA)	5.3 km
Urban capable land in Wilton Growth Area (Wilton)	6.5 km
Urban capable land in Greater Macarthur Growth Area (GMAC)	15.8 km

The proposed development will support an increasing population in Western Sydney. The Metropolis of Three Cities plan projects that the population of the Western Parkland City will increase from 740,000 in 2016 to over 1.5 million in

2056 (GSC, 2018). Population growth of this size in close proximity to the GBMWHA is anticipated to increase visitor numbers and in turn increase the pressure on the World Heritage Area from visitors.

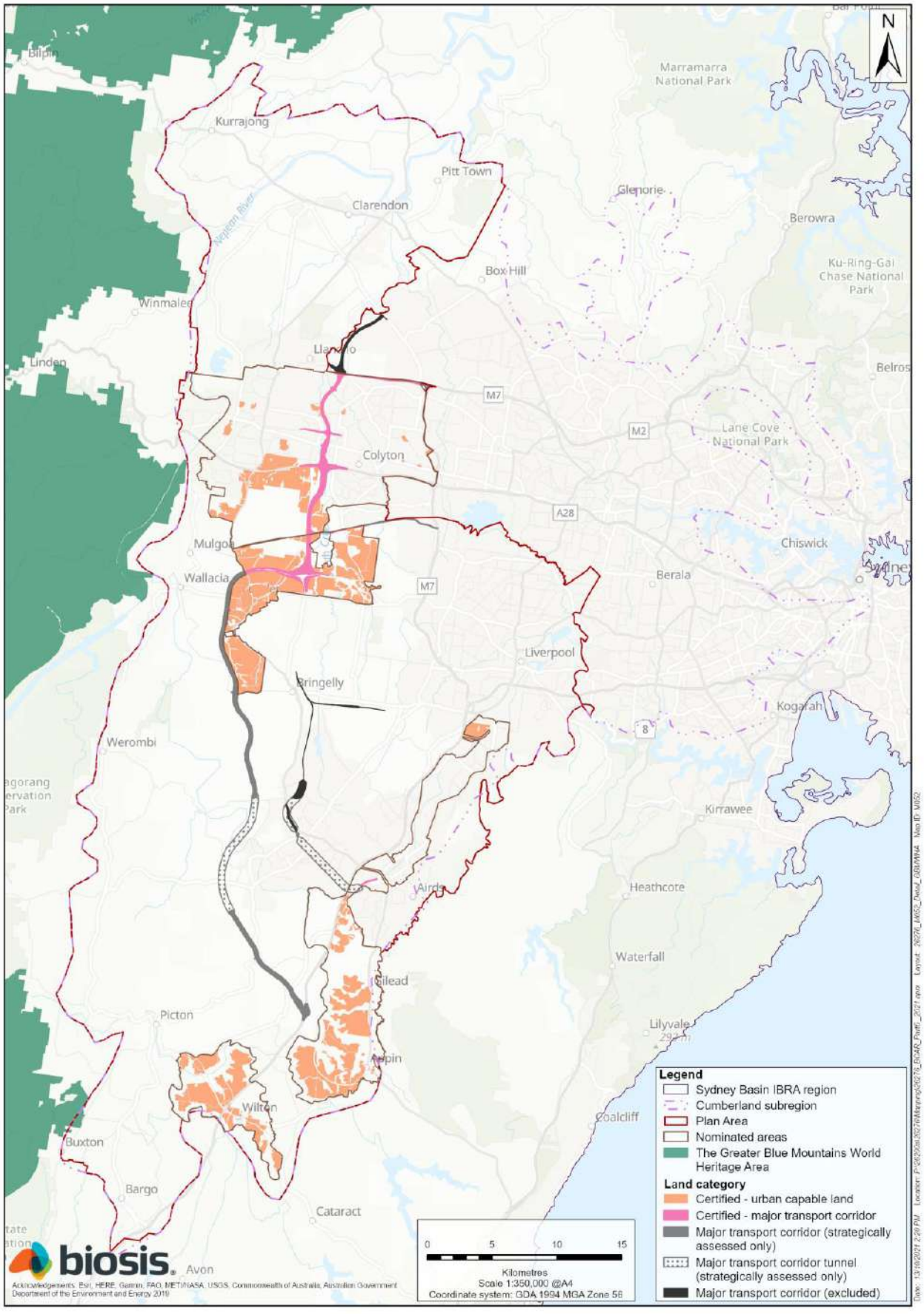

Figure 34-2: GBMWHA and the Plan Area

34.2.5 POTENTIAL IMPACTS TO OUTSTANDING UNIVERSAL VALUE

It is not reasonably foreseeable that any of the impacts described in this section will affect the level of conservation protection for the GBMWHA. As a result, this section will focus on the possibility of impacts to the OUV and integrity of the GBMWHA, as well as its supporting values.

POTENTIAL DIRECT IMPACTS

The Plan does not include any actions or development within the GBMWHA. As a result, there will be no direct impacts to OUV or the GBMWHA's supporting values from the Plan.

POTENTIAL INDIRECT IMPACTS

Potential indirect impacts to the GBMWHA are discussed below in relation to:

- Habitat connectivity
- Edge effects
- Visual impacts
- Other impacts

Habitat connectivity

Of the attributes that support criterion (x), several wide-ranging fauna species (e.g. bats, such as the Grey-headed Flying-fox, and birds) are likely to move between the World Heritage Area and the Cumberland subregion. This is particularly the case in the context of the recent bushfires, which affected over 81 per cent of the Greater Blue Mountains World Heritage Area (DPIE, 2020b) and may have increased the importance of habitat outside the area for these species.

Habitat within the nominated areas may provide connectivity for these wide-ranging species to foraging resources or smaller areas of habitat within or surrounding the subregion, including protected areas to the north-east and south-east of the subregion, or the Holsworthy Military Reserve to the south-east.

The direct impacts of urban and other development may reduce habitat connectivity within the nominated areas for wide-ranging fauna species associated with GBMWHA, which may affect ecosystem processes that may cause impacts to the OUV and integrity of the GBMWHA, as well as its supporting values.

Habitat connectivity refers to the degree of connectedness of areas of habitat. Habitat connectivity can include:

- Corridors of vegetation linking other areas of habitat
- Isolated patches of habitat that provide 'stepping stones' between other areas of habitat
- Habitat features (such as large trees with hollows) scattered within areas of non-habitat (e.g. urban land) that provide habtiat connectivity between intact areas of habitat

Habitat connectivity was mapped within the nominated areas as part of this Assessment Report by:

- Identifying BIO Map regional corridors and core areas (DECCW, 2010), which have been identified by EES and represent the areas where the protection and management of native vegetation is likely to maximise benefits to biodiversity within the subregion. These areas are likely to represent the most important areas of habitat connectivity in the nominated areas for the majority of species[1]
- Identifying local corridors using the native vegetation mapping to identify connected patches of native vegetation. This was done visually in GIS, with only contiguous patches identified as being connected

- [1] Note that EES has only identified BIO Map corridors within the boundaries of the Cumberland subregion. To undertake the mapping for the small parts of the nominated areas outside the subregion the Priority Conservation Lands layer (DECCW, 2010) (EES used this layer as basis for BIO Map) or the native vegetation map prepared for this Assessment Report (see Chapter 11) was used to extend the BIO Map corridor mapping

- Identify any remaining native vegetation not within a regional corridor or local corridor as:
    - Connected patches – within 100 m of another patch of woody vegetation
    - Isolated patches – greater than 100 m from another patch of woody vegetation

Key areas of habitat connectivity in the nominated areas are shown in Chapter 28, Map 28-1 The impacts of urban and other development on this habitat connectivity are described in Table 34-7.

Urban and other development is not considered likely to impact habitat connectivity within the nominated areas to the extent that this would cause impacts to the OUV and integrity of the GBMWHA, as well as its supporting values through impacts to wide-ranging fauna species. The vast majority of BIO Map regional corridors/core areas and smaller habitat corridors have been avoided and will not be impacted. Where impacts occur to these areas, this is generally to the edges of habitat and connectivity is generally maintained. Many smaller connected and isolated patches of habitat will be directly impacted, which is likely to reduce habitat connectivity within the nominated areas for more mobile species, such as microbats and birds. These impacts are not considered substantial in the context of maintaining habitat connectivity within the broader landscape and between the nominated areas and GBMWHA.

Furthermore, the conservation program under the Plan (see Part 2) will result in:

- Protecting a minimum of 5,325 hectares of native vegetation in the Cumberland subregion (Commitment 8)
- Protecting key koala corridors in the Cumberland subregion, including those along the Nepean River, Georges River, Cataract River and Ousedale Creek (Commitment 12)
- Undertaking ecological restoration in conservation land established under the Plan, including ecological reconstruction of up to a maximum of 25% of the Plan's offset target for native vegetation (Commitment 13)
- Managing landscape threats in strategic locations to improve habitat values, including weeds (Commitment 15) and pests (Commitment 16) and fire (Commitment 17)

Importantly, the Strategic Conservation Area (SCA) where these commitments will be delivered, represent the areas in the Cumberland subregion that are considered most likely to be viable in the long-term and to maximise ecological function and connectivity across the landscape. In determining the location of the SCA, priority was given to including the largest, best condition and best-connected areas of native vegetation remaining in the subregion (see Part 2).

The Plan also includes several measures that will minimise impacts to habitat connectivity within the nominated areas for wide-ranging fauna species. These include:

- Avoiding riparian corridors across the nominated areas (see Chapter 14, Section 14.2)
- Retaining large trees (including dead trees) (≥50cm DBH) during precinct planning where possible and avoid impacts to soil within the dripline of these trees during construction
- Retaining areas of high density proteaceae shrubs where possible, particularly along riparian corridors
- Establishing ecological setbacks to provide a buffer to adjacent development for:
    - Raptor nests and owl nests
    - Grey-headed Flying Fox camps (see Appendix E of the Plan and Chapter 15, Section 15.8)

These commitments and other measures are considered to adequately address any residual risks of impacts to habitat connectivity that may cause impacts to the OUV and integrity of the GBMWHA, as well as its supporting values.

Table 34-7: Potential impacts on habitat connectivity from urban and other development in the nominated areas

Nominated area	Nature	Extent	Duration
Wilton	**Direct impacts:** The main direct impact occurs in the southern part of the nominated area where the development will remove part of a corridor/core area that connects native vegetation either side of the nominated area in this location. The impact reduces the width of the corridor/core area by about half. Connectivity is maintained to the south and east of the impacted area. In all other areas, direct impacts occur only to the edges of corridors/core areas in a few locations and connectivity along these areas is maintained There are very minor direct impacts to the local corridor on the eastern side of the nominated area between the Hume Motorway and Wilton Road The majority of impacts to connected vegetation occur to smaller scattered patches in the middle of the nominated area and to the edge of larger areas of connected vegetation where it occurs adjacent to BIO Map regional corridors/core areas around the nominated area	**Direct impacts:** The following approximate amounts of each category of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 70 ha (6.7%) • Local corridor – 6.5 ha (3.3%) • Connected vegetation – 125.9 ha (23.2%) • Isolated vegetation – 1 ha (45.5%)	Long-term
	Indirect impacts: The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance.	**Indirect impacts:** Areas of habitat connectivity adjacent to urban capable lands/transport corridors	Temporary or long-term
GMAC	**Direct impacts:** Direct impacts occur only to the edges of corridors/core areas in a few locations. There are no locations where direct impacts completely sever or significantly narrow a core area/corridor and connectivity is maintained for these areas of habitat connectivity across all parts of the nominated area The vast majority of the local corridor in the middle of the southern part of the nominated area has been avoided and is not directly impacted. Impacts occur only to the edges of the corridor and connectivity is maintained in this location across the nominated area The majority of impacts to connected vegetation occur to smaller scattered patches, where patches will be completely cleared. Impacts also occur to the edges of several larger areas of connected vegetation in the southern part of the nominated area. In these cases, the size of the patches will be reduced, but the impacts will not generally sever connectivity between this connected vegetation and other areas of native vegetation, such as BIO Map corridors/core areas	**Direct impacts:** The following approximate amounts of each category of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 60.7 ha (2.9%) • Local corridor – 20.2 ha (12.8%) • Connected vegetation – 189.6 ha (18.9%) • Isolated vegetation – 1.4 ha (11.8%)	Long-term

Nominated area	Nature	Extent	Duration
	Indirect impacts: The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance Further, connectivity will be disrupted for two east-west corridors which link the Nepean and Georges River through GMAC through installation of Koala exclusion fencing. The purpose of this is to exclude Koalas from corridors which are too narrow and may pose dangers to the species. As habitat within these corridors will be avoided by development and protected for other biodiversity and amenity values, fencing of these corridors is considered an indirect impact as opposed to a direct impact	**Indirect impacts:** Areas of habitat connectivity adjacent to urban capable lands/transport corridors, in addition to two east-west corridors through GMAC which provide linkages between the Georges River and Nepean River	Temporary or long-term
WSA	**Direct impacts:** The vast majority of BIO Map regional corridors/core areas have been avoided and will not be directly impacted. The main direct impact occurs in the south-eastern part of the nominated area where the development will remove the majority of a corridor/core area that connects Wianamatta (South Creek) and Kemps Creek in the Kemps Creek area. While this area is identified as a regional corridor, connectively has already been completely severed in this location by existing industrial land use. In all other areas, direct impacts occur only to the edges of corridors/core areas in a few locations and connectivity along these areas is maintained The majority of local corridors have been avoided and will not be directly impacted. Direct impacts occur: • At Cosgrove Creek in the middle part of the nominated area where the OSO severs the riparian corridor in two locations • At Badgerys Creek in the middle part of the nominated area where the OSO severs the riparian corridor in one location The majority of impacts to connected vegetation occur to smaller scattered patches, where patches will be completely cleared. Impacts also occur to the edges of several larger areas of connected vegetation in the north-eastern, middle, and southern parts of the nominated area. In some cases, the impacts will sever or reduce connectivity between this connected vegetation and other areas of connected vegetation within and outside the nominated area	**Direct impacts:** The following approximate amounts of each category of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 52.4 ha (16.5%) • Local corridor – 39.2 ha (31.6%) • Connected vegetation – 309.8 ha (55.9%) • Isolated vegetation – 10.2 ha (63.7%)	Long-term

Nominated area	Nature	Extent	Duration
	Indirect impacts: The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance	**Indirect impacts:** Areas of habitat connectivity adjacent to urban capable lands/transport corridors	Temporary or long-term
GPEC	**Direct impacts:** The majority of BIO Map regional corridors/core areas have been avoided and will not be directly impacted. The main direct impacts occur: • Within Wianamatta Regional Park where the OSO severs the eastern part of the regional park that is connected to Ropes Creek with the western part of the park • Along Wianamatta (South Creek) where the OSO directly impacts the Wianamatta (South Creek) riparian corridor and severs the narrow connection along the corridor that links Wianamatta Regional Park and Orchard Hills In all other areas direct impacts have been avoided, except in the western part of the nominated area near Glenmore Park where there is a small direct impact to the edge of a corridor/core area No local corridors occur within the nominated area The majority of impacts to connected vegetation occur to smaller scattered patches, where patches will be completely cleared. Impacts also occur to the edges of several larger areas of connected vegetation in some parts of the nominated area. In these cases, the size of the patches will be reduced, but the impacts will not generally sever connectivity between this connected vegetation and other areas of native vegetation, such as BIO Map corridors/core areas	**Direct impacts:** The following categorises of habitat connectivity will be directly impacted by the development: • BIO Map corridors – 189.7 ha (5.8%) • Local corridor – 0 ha (0%) • Connected vegetation – 194 ha (17.5%) • Isolated vegetation – 0.5 ha (5.9%)	Long-term
	Indirect impacts: The development may cause a range of indirect impacts to areas of habitat connectivity. Key risks are weed invasion, pest animals, changes to hydrology, increased risk of fire, and human disturbance	**Indirect impacts:** Areas of habitat connectivity adjacent to urban capable lands/transport corridors	Temporary or long-term

Edge effects

Potential indirect impacts from the Plan relating to edge effects, such as the introduction of weeds and feral animals, changes to water quality, inappropriate fire regimes or disturbance from light or noise are also considered unlikely to affect the OUV or the supporting values of the GBMWHA for the following reasons:

- The urban capable land and major transport corridors are at least 1 km from the GBMWHA. Where development occurs close to the World Heritage area (e.g. on the western edge of the footprints in GPEC), it takes place in existing urban or highly modified environments. These areas have already been disturbed, and further disturbance is unlikely to lead to substantial edge effects
- Most of the development proposed by the Plan is over 5 km from the edge of the GBMWHA. This distance is sufficient to protect the World Heritage area from edge effects
- The urban capable land and major transport corridors are downstream of or outside the catchment for the GBMWHA. The Plan is therefore unlikely to influence aquifer drawdown, ground water quality or surface water quality relating to the GBMWHA

Furthermore, the Plan commits to mitigating indirect impacts of the development (Commitment 5) and a range of mitigation measures will be implemented to address potential indirect impacts relating to edge effects. These mitigation measures are identified in Appendix E of the Plan and Chapter 15, Section 15.6, and Section 15.8, and further minimise the risks associated with edge effects.

Visual impacts

Scenic and aesthetic attributes are identified in the Strategic Plan as a supporting value for the World Heritage Area. Of particular relevance are views of uninterrupted forest wilderness, contrasting forested slopes and cleared valleys, sandstone canyons and pagoda rock formations. However, these views are not typically related to the Cumberland subregion.

Development within parts of the nominated areas will be visible from some areas in the GBMWHA. However, impacts to scenic and aesthetic values are likely to be limited in scope and scale because:

- The Cumberland subregion does not represent the key scenic values identified in the Strategic Plan
- Development that does occur near to the GBMWHA will generally occur within existing urban or highly modified environments, or where it occurs in greenfield areas, will be distant from the World Heritage area and is likely to have limited visual impact
- The urban capable land and major transport corridors are only visible from the eastern fringes of the World Heritage area and are not visible from the most popular and sensitive tourism and recreation sites (e.g. the Jamison Valley south of Echo Point or Wentworth Falls lookouts, the Grose Valley east of Evans or Govetts Leap lookouts, Kanangra Walls, or other wilderness areas)

Visual impacts will be negligible and do not present a risk to the scenic and aesthetic values of the GBMWHA.

Other impacts

It is not anticipated that the Plan will indirectly impact on the social, economic, cultural, historical, Indigenous, or other values of the GBMWHA.

POTENTIAL FACILITATED IMPACTS

Facilitated impacts are the main source of risk to the GBMWHA from the Plan and the focus of the remaining Chapter.

The population of Sydney is already growing, and the overarching Strategic Plan and the plans of management for each individual reserve within the GBMWHA recognise the pressure from increasing visitors as a major management challenge. The Plan will facilitate further population growth, potentially intensifying these impacts.

The potential impacts from increased visitors to the GBMWHA are:

- Disturbance from people, vehicles, and horses
- Increased frequency of fires
- Removal of bushrock and fallen timber

- Introduced plants
- Development or increased maintenance of visitor or management facilities or infrastructure

The plans of management set out a range of policies and actions, and monitoring processes for managing the impacts listed above. The impacts and the relevant management and monitoring policies are discussed below.

Increased disturbance from people, vehicles and horses

Additional visitors to the GBMWHA may increase disturbance to flora, fauna, ecological communities, geological features, and cultural or historical sites. This is listed as a key management challenge in the GBMWHA Strategic Plan (DECC, 2009b). The impacts of disturbance vary according to the type, intensity and frequency of visitor use and the sensitivity of the ecosystems and landscape features found throughout the World Heritage area. Unmarked tracks in wilderness areas may see around a thousand visits, remote wilderness areas may not be visited at all, and popular lookouts or tracks may see over a million visits each year. Visitors may be on foot, in vehicles, with horses (in limited parts of the GBMWHA), using watercraft, or using ropes to rock climb or access canyons.

Potential impacts are varied and include soil loss and compaction, loss of vegetative cover, erosion, lack of regeneration, creation of fireplaces, damage to trees, removal of firewood, installation of rock climbing and canyoning anchors, individual mortality of flora and fauna, incorrect disposal of waste, and damage to cultural or historic sites (DECC, 2001).

Potential impacts to Outstanding Universal Value and supporting values

The OUV of the GBMWHA reflects its outstanding examples of eucalyptus diversification and evolution and its diversity of habitats, ecological communities, and species. Without appropriate management, increased disturbance from people, vehicles and horses could notably diminish or alter these values through:

- Impacts across large areas, or to many high-quality sites that support examples of eucalyptus diversification and evolution
- Intense impacts in important, sensitive areas especially habitats for species and ecological communities with a limited extent in the World Heritage area
- Any impacts to highly sensitive areas, including habitat for the Wollemi pine

Impacts that notably diminish the integrity of the GBMWHA are unlikely, but could result from:

- Widespread impacts in otherwise pristine environments
- Impacts to culturally sensitive areas

Impacts to supporting values including geodiversity and biodiversity, water catchments, Indigenous and historical values, recreation and tourism, wilderness, and scenic and aesthetic values could be notably degraded by:

- Intense impacts in sensitive areas, especially geological formations, historic and cultural sites, or key visitor locations
- Widespread impacts across high-quality areas such as water catchments, visitor sites, or areas of scenic and aesthetic value
- Impacts in highly sensitive areas, especially wilderness areas

Impacts to the protection arrangements for the GBMWHA are not reasonably foreseeable.

Impacts that notably diminish OUV or its supporting values from disturbance by people, vehicles and horses are only likely if they occur across many sites or in highly sensitive areas.

Existing management and monitoring policies

Disturbance by people, vehicles and horses is already managed in the conservation reserves that make up the GBMWHA. The sections in the plans of management for each conservation reserve that discuss management or monitoring of these impacts are listed in Table 34-8.

Table 34-8: Management and monitoring of impacts from people, vehicles, and horses

Conservation Reserve	Management of Impacts	Monitoring
Blue Mountains National Park	• s3.2 lists management of recreation and tourism to ensure minimal impacts as a specific objective of the plan. • s1.1 established a policy to manage erosion from visitor use and management activities. • s4.3 lists policies and actions to manage impacts from visitor use (including people, vehicles, and horses).	• s3.3 emphasises monitoring and improved management of public and commercial recreation opportunities with potential adverse impacts. • s4.3 lists a range of monitoring actions for different types of use within the park.
Gardens of Stone National Park	• s4.3 lists policies and actions to manage impacts from visitor use (including people, vehicles, and horses). • s4.1.1 commits NPWS to develop maintenance priorities to minimise erosion from roads, trails, and tracks.	• s4.3.1 commits to monitor visitor impacts at popular sites around the park.
Kanangra-Boyd National Park	• s3.2 describes management of recreation and tourism within the park to minimise impacts is a specific objective for the plan of management. • s1.1 commits to manage erosion from visitor use and management activities. • s4.3 lists policies and actions to manage impacts from visitor use (including people, vehicles, and horses).	• s3.3 commits to monitoring of recreation and commercial tourism with potential adverse impacts. • s4.3 lists a range of monitoring actions for different types of use within the park.
Nattai National Park	• s3 lists appropriate recreational use as an objective of the plan of management. • s4.3 sets out a limited set of appropriate uses for the park and policies and actions to manage impacts from these uses.	• s4.3 lists monitoring priorities including water quality and four-wheel drive access and impacts.
Thirlmere Lakes National Park	• s3.2 lists appropriate recreational use as an objective of the plan of management. • s4.3 sets out a limited set of appropriate uses for the park and policies and actions to manage impacts from these uses.	• The plan of management does not list actions or policies for monitoring of impacts from visitor use.
Wollemi National Park	• s4.1.1 commits to minimise erosion from management activities. • s4.3 list policies and actions to manage impacts from visitor use (including people, vehicles, and horses).	• s4.3 commits to monitor a range of impacts from visitor use within the park.
Yengo National Park	• s3.0 lists maintenance of dispersed, low-impact recreation activities as a management objective. • s4.3 gives management policies and actions for use of the park	• s4.3 lists monitoring actions for the park.
Jenolan Caves Karst Conservation Reserve	• s3.5 sets out policies and actions for managing impacts from visitor use within the reserve.	• Table 5 in s3.5 sets out a range of monitoring processes for impacts associated with visitor use.

The plans of management set out an extensive set of policies and actions to manage impacts from visitors across the GBMWHA. They include actions to limit the areas that are subject to impacts from visitors, manage impacts in areas of frequent visitation, limit visitor numbers in wilderness and key recreation areas, and protect sensitive environments. The plans address impacts to OUV and supporting values.

These policies and actions are considered sufficient to mitigate the existing risk from visitor use and have been developed to manage increasing visitor pressure. Monitoring programs are generally sufficient to inform adaptive management and enable policies and actions to be changed to manage increasing impacts as required. The one exception is Thirlmere Lakes National Park, which does not have a monitoring program for impacts associated with visitor use.

Increased frequency of fires

NSW experienced extensive bushfires throughout the spring and summer of 2019-20. As of 3rd February 2020, the fires had burnt 5.4 million hectares of land (approximately 7 per cent of NSW). This includes 81 per cent of the Greater Blue Mountains World Heritage Area (DPIE, 2020b). Of the fire affected national parks in NSW, 23 per cent were subject to full canopy damage, 36 per cent had partial canopy damage, and for 27 per cent the canopy was unburnt. Note that areas where the canopy was unburnt may have been affected by fire through the understorey (DPIE, 2020b).

The full impact of the fires will not be understood for some time. However, the extent and intensity of the fires will have notably altered or diminished many of the attributes that contribute to OUV within the GBMWHA.

High frequency fire is identified as a key threatening process for all national parks in the GBMWHA.

Currently arson is the most common ignition source for bushfires in the Blue Mountains National Park and escaped campfires and burn offs are also a significant source of fires (35 per cent and 9 per cent respectively) (Hammill & Tasker, 2010). The population increase in Western Sydney associated with the Plan could facilitate an increase in the number of deliberate or accidental fires in the GBMWHA and could increase overall fire frequency in the World Heritage area.

Fire regimes in the GBMWHA are also predicted to be affected by climate change. The recent NSW bushfires may have been exacerbated by climate change. Climate change modelling suggests that dangerous fire conditions will occur more often and over a longer season by 2050 (Hammill & Tasker, 2010). This has the potential to amplify the impacts of deliberate or accidental fires in the GBMWHA.

Potential impacts to Outstanding Universal Value and supporting values

Inappropriate fire regimes could notably diminish or alter all the attributes that contribute to OUV within the GBMWHA. The risk to OUV from fires facilitated by the Plan depends on the location of the fires and their contribution to the broader fire regime. OUV is at risk from:

- Widespread fires in wet sclerophyll forest, especially where those fires burn the canopy
- Frequent (less than five to seven years apart), intense fires, especially where these fires are widespread or in ecosystems with a limited extent within the GBMWHA
- Any intense fires in highly sensitive areas (e.g. Wollemi pine habitat) or rainforest areas
- Intense or widespread fires in refugia areas (including rainforests, wetlands, swamps, and wet sclerophyll forests)

Impacts that notably diminish the integrity of the GBMWHA could result from:

- Frequent fires that degrade the condition of natural bushland in previously undisturbed areas or disrupt the structure and composition of plant communities
- Frequent, intense fires in drought conditions that degrade wetland and swamp environments that regulate water flow
- Fires that damage or degrade culturally sensitive areas

All the supporting values of the GBMWHA are at risk from potential fires facilitated by the Plan, especially from:

- Fires that threaten visitor infrastructure, businesses, or homes in or near the GBMWHA
- Fires that damage cultural or historical sites
- Widespread fires in water catchments, areas of scenic or aesthetic value

- Changes to OUV that follow from increased fire frequency and affect the research, bequest, and existence values of the GBMWHA

Impacts to the protection arrangements for the GBMWHA are not reasonably foreseeable.

Impacts that notably diminish OUV from potential fires facilitated by the Plan are only likely if they burn in sensitive areas or are intense fires that occur too frequently.

Existing management strategies

Fire frequency and intensity and the risk of accidental or deliberate fires are managed within the conservation reserves that make up the GBMWHA. Fuel loads are managed within the GBMWHA and, where appropriate and possible, fires are contained or extinguished to protect human life and property and biodiversity.

Under the Enhanced Bushfire Management Program, NSW NPWS plans to treat over 135,000 hectares per year in 800 or more hazard reduction activities across NSW, including within GBMWHA. Over 1,000 burns were carried out by NPWS in the last 5 years. Achieving this target is dependent on suitable weather conditions for burning safely and effectively.

Climate change is predicted to increase fire seasons and reduce these opportunities and NSW NPWS is continuing to adapt its fire management strategies to a changing climate (Hammill & Tasker, 2010).

The sections in the plans of management for each conservation reserve that discuss management of impacts from fire or monitoring of fire management practices are listed in Table 34-9.

Table 34-9: Management and monitoring of impacts from increased frequency of accidental fires

Conservation Reserve	Management of Impacts	Monitoring
Blue Mountains National Park	• s4.1.5 sets out the fire management policies and actions • The plan of management stands alongside the Blue Mountains National Park Reserve Fire Management Plan	• s4.1.5 and §4.3.10 prioritise research into fire behaviour and effects within the World Heritage area
Gardens of Stone National Park	• s4.1.5 sets out a range of fire management policies and actions to protect threatened species and fire sensitive areas • A fire management plan will be developed for the park	• s4.1.5 encourages research into fire ecology
Kanangra-Boyd National Park	• s4.1.4 sets out a range of fire management policies and actions to protect threatened species and fire sensitive areas • The plan of management stands alongside the Kanangra-Boyd National Park Fire Management Plan	• s4.1.4 encourages research into fire behaviour and ecology
Nattai National Park	• s4.1.4 sets out fire management policies and actions for the park	• s4.1.4 encourages research into fire behaviour and ecology
Thirlmere Lakes National Park	• s4.1.4 sets out fire management policies and actions for the park	• s4.1.4 commits to develop criteria for measure fire regime thresholds and review fire regimes annually
Wollemi National Park	• s4.1.5 sets out fire management policies and actions for the park	• s4.1.5 encourages research into fire behaviour and ecology

Conservation Reserve	Management of Impacts	Monitoring
Yengo National Park	• s4.1.5: NPWS will develop a fire management strategy for the Park including annual hazard reduction burns, assessment of neighbouring farm dams for fire management purposes, and maintenance of management trails	• s4.1.3: NPWS will undertake biodiversity surveys to improve fire management
Jenolan Caves Karst Conservation Reserve	• s3.5 includes policies and actions to manage the risk from accidental fires • s4.2 sets out a range of policies and actions to manage fire in the conservation reserve	• s4.2 includes commitments to monitor fire regimes and their impact on threatened flora

The discussion above shows that fires that could notably diminish OUV fall into two main categories:

- Individual fire events in sensitive areas
- Changes to fire regimes across the GBMWHA

It is possible that population growth associated with the Plan could facilitate an individual fire event that impacts OUV or its supporting values. However, the risk of deliberate or accidental fires in the GBMWHA in sensitive areas is already managed under the existing protection arrangements for the GBMWHA.

Impacts from potential changes to fire regimes across the GBMWHA are more difficult to assess.

Considered in isolation, it is possible that the risk of additional fires facilitated by the Plan could contribute to a broader change in fire regimes across the GBMWHA. This is unlikely and management of fire loads, management of visitor use, total fire bans, and policing of arson are already used to mitigate this risk. Existing monitoring and adaptive management programs are sufficient to manage any increase in this risk facilitated by the Plan.

Climate change is projected to increases the frequency of dangerous fire conditions and has the potential to amplify the impacts of deliberate or accidental fires in the GBMWHA. However, there are many ignition events from existing sources to start fires, and the Plan is unlikely to substantially increase these. It is considered that the existing protection arrangements for the GBMWHA are sufficient to manage the risk of increased fire frequency from the Plan.

Increased spread of introduced plants

A number of introduced plant species are already present in the GBMWHA. Introduced plants are listed as a key management challenge or important threatening process in some of the plans of management for the conservation reserves that make up the GBMWHA. Increased visitor use of the World Heritage area has the potential to introduce weed species or spread existing infestations to new areas through human visitation.

Potential Impacts to Outstanding Universal Value and supporting values

The OUV attributes that support the GBMWHA's outstanding examples of eucalyptus diversification and evolution and diversity of habitats, ecological communities, and species could be notably diminished or altered by:

- Introduction and establishment of weeds in habitats for species and ecological communities that have a limited extent within the GBMWHA
- Infestation of sensitive habitats by introduced plants
- Introduction and establishment of weeds in large areas across the GBMWHA
- Introduction of weeds to highly sensitive areas (e.g. Wollemi pine habitat)

Impacts that notably diminish the integrity of the GBMWHA could result from:

- Spread of or establishment of new weed infestations in undisturbed areas
- Introduction of weeds to culturally sensitive areas

The impacts of introduced plants to the supporting values of the GBMWHA are likely to be limited. Notable impacts could result from:

- Infestation of wilderness areas or popular recreation areas by introduced plants
- Infestation of sensitive historic or cultural sites by weeds

Impacts to the protection arrangements for the GBMWHA are not reasonably foreseeable. Introduced plants are only likely to notably alter or diminish the OUV or supporting values of the GBMWHA following the widespread introduction and establishment of weeds or new weed infestations in sensitive areas. Natural processes can also transfer weeds, which can amplify the impacts of human activity. In particular, weeds are often spread along watercourses. Introduction of weeds in new catchments or riparian corridors presents a greater risk to OUV.

Existing management strategies

All of the conservations reserves except for Thirlmere Lakes National Park note the presence of substantial weed infestations from a range of introduced plant species. These are typically in disturbed areas, areas of grazing land that have been incorporated into the conservation reserves, or along watercourses. All the conservation reserves have plans to manage existing infestations or new outbreaks. The sections in each plan that deal with management and monitoring of introduced plants are given in Table 34-10.

Table 34-10: Management and monitoring of impacts from increased movement of disease and introduced plants

Conservation Reserve	Management of Impacts	Monitoring
Blue Mountains National Park	• s4.1.4 lists management policies and actions for introduced plants.	• s4.1.4 commits to develop an introduced species management database. • s4.3.10 gives priority to research into introduced species.
Gardens of Stone National Park	• s4.1.3 commits to manage introduced plants, with priority given to species that have a high capacity for dispersal.	• s4.1.3 commits to systematically survey introduced plants and monitor weed control programs.
Kanangra-Boyd National Park	• s4.1.3 lists management policies and actions for introduced plants.	• s4.1.3 commits to monitoring of introduced plant management activities.
Nattai National Park	• s4.1.2 commits to manage impacts from introduced plants. • s4.1.5 commits to implement control programs for introduced plants in wilderness areas.	• s4.3.3 prioritises research into management of introduced plants.
Thirlmere Lakes National Park	• s4.1.2 states that current levels of infestation in the park are low and sets out a range of priorities for control of introduced plants in the event of future outbreaks.	• s4.1.2 commits to develop a Pest Species Management Plan for the park.
Wollemi National Park	• s4.1.4 commits to manage impacts from introduced plants.	• s4.1.4 commits to monitor control programs for introduced plants.
Yengo National Park	• s4.1.4 commits NPWS to develop a program for control of weeds, consider strategic burning for Blackberry and other weeds, and survey and control infestations in the Macdonald River and Webbs Creek catchment.	• s4.1.3 commits NPWS to undertake biodiversity surveys to improve management of introduced plants. • s4.1.4 commits NPWS to undertake weed surveys and monitor weed control activities every 2 years.
Jenolan Caves Karst Conservation Reserve	• s4.1 sets out a range of actions and policies to manage introduced plants within the conservation reserve.	• s4.1 commits to monitor introduced plant control activity.

All the plans of management for the conservation reserves within the GBMWHA include policies and actions to manage introduced plants. They all contain commitments to monitor weeds or encourage research into weeds. As visitor pressure on the conservation reserves increases, these monitoring commitments will be sufficient to ensure that management actions and policies can be altered as required.

Removal of bushrock and fallen timber

Bushrock is an important habitat feature for a range of flora and fauna in the GBMWHA. Its removal is identified as one of three key threatening processes in the Blue Mountains National Park Plan of Management (DECC, 2001). Bushrock removal impacts on habitat for a range of species within the World Heritage area and can increase erosion.

The plan of management for the Gardens of Stone National Park also lists illegal collection of fallen timber for firewood as a major threat to vegetation communities (DECC, 2009a). This potential impact is similar in its management and impacts to removal of bushrock and will be included in the discussion below.

Potential impacts to Outstanding Universal Value and supporting values

Collection of bushrock is unlikely to impact any attributes of OUV that relate to eucalyptus diversification and evolution in the GBMWHA. However, without appropriate management, bushrock removal could notably diminish or alter the attributes associated with outstanding diversity of species and ecological communities, especially through:

- Widespread bushrock removal or removal of bushrock or fallen timber from sensitive areas that impacts flora or fauna with a limited extent in the GBMWHA
- Bushrock removal in habitat for threatened species that are dependent on this habitat feature (e.g. the Broad-headed snake (DoE, 2014b))

Impacts that notably diminish the integrity of the GBMWHA are unlikely, but could result from:

- Extensive bushrock removal in undisturbed areas
- Intensive bushrock removal in sensitive areas that impacts the property's geological structure, geomorphology and water systems
- Bushrock removal in culturally sensitive areas

Impacts to supporting values from removal of bushrock are likely to be limited. Impacts could follow from:

- Disturbance of geological features in areas that contribute to the geodiversity of the GBMWHA
- Widespread removal of bushrock that leads to erosion in water catchments

Impacts to the protection arrangements for the GBMWHA are not reasonably foreseeable.

Impacts that notably diminish OUV from bushrock removal and firewood collection are only likely if they occur across many sites or in highly sensitive areas.

Existing management strategies

Bushrock removal is prohibited from all the conservation reserves that make up the GBMWHA. Education and law enforcement has reduced the incidence of illegal bushrock removal, but the practise is still a problem in some easily accessible areas that are remote from management supervision (DECC, 2001). Illegal bushrock removal is managed under all the plans of management for the conservation reserves that make up the World Heritage area. The relevant sections for management and monitoring of impacts are set out in Table 34-11.

Table 34-11: Management and monitoring of impacts from removal of bushrock

Conservation Reserve	Management of Impacts	Monitoring
Blue Mountains National Park	• s4.1.4: Commits to manage bushrock removal	• No specific commitment is made to monitor bushrock removal, but s4.3 commits to monitor a range of impacts at visitor facilities which could include bushrock removal.
Gardens of Stone National Park	• s4.1.2: Education programs in the local community will discourage collection of firewood and bushrock. Signage will be altered to note penalties associated with collection of firewood and bushrock.	• No commitment is made to monitor bushrock removal.
Kanangra-Boyd National Park	• Bushrock removal is not listed as management concern in the plan of management.	• The plan of management does not include monitoring of bushrock removal.
Nattai National Park	• Bushrock removal is associated with unauthorised vehicle access. §4.3.2 sets out a range of policies and actions to limit and manage unauthorised access.	• s4.3.2 commits to supervise and monitor four-wheel drive access.
Thirlmere Lakes National Park	• Bushrock removal is not listed as management concern in the plan of management.	• The plan of management does not include monitoring of bushrock removal.
Wollemi National Park	• s4.1.3 notes that bushrock is "managed reasonably well" within the park. No policies or actions are given for bushrock removal.	• The plan of management does not include monitoring of bushrock removal.
Yengo National Park	• s4.1.3: Notes bushrock removal as a significant threat to reptiles and amphibians in the park. Policies commit to maintain plant and animal diversity and distribution. • s4.1.1: Commits to manage unauthorised use of management trails – a key means of illegal bushrock removal.	• No specific commitments are made to monitor bushrock removal. However, commitments are made to monitor trail use (§4.3.3) and species distributions (§4.1.3) which will capture the main means of bushrock removal and its impacts.
Jenolan Caves Karst Conservation Reserve	• Bushrock removal is not listed as management concern in the plan of management.	• The plan of management does not include monitoring of bushrock removal.

Bushrock removal is recognised as a threatening process for several fauna species within the GBMWHA. It is managed in four of the eight conservation reserves within the GBMWHA. There is no plan to monitor bushrock removal or the key activities that are associated with it (e.g. unauthorised vehicle access) at:

- Gardens of Stone National Park (although the plan of management includes bushrock removal management actions)
- Kanangra-Boyd National Park
- Thirlmere Lakes National Park
- Wollemi National Park
- Jenolan Caves Karst Conservation Reserve

Without appropriate monitoring for this threatening process across the World Heritage area, potential increases in bushrock removal associated with population growth in Western Sydney could impact on the OUV or the supporting values of the GBMWHA. Bushrock removal may not be a serious risk to these reserves, either because of the ecology and landscape of the reserve or the current patterns in visitor use. If visitor use of these reserves changes, it is expected that

the plans of management for these reserves will be updated under existing review processes to include monitoring and other measures as necessary to support best practice management of this threatening process.

Development and maintenance of new visitor facilities or increased maintenance of existing facilities

An increase in visitors to the World Heritage area will increase the demand for and maintenance requirements of a range of facilities and infrastructure, including:

- Information and interpretation centres or signage
- Camping and day use facilities
- Walking tracks
- Roads and parking areas
- Service trails
- Toilets and waste disposal facilities

Facilities and infrastructure are essential for appropriate and sustainable use of the GBMWHA and are often used to manage or mitigate other impacts from visitor use. However, the construction and maintenance of these structures or earthworks can lead to a range of impacts, including:

- Clearing
- Individual mortality
- Altered surface water hydrology and erosion
- Reduced water quality
- Fragmentation and edge effects

Development and maintenance activity in conservation reserves is often required to mitigate or manage impacts from visitor use. NSW NPWS do not have complete control over where development and maintenance activities are required, and these works may be necessary in sensitive areas within the GBMWHA.

Potential impacts to Outstanding Universal Value

Without appropriate management, the cumulative impacts from development and maintenance of visitor facilities could notably alter or diminish the OUV of the GBMWHA. Attributes of OUV that relate to the outstanding examples of eucalyptus diversification and evolution and the diversity of habitats, species and ecological communities could be notably impacted by:

- Impacts across many high-quality or important sites that support examples of eucalyptus diversification and evolution
- Intense impacts over large areas, or in important, sensitive areas especially habitats for species and ecological communities with a limited extent in the World Heritage area
- Any impacts to highly sensitive areas, including habitat for the Wollemi pine

Impacts that notably diminish the integrity of the GBMWHA are unlikely, but could result from:

- Widespread impacts in otherwise pristine environments
- Impacts to culturally sensitive areas

Development of additional visitor infrastructure is likely to have beneficial effects on many supporting values of the GBMWHA. Impacts could result from:

- Impacts in wilderness areas or water catchments
- Widespread impacts in areas of scenic or aesthetic value

Impacts to the protection arrangements for the GBMWHA are not reasonably foreseeable.

Impacts that notably diminish OUV from development and maintenance of visitor facilities are only likely if they occur across many important sites or in highly sensitive areas.

Existing management strategies

The plans of management for the conservation reserves that make up the GBMWHA include a range of measures to limit the impacts from the provision of visitor facilities. These range from limiting the development of new infrastructure to locating infrastructure in appropriate areas and managing impacts from maintenance work. Importantly, the plans of management include possible closures of areas that are subject to intense impacts from visitor use, which allows recovery of these areas without the need for substantial infrastructure. They also set out mitigation measures and controls to ensure any new infrastructure minimises impacts on the supporting values of the GBMWHA.

Table 34-12 gives the relevant sections within each plan of management for management and monitoring of impacts from visitor infrastructure.

Table 34-12: Management and monitoring of impacts from development or maintenance of visitor facilities

Conservation Reserve	Management of Impacts	Monitoring
Blue Mountains National Park	• s4.3 sets out a range of management actions and policies for new and existing visitor infrastructure.	• s4.3.10 sets out monitoring programs for impacts from management facilities and activities.
Gardens of Stone National Park	• s4.3.10 sets out a range of management actions and policies for new and existing visitor infrastructure.	• s4.3 commits to monitor a range of impacts associated with visitor infrastructure around the park.
Kanangra-Boyd National Park	• s4.3.12 sets out a range of management actions and policies for new and existing visitor infrastructure.	• s4.3 commits to monitor a range of impacts associated with visitor infrastructure around the park.
Nattai National Park	• s4.3.4 sets out management action and policies for new and existing visitor infrastructure.	• s4.3 commits to monitor a range of impacts associated with visitor infrastructure around the park.
Thirlmere Lakes National Park	• s4.3 sets out management action and policies for new and existing visitor infrastructure.	• The plan of management does not list actions or policies for monitoring of impacts from new or existing infrastructure.
Wollemi National Park	• s4.3.10 sets out a range of management actions and policies for new and existing visitor infrastructure.	• s4.3 commits to monitor a range of impacts associated with visitor infrastructure around the park.
Yengo National Park	• s4.3.8 sets out policies and actions to minimise impacts from management operations.	• s4.3.8 describes a range of long-term adaptive actions that including monitoring of impacts from management operations.
Jenolan Caves Karst Conservation Reserve	• s5.1 sets out policies and actions to minimise impacts from management operations.	• Table 5 in s3.5 sets out a range of monitoring processes for impacts associated with management activities.

All the conservation reserves within the GBMWHA have actions and policies to manage impacts from new visitor facilities and maintenance of existing facilities. These actions and policies typically include commitments to review infrastructure needs and decommission or upgrade facilities as required. Appropriate monitoring or adaptive management commitments are made at all the conservation reserves except for Thirlmere Lakes National Park. While it is likely that the management arrangements at Thirlmere Lakes National Park are adequate, impacts from visitor use and increased maintenance or new development of visitor facilities and infrastructure should be monitored as appropriate to ensure that management measures can be adjusted to minimise impacts as visitor pressures increase.

34.2.6 CONSISTENCY WITH THE STRATEGIC PLAN

Neither the Plan nor its likely impacts will prevent the achievement of any of the objectives for management of the GBMWHA set out in the Strategic Plan. The likely effects of the Plan on each of the key management issues are discussed in Table 34-13.

Table 34-13: Impacts of the Plan on the management objectives for the GBMWHA

Key management issue and objectives	Likely impacts of the Plan
Integrity • To maintain, and wherever possible, improve the current and future integrity of the GBMWHA.	Current management and monitoring measures are considered sufficient to ensure that the Plan does not undermine or prevent future improvement of the integrity of the GBMWHA.
Major impacts • To reduce the potential for major impacts to adversely affect the integrity of the GBMWHA. Major impacts include mining adjacent to or underlying the GBMWHA, highway construction through the GBMWHA, or other development within or adjacent to the GBMWHA.	The Plan will not have major impacts on the GBMWHA and will not reduce the opportunities to manage or minimise major impacts from other projects.
Biodiversity • To conserve the GBMWHA's biodiversity and ensure the ecological viability and capacity for ongoing evolution of its World Heritage and other natural values is maintained.	Current management and monitoring measures are sufficient to ensure that the Plan does not appreciably impact the biodiversity or ecological viability of the GBMWHA.
Geodiversity • To protect the GBMWHA's geodiversity.	Current management and monitoring measures are sufficient to ensure that the Plan does not appreciably impact the geodiversity of the GBMWHA.
Water catchment protection • To maintain and improve the water quality and water catchment values of the GBMWHA.	Current management and monitoring measures are sufficient to ensure that the Plan does not appreciably impact water quality of the catchment values of the GBMWHA.
Cultural heritage • To identify, formally recognise and protect the cultural heritage values of the GBMWHA. • To manage the GBMWHA jointly with local Indigenous people.	Current management and monitoring measures are sufficient to ensure that the Plan does not appreciably impact cultural heritage values within the GBMWHA. The Plan will not affect joint management of the GBMWHA with local Indigenous people.
Landscape, natural beauty and aesthetic values • To protect the landscape, natural beauty and aesthetic values of the GBMWHA.	The Plan is anticipated to have minor visual impacts along part of the eastern fringe of the GBMWHA. These impacts will not appreciably affect the landscape, natural beauty or aesthetic values of the GBMWHA, which are located elsewhere in the World Heritage area.
Recreation and visitor use • To provide for an appropriate range of recreation and visitor use, consistent with the protection of World Heritage and related values.	The Plan is likely to increase visitor pressures on the GBMWHA. Current management and monitoring measures are sufficient to manage these impacts and ensure an appropriate range of recreation and visitor use opportunities.
Social and economic issues • Consistent with the protection of World Heritage and other values, optimise the potential and existing social and economic benefits derived from visitation to the GBMWHA.	The Plan is likely to enhance the social and economic benefits. Where impacts are possible (e.g. from increasing fire frequency), the current management and monitoring measures are sufficient to manage the risk to social and economic benefits.

Key management issue and objectives	Likely impacts of the Plan
Education, community participation and consultation • To encourage community stewardship of the GBMWHA through education, consultation and the provision of opportunities for community participation in its protection.	The Plan is not anticipated to affect this objective.

The desired outcomes have also been reviewed and found to be not inconsistent with the Plan. There are too many desired outcomes to warrant a detailed discussion here, but they are generally consistent with the objectives for each management issue and thus not affected by the Plan.

34.2.7 CONCLUSION

The potential facilitated impacts of the Plan on the GBMWHA are intensifications of existing threats that are already managed across the conservation reserves that make up the World Heritage area. The management plans for each of the reserves set out a range of management actions and monitoring programs that will support adaptive management of these threats over the life of the Plan. The protection arrangements for each of the conservation reserves and the GBMWHA as a whole are considered adequate to manage the potential facilitated impacts associated with the Plan.

The Plan will not prevent the achievement of any of the objectives or desired outcomes for the management of the GBMWHA set out in the Strategic Plan. It is not inconsistent with the Strategic Plan.

34.2.8 ADDRSSING INTERNATIONAL OBLIGATIONS FOR WORLD HERITAGE

To satisfy requirements under section 146G of the EPBC Act, section 4.7 of the ToR requires the Assessment Report to consider the extent to which the impacts of the Plan are consistent with Australia's international obligations. The World Heritage Convention sets out a broad range of obligations to recognise and protect World Heritage properties and cooperate internationally for the ongoing preservation.

The Plan includes a combination of avoidance and mitigation measures relevant to managing impacts on GBMWHA. As described in Section 34.2.5 and considered further in Chapter 15, the Plan includes commitments to mitigate indirect impacts from development under the Plan (Commitment 5 and Commitment 6).

The Plan also includes an evaluation program (Commitment 25) that provides for public reporting on progress in achieving the commitment and actions, and regular and consistent monitoring and evaluation to inform adaptive management responses. The commitment also includes an action to publish yearly updates over the life of the Plan.

The World Heritage Convention has been considered in the development of the Plan, which includes consideration of avoidance, mitigation and management measures for GBMWHA. The Plan requires information related to the development to be publicly available to ensure equitable sharing of information and improved knowledge relating to the site.

A key test for approval for World Heritage properties is that the outcomes of the Plan are not inconsistent with the property's management plan. Impacts to GBMWHA are unlikely and the Plan is not considered to be inconsistent with the World Heritage Convention.

34.3 PARRAMATTA FEMALE FACTORY AND INSTITUTIONS PRECINCT

The Parramatta Female Factory and Institutions Precinct (the Precinct) is a National Heritage site whose values relate to the history of convict women and institutional care of women and children in Australia.

It is located in North Parramatta, approximately 13 km from the nearest urban capable land or major transport corridor and is unlikely to be impacted by the Plan.

34.3.1 DESCRIPTION OF THE PRECINCT

The Precinct is located between Fleet Street and the Parramatta river in North Parramatta (PFFPA, 2018). Its location is shown in Figure 34-3. The site covers 7.3 ha and contains a range of buildings from the early 19th to late 20th centuries.

Some buildings are still occupied, while others are vacant and dilapidated. The site has served a range of purposes typically related to institutionalisation of women and children, including:

- The Parramatta Female Factory (1821-1847)
- The Parramatta Lunatic Asylum (under various names, 1847-1983)
- The Roman Catholic Orphanage (1844-1886)
- The Parramatta Girls Industrial School (1886-1974)
- The Norma Parker Centre (1974-2008) (DoEE, 2019)

After several name changes, the site of the Parramatta Lunatic Asylum was renamed the Cumberland Hospital in 1983. The Cumberland Hospital and the NSW Institute of Psychiatry continue to operate at the site.

34.3.2 EPBC ACT APPROVAL CONSIDERATIONS

The Parramatta North Historic Sites Consolidated Conservation Management Plan (TKD Architects, 2017) meets the conditions of Section 146H of the EPBC Act for a plan of management for this National Heritage place. It sets out a range of principles for management of heritage values at the site. These principles prioritise:

- The need to understand, retain, protect, and communicate heritage values at the site
- Application of best-practise heritage management guidelines including ensuring that works at the site are carried out by appropriately skilled and experienced people
- Community engagement in the management and care of the site

To meet the requirements of the EPBC Act, the Plan must not make it impossible to follow these principles or meet their aims.

34.3.3 HERITAGE VALUES

The Precinct meets three criteria for National Heritage listing:

- Criterion A Events, Processes
- Criterion B Rarity
- Criterion C Research

The Precinct provides insight into the experiences of women and children, particularly convict women, in institutions over 150 years of Australian history. It reflects government attitudes to vulnerable women and children and the role of institutions in the welfare system over 150 years. It is a physical locus of the stories of women and children who were institutionalised and whose experiences have often been dismissed or disbelieved (DoEE, 2019).

There are limited examples of sites associated with convict women in Australia. Nine of 12 female factories have been completely demolished. The presence of original buildings and walls in the Precinct and its connection to the history of convict women and institutionalised women and children make the site outstandingly valuable to the nation (DoEE, 2019).

Further archaeological study within and around the Precinct has the potential to reveal more about the lives of convict women and the history of institutional care (DoEE, 2019).

The heritage values for the Precinct are expressed in the remaining physical fabric of the precinct including the buildings, grounds and walls of the Female Factory, Roman Catholic Orphanage, Parramatta Girls Industrial School, The Norma Parker Centre and the Cumberland Hospital (DoEE, 2019).

34.3.4 POTENTIAL IMPACTS FROM THE PLAN

The Precinct is over 13 km from the urban capable land or major transport corridors in an existing urban area. Its heritage values are expressed in structures and areas that are unlikely to be susceptible to indirect or facilitated impacts. It is unlikely that there will be any impacts to the National Heritage values of the Precinct as a result of implementation of the Plan. The Plan will not prevent the application of any of the principles from the management plan for this National Heritage place, nor will it prevent the management plan from achieving its aims.

34.3.5 CONCLUSION

There are unlikely to be any notable impacts to the National Heritage values of the Parramatta Female Factory and Institutions Precinct as a result of the Plan. The Plan is not inconsistent with the plan of management for National Heritage values at this site.

34.4 OLD GOVERNMENT HOUSE AND THE GOVERNMENT DOMAIN

Old Government House and the Government Domain is World and National Heritage place in North Parramatta. Its buildings and open spaces played a role in the early government and agriculture of colonial Australia and have been recognised as having heritage value (DoEE, 2019). The site is over 12 km from the nearest urban capable land or major transport corridor and unlikely to be impacted by the Plan.

34.4.1 DESCRIPTION OF THE HERITAGE PLACE

The Government Domain covers an area of 85 ha and contains buildings, memorials, relics, historic plantings, and archaeological sites. It is mostly made up of open, grassy areas and includes patches of native vegetation. These open spaces were the site of early colonial agriculture including some of the first successful crops in Australia (DoEE, 2019). Its location is shown in Figure 34-3.

Situated at the southern end of the Government Domain, Old Government House is the site of the first governor's residence in Parramatta. The first governor's cottage was constructed in 1790 and the house and its surrounding buildings were variously extended, renovated and replaced over the next 65 years. The house ceased to be used as an official residence, fell into disrepair, and was leased out in 1856. It was extensively restored and renovated in 1909 when the building was repurposed as a school. It was acquired by the National Trust in 1967, which has undertaken a range of restoration works to return the house to the configuration that was used by Governor Macquarie. The house and surrounding grounds is now used as a museum (DoEE, 2019).

34.4.2 EPBC ACT APPROVAL CONSIDERATIONS

The key management document for this World Heritage property is the Old Government House and Domain, Parramatta Park Management Plan (PPT, 2009). This document serves as a management plan under Section 146G of the EPBC Act.

The management plan sets out a range of policies for management of World Heritage and National Heritage values at the site. Summarised, these policies have the following objectives:

- Manage the landscape, buildings, and other structures at the site to conserve their historical values, ensuring maintenance, new works and repairs maintain or restore the historical character of the site
- Ensure the Government Domain grounds are primarily used for recreation, sport and entertainment, and that use of Old Government House enhances and facilitates understanding of its history and significance
- Restore, protect and maintain natural systems within the site
- Maintain historical views and the infrastructure at and around the site to preserve the character of the site
- Promote and enable research at the site

To meet the requirements of the EPBC Act, the Plan must not prevent the achievement of any of these objectives.

34.4.3 HERITAGE VALUES

Old Government House and the Government Domain meets four criteria for National Heritage listing:

- Criterion A Events, Processes
- Criterion C Research
- Criterion D Principal characteristics of a class of places
- Criterion H Significant people (DoEE, 2019)

It is also one of 11 convict sites across Australia that are jointly listed as a World Heritage place, under two criteria:

- Criterion (iv): recognising the importance of these buildings to the system of deportation and forced labour that contributed to the British Empire's colonial project
- Criterion (vi): recognising that these sites are an outstanding example of the transportation of convicts to colonial lands and reflect the history of attitudes to penal, political, and colonial systems in contemporary and modern Europe (UNESCO, 2018a)

The site is a tangible link with the earliest days of colonial history in Australia which has been recognised as having outstanding heritage value for all Australians. Old Government House is the oldest surviving public building in mainland Australia and contains:

- Brick floors from the 1790 cottage of Governor Phillip
- Rooms dated to 1799, constructed by order of Governor Hunter
- Rooms dated to 1818, constructed by order of Governor Macquarie (DoEE, 2019)

The house, surrounding buildings, relics and open areas are examples of convict workplaces and important sites in the foundation of British settlement in Australia. These areas have the potential to yield further insight through archaeological research (DoEE, 2019).

The Government Domain contains historic agricultural areas (an area called "the Crescent"), a dairy, a bathhouse, a Boer War Memorial, carriageways and gatehouses, and the remains of Governor Brisbane's astronomical observatory. These elements reflect Australia's development from a penal colony dependant on Great Britain to a self-governing nation. Old Government House provides evidence of the development of early administration in the colony (DoEE, 2019).

Old Government House and the Government Domain provide a connection to the life and work of Australia's early colonial governors. The house and surrounding buildings provide insight into Governors Phillip, Hunter, King, Macquarie, and Brisbane, who all lived and worked at the site (DoEE, 2019).

34.4.4 POTENTIAL IMPACTS FROM THE PLAN

Old Government House and the Government Domain is over 12 km from the urban capable land or major transport corridors in an existing urban area. Its heritage values are expressed in structures and areas that are unlikely to be susceptible to indirect or facilitated impacts.

The *Conservation Agreement for the protection and conservation of the World Heritage Values and National Heritage Values of the Australian Convict Sites, Old Government House and Domain, Parramatta New South Wales* notes possibility of impacts to the landscape values of the sites from development in nearby urban areas (DoE, 2013a), but the urban capable land and major transport corridors are well outside the range of possible visual impacts.

It is unlikely that there will be any impacts to the National Heritage values of Old Government House and the Government Domain as a result of the Plan. The Plan will not prevent the achievement of any of the objectives from the management plan for this property.

34.4.5 CONCLUSION

There are unlikely to be notable impacts to the World or National Heritage values of Old Government House and the Government Domain as a result of the Plan. The outcomes of the Plan are not inconsistent with the management plan for the property.

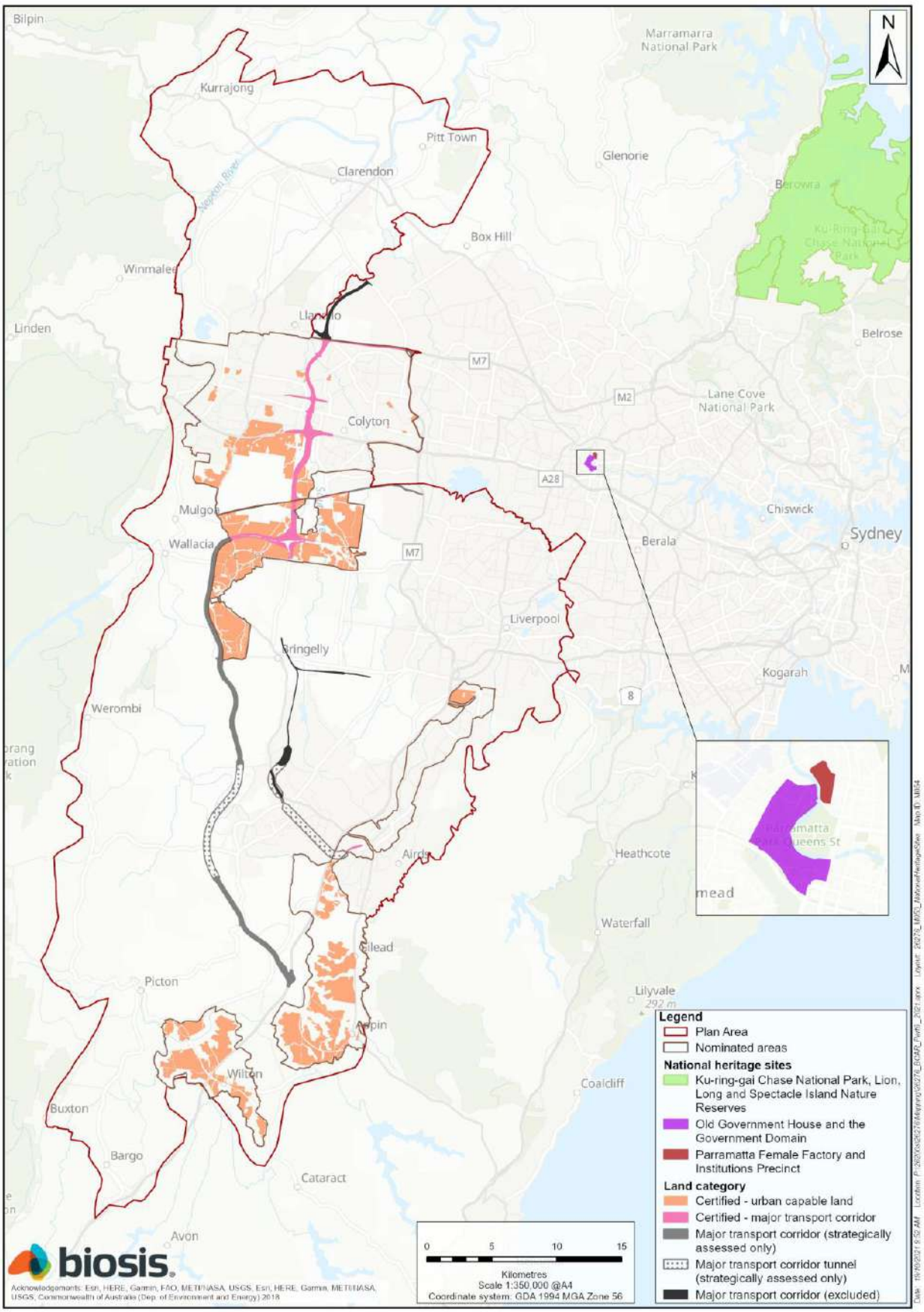

Figure 34-3: The location of Parramatta Female Factory and Institutions Precinct, Old Government House and the Government Domain

35 Commonwealth land impact assessment

This Chapter assesses the potential impacts to Commonwealth land from the Plan. It provides:

- An introduction (Section 35.1)
- A description of the assessment approach for Commonwealth land (Section 35.2)
- An assessment of the potential impacts to each Commonwealth land site within the Strategic Assessment Area (Section 35.3)
- An overview of how the Plan addresses the risks associated with PFAS (Section 35.4)

35.1 INTRODUCTION

Commonwealth land is a matter protected under Section 26 of the EPBC Act. There are 12 known Commonwealth land sites within the Strategic Assessment Area (see Map 35-1), excluding Shanes Park.

This Chapter provides an assessment of potential impacts to the environment on this land from the urban and industrial development, infrastructure, intensive plant agriculture, and major transport corridors under the Plan.

The impact assessment has been based on desktop information and framed around the Commonwealth's *Significant Impact Guidelines 1.2 – Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies* (DSEWPC, 2013). The assessment provides an understanding of the range of environmental values on each site.

Three of the 12 Commonwealth land sites occur within the nominated areas:

- Site 3 in GPEC
- Site 4 in GMAC
- Site 5 in GPEC

None of these sites will be directly impacted by urban and industrial development, infrastructure, and intensive plant agriculture.[2]

Potentially only one site (Site 10) will be directly impacted by development – by the major transport corridors outside the nominated areas. However, three other sites – Site 4 (Western Sydney University), Site 6 (Camden Airport), and Site 7 (a small site at Grasmere) – may also be directly impacted by the tunnels associated with the transport corridors. The tunnels extend under these sites and some disturbance to the land surface within these sites may be necessary for construction activities and permanent infrastructure.

While all Commonwealth sites are potentially at risk from indirect and facilitated impacts, the likelihood of many of these impacts varies significantly between sites, and this largely depends on each site's proximity to the urban capable land and major transport corridors in the context of that impact. For example, construction of the development is very unlikely to cause any indirect impacts to Commonwealth sites that are distant (many km) from construction areas.

[2] For three of these sites, GIS analysis suggests there are very small direct impacts, as follows:

- Site 4 – 0.3 ha along the southern boundary of the site
- Site 5 – 0.001 ha along the northern and eastern boundary of the site
- Site 8 – 0.1 ha along the northern and western boundaries of the site

Inspection of aerial photos and cadastre boundaries shows that there are slight errors with the GIS spatial data of the boundaries of the urban capable land and major transport corridors in these areas and direct impacts will not occur to these sites.

35.1.1 SHANES PARK

Shanes Park is an area of bushland that was historically Commonwealth land that occurs along the northern boundary of GPEC (north of Willmot). The M7/Ropes Crossing Link Road will directly impact approximately 4.7 hectares of native vegetation in Shanes Park, comprising Commonwealth-listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

On 26 September 2021, the NSW Government announced that Shanes Park will become a new State National Park. It will be managed to exclude feral predators and a range of native animals will be reintroduced. Given that the park has (or will imminently be) transferred from the Commonwealth to the State it is not discussed further in this chapter. The potential impacts on TECs and species within Shanes Park are addressed in Chapters 29, 30 and 31.

35.2 ASSESSMENT APPROACH

35.2.1 COMMONWEALTH ASSESSMENT CRITERIA

There are 12 Commonwealth land sites in the Strategic Assessment Area.

Under the EPBC Act, an assessment of impacts to Commonwealth land needs to consider the whole of the environment, which is much broader than MNES. Environment in this context is defined under Section 528 to include:

- Ecosystems and their constituent parts, including people and communities; and
- Natural and physical resources; and
- The qualities and characteristics of locations, places, and areas; and
- Heritage values of places; and
- The social, economic, and cultural aspects of a thing mentioned in paragraph (a), (b), (c) or (d).

Direct, indirect and facilitated impacts have been assessed for the 12 Commonwealth land sites in the Strategic Assessment Area using the Commonwealth's *Significant Impact Guidelines 1.2* (DSEWPC, 2013). The sites have been described and assessed against the list of matters required to be considered in the guidelines, including:

- Landscapes and soils
- Water resources
- Biodiversity values – vegetation and plant and animal species
- Conservation and special use areas
- Heritage values
- Services and infrastructure/people and communities

35.2.2 DATA SOURCES

The assessment in this Chapter is based on the desktop information outlined in Table 35-1. Profiles for each of the 12 Commonwealth land sites have been generated from this information (see sections 35.3.1 to 35.3.12).

The limitations in the data for Commonwealth land are similar to the limitations for the Assessment Report generally (see Chapter 13). Key limitations include:

- Ground truthing was not generally undertaken as part of the impact assessment for Commonwealth land
- Impacts on species are based on potential habitat mapping which is likely to greatly over-predict the extent of actual habitat (see Part 3, Chapter 11)

Table 35-1: Data sources for the Commonwealth land assessment

Data type	Data source
General	• Unclipped spatial data of Commonwealth land in the Strategic Assessment Area provided by the Commonwealth of Australia • Existing reports and statutory documents such as the Biodiversity Offset Delivery Plan for Western Sydney, Liverpool Biodiversity Management Plan, Holsworthy MUR Project, Western Sydney Airport EIS, Local Environmental Plans • Information generated as part of the broader strategic assessment for MNES, including species habitat mapping across the Cumberland subregion, Strategic Assessment Area boundary, and the urban capable land and major transport corridors
Soils	• Area of soil landscapes from eSPADE v2.0 (OEH, 2018).
Waterways and topography	• Mapped watercourses and waterbodies in NSW from the *Water Management (General) Regulation 2018* hydroline spatial data 1.0

Vegetation	• Vegetation mapping for this project:
	  ○ Vegetation mapping for this project within the nominated areas
	  ○ EPBC TEC mapping for this project across the Cumberland subregion
	• Existing vegetation mapping:
	  ○ Remnant Vegetation of the Western Cumberland Subregion 2013 Update VIS_ID 4207 (OEH, 2013)
	  ○ The Native Vegetation of the Sydney Metropolitan Area VIS_ID 4489 (OEH, 2016)

Fauna and flora	• Threatened flora and fauna records from Atlas of NSW Wildlife (BioNet) • Important populations spatial data provided by Biosis and created from BioNet records • Commonwealth SPRAT database • NSW Threatened Species Profiles • OEH Threatened Biodiversity Data Collection • Recovery plans and conservation advices
Heritage	• World, Commonwealth and National heritage list and Register for the National Estate information from the Australian Heritage Database • NSW Heritage information from the Office of Environment and Heritage website • World, Commonwealth, and National heritage list spatial data from the Department of Environment and Energy database • Register for the National Estate (non-statutory) spatial data from the Department of Environment and Energy database • State Heritage Register (curtilages & centroids) from the NSW SEED database
Landscape context	• Area of priority conservation lands (PCLs) from the NSW SEED database • Area of core and corridors from the Biodiversity Investment Opportunities Map (BIO Map)

35.3 ASSESSMENT OF IMPACTS TO EACH SITE

35.3.1 SITE 1 (RAAF TRANSMITTING STATION)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	RAAF Transmitting Station
Site ID number	1
Area	63.3 ha
Address	419-499 Londonderry Road, Londonderry NSW
Folio	1/598180, 1/91240
General description	Site 1 is located at 419-499 Londonderry Road, Londonderry. Based on available information, the site has limited ecological value. A main building with four smaller outhouses is located in the south-west corner of the site. It is located within the Strategic Assessment Area approximately 50 km north-west of the Sydney CBD
Site map	The location of Site 1 is shown in Map 35-2
DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS	
Site 1 is located approximately 9 km from the nearest development under the Plan	
LANDSCAPES AND LANDFORMS	
The site occurs in a gently undulating low rise landscape on Tertiary terraces of Hawkesbury-Nepean River system	
SOIL AND SUBSTRATES	
The soil landscape is made up of Berkshire Park soil. Berkshire Park soil consists of heavy clays and clayey sands that are made up of less than a third of soil aggregates (OEH, 2018)	
WATER	
The site has a first order watercourse that flows from north-south through the north-east corner of the site. It is a tributary of Rickabys Creek (DoI, 2019; DTA, DCA et al., 2019) The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018)	
VEGETATION	
The site is largely unvegetated other than a narrow strip of vegetation that forms part of a riparian corridor, connecting with larger areas of vegetation to the north and east of the site Approximately 1.1 ha (or 1.7 per cent of the site) has been mapped as native vegetation	

Plant Community Types (PCTs)/NSW listed threatened ecological communities (TECs)

PCT number	PCT name	NSW TEC name	BC Act status	Area (ha)
724	Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Shale Gravel Transition Forest in the Sydney Basin Bioregion	Endangered	0.3
725	Broad-leaved Ironbark – Melaleuca decora shrubby open	Cooks River/Castlereagh	Endangered	0.0

	forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Ironbark Forest in the Sydney Basin Bioregion		
883	Hard-leaved Scribbly Gum – Parramatta Red Gum healthy woodland of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion Castlereagh Swamp Woodland Community	Vulnerable Endangered	0.4
1067	Parramatta Red Gum on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Swamp Woodland Community	Endangered	0.4

Commonwealth listed threatened ecological communities (TECs)		
Commonwealth TEC name	**EPBC Act status**	**Area (ha)**
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	0.1
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	<0.1
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	0.2

Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of potential habitat (ha)**	**Number of BioNet records**
Dillwynia tenuifolia	Vulnerable (BC Act)	0.0	1
Persoonia nutans (Nodding Geebung)	Endangered (BC Act & EPBC Act)	63.3	1
Acacia bynoeana (Bynoe's Wattle)	Vulnerable (BC Act) Endangered (EPBC Act)	56.1	0
Micromyrtus minutiflora	Endangered (BC Act) Vulnerable (EPBC Act)	63.3	0
Persoonia hirsuta (Hairy Geebung)	Endangered (BC Act & EPBC Act)	0.6	0
Pimelea spicata (Spiked Rice-flower)	Endangered (BC Act & EPBC Act)	1.4	0
Pomaderris brunnea (Brown Pomaderris)	Endangered (BC Act) Vulnerable (EPBC Act)	0.4	0
Pultenaea parviflora	Endangered (BC Act) Vulnerable (EPBC Act)	21.8	0

BIO Map Priority Investment Areas
No BIO Map core or corridor areas have been identified on this site
ANIMAL SPECIES
There is one threatened species record known from the site – Cumberland Plain Land Snail

Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of potential habitat (ha)**	**Number of BioNet records**
Litoria aurea (Green and Golden Bell Frog)	Endangered (BC Act) Vulnerable (EPBC Act)	7.9	0

Pommerhelix duralensis (Dural Land Snail)	Endangered (BC Act & EPBC Act)	49.3	0
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	0.1	0
Petauroides volans (Greater Glider)	Vulnerable (EPBC Act)	0.8	0
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	1.1	0
Dasyurus maculatus maculatus (Spot-tailed Quoll)	Vulnerable (BC Act) Endangered (EPBC Act)	0.8	0
Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	1.1	0
Meridolum corneovirens (Cumberland Plain Land Snail)	Endangered (BC Act)	0.0	1
CONSERVATION AND SPECIAL USE AREAS			
There are no conservation or special use areas present on this site The closest conservation or special use areas are: • Western Sydney University EucFACE experiment site (approximately 1.4km north) • Agnes Banks Nature Reserve (approximately 3km west) • Castlereagh Nature Reserve (approximately 3km south)			
HERITAGE PLACES AND ITEMS			
It is not known whether the site has any historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having heritage values			
SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES			
The site is a former RAAF transmitting station and appears to be no longer in use Medium density urban housing borders the southern edge of the site, while low density rural lots border the north, east and part of the western edge of the site No mining or petroleum tenements exist on this site (NNTT, 2020) No Native Title Claims exist over this site (NNTT, 2020)			

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 1 due to the Plan.

Indirect and facilitated impacts

Site 1 occurs approximately 9 km from the nearest development under the Plan – urban and industrial development and transport development within GPEC. The site is also located upstream of the nearest development and within a separate sub-catchment. The location of the site relative to the development means:

- The site is very unlikely to be impacted by impacts typically associated with construction of the development in GPEC, such as air quality, noise, construction traffic, or the spread of weeds or disease
- The site will not be impacted by soil erosion of sedimentation, changes to surface and groundwater quantity and flows, or water quality impacts associated with the construction and operation of the development

Furthermore, the site no longer appears to be in use. If this is the case, the development would not disrupt any services or infrastructure or affect the health or safety of any person associated with the site.

The potential indirect or facilitated impacts associated with the development in GPEC and the key values of the environment of Site 1 that are potentially impacted are shown in Table 35-2.

Table 35-2: Potential indirect impacts on Site 1 associated with the development

Potential indirect impact	Extent within site 1	Duration	Values of site potentially impacted
Construction			
Clearing of habitat during construction of the development that links the site to other areas of habitat, leading to impacts on biodiversity values	Whole of site	Long term	Biodiversity values

Biodiversity values

There is a small amount of potential habitat for native species at Site 1, primarily associated with the riparian corridor on the site. This riparian corridor is connected to vegetation within the surrounding area and also to the Hawkesbury River.

The connectivity of this riparian corridor to the surrounding area will not be directly impacted by development under the Plan, and therefore the habitat values of the site are unlikely to be impacted indirectly by the Plan.

Commitments and mitigation measures

No commitments or mitigation measures are considered necessary to address the potential indirect impacts on the environment of Site 1 from the development under the Plan.

35.3.2 SITE 2 (RICHMOND AIR BASE)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	RAAF Richmond Air Base and surrounding area
Site ID number	2
Area	379.1 ha
Address	115 Dight St, Richmond NSW 5 Wood St, Richmond NSW 24-162 Percival St, Clarendon NSW
Folio	197/824047, 2/90072, 196/824045, 1/616709, 5-67244683, 11-13/563483, 1-3/572977
General description	Site 2 is made up of several lots of land located adjacent to each other at the addresses given above. Approximately 1.2 per cent of the site is covered by vegetation. The southern part of the site is comprised of a landing strip with aeroplane hangars and other smaller buildings located towards the north-east of the site. The part of the site located on Percival street appears to mostly comprise exotic grassland with a few buildings located in the north west corner The site is used as a Royal Australian Airforce (RAAF) base. It is located approximately 47 km north-west of the Sydney CBD, within the Strategic Assessment Area
Site map	The location of Site 2 is shown in Map 35-3
DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS	
Site 2 is located over 12 km from the nearest development under the Plan	
LANDSCAPES AND LANDFORMS	
The site is mostly flat and occurs on the terraces and floodplain of the Nepean River	
SOIL AND SUBSTRATES	
The soil landscape of Site 2 is made up of: • 85.9 ha of Freemans Reach soil – Freemans Reach soil consists of deep brown sands and loams on the active floodplain of the Nepean River • 292.8 ha of Richmond soil – Richmond soils consist of orange to red clay loams, clays, and sands that are poorly structured (OEH, 2018) • < 1 ha of Upper Castlereagh soil – Upper Castlereagh soil consists of apedal sandy clay loam or fine sandy clay loam overlying light medium clay	
WATER	
The site is bordered on the eastern side by Rickabys Creek, a minor perennial creek. Two canal lanes occur in the east of the site and drain into Rickabys Creek The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018)	
VEGETATION	
There is 5 ha of native vegetation on the site and the vegetation is relatively isolated from other areas of vegetation	

Plant Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)				
PCT number	**PCT name**	**NSW TEC name**	**BC Act status**	**Area (ha)**
781	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	1.8
		Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Endangered	
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvium flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	3.3

Commonwealth listed threatened ecological communities (TECs)		
TEC name	**EPBC Act status**	**Area (ha)**
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria	Critically Endangered	3.3

Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Acacia bynoeana (Bynoe's Wattle)	Vulnerable (BC Act) Endangered (EPBC Act)	54.3	0
Micromyrtus minutiflora	Endangered (BC Act) Vulnerable (EPBC Act	0.3	0
Pimelea spicata (Spiked Rice-flower)	Endangered (BC Act & EPBC Act)	0.7	0
Pomaderris brunnea (Brown Pomaderris)	Endangered (BC Act) Vulnerable (EPBC Act)	2.5	0
Pultenaea parviflora	Endangered (BC Act) Vulnerable (EPBC Act)	1.9	0

BIO Map Priority Investment Areas	
A small area (0.5 per cent) of Richmond air base has been identified as a BIO Map corridor	
Type	**Area (ha)**
Core areas	0
State and Regional Biodiversity Corridors	2

ANIMAL SPECIES
Records of two threatened fauna species occur on the site It is likely that some common, urban-adapted native fauna species inhabit or move through the site, based on the presence of PCTs and condition/quality of the vegetation described above

Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Litoria aurea (Green and Golden Bell Frog)	Endangered (BC Act) Vulnerable (EPBC Act)	2.2	0
Pommerhelix duralensis (Dural Land Snail)	Endangered (BC Act & EPBC Act)	163.5	0
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	2.1	0
Botaurus poiciloptilus (Australasian Bittern)	Endangered (BC Act & EPBC Act)	1.5	0
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	3.3	0
Rostratula australis (Australian Painted Snipe)	Endangered (BC Act & EPBC Act)	1.8	0
Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	3.3	0
Ephippiorhynchus asiaticus (Black-necked Stork)	Endangered (BC Act)	0.0	1
Glossopsitta pusilla (Little Lorikeet)	Vulnerable (BC Act)	0.0	1
Hirundapus caudacutus (White-throated Needletail)	Vulnerable (EPBC Act)	0.0	1

CONSERVATION AND SPECIAL USE AREAS

There are no conservation or special use areas present on this site

The closest conservation or special use areas are:

- Windsor Downs Nature Reserve (approximately 3.5 km south)
- Pitt Town Nature Reserve (approximately 4.5 km north east)

HERITAGE PLACES AND ITEMS

A large part of the site is listed as a historic place on the Commonwealth Heritage List (place ID 105653) and is also registered as a historic place on the Register of the National Estate (non-statutory) (place ID 102845) as *RAAF Base Richmond*. The site meets six of the nine Commonwealth Heritage List listing criteria (DoEE, 2019):

- Criterion A (Process): the site is associated with a number of events and cultural phases that have been significant in the development of the Royal Australian Air force
- Criterion B (Rarity): the site demonstrates the design and construction of Australia's first purpose built military air force base under British influences in the 1930s
- Criterion D (Characteristic value): the site includes features that demonstrates the principal characteristics (design, layout, architectural style) of the first purpose built military air force base under British influences in the 1930s
- Criterion E (Aesthetic characteristics): parts of the site are valued in the wider community for its cultural, aesthetic and social associations
- Criterion F (Technical achievement): the site illustrates the achievements of the Commonwealth architectural staff in the 1930s
- Criterion G (Social value): parts of the site are valued in the wider community for its cultural, aesthetic and social associations

It is not known whether the site has any other historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having other heritage values

SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES
The site is an RAAF air base. It operates the majority of the RAAFs fixed wing aircraft. It includes a single 2,134 m runway. The base includes the headquarters building of the 36th and 37th Squadron. The base also serves as the headquarters for the Air Lift Group, and houses the following wing units: No. 84 Wing (air-to-air refuelling), No. 86, No. 37 (transport), No.44 (air traffic control), No. 1 (combat communication), No. 22 (air force reserve), No. 87 (photography), No. 285 (flight simulator) and No. 3 (combat support hospital) No mining or petroleum tenements exist on this site (NNTT, 2020) No Native Title Claims exist over this site (NNTT, 2020)

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 2 due to the Plan.

Indirect and facilitated impacts

Site 2 occurs over 12 km from the nearest development under the Plan – urban and industrial development and transport development within GPEC. The site is also located upstream of the nearest development and within a separate sub-catchment. The location of the site relative to the development means:

- The site is very unlikely to be impacted by impacts typically associated with construction of the development in GPEC, such as air quality, noise, construction traffic, or the spread of weeds or disease
- The site will not be impacted by soil erosion of sedimentation, changes to surface and groundwater quantity and flows, or water quality impacts associated with the construction and operation of the development

The potential indirect or facilitated impacts associated with the development under the Plan and the key values of the environment of Site 2 that are potentially impacted are shown in Table 35-3.

Table 35-3: Potential indirect impacts on Site 2 associated with the development

Potential indirect impact	Extent within site 1	Duration	Values of site potentially impacted
Construction			
Clearing of habitat during construction of the development that links the site to other areas of habitat, leading to impacts on biodiversity values	Whole of site	Long term	Biodiversity values
Operation			
Disruption to land uses, services or infrastructure	Whole of site	Long term	People and communities

Biodiversity values

Although Site 2 is mostly cleared, there are small areas of vegetation present which provide some habitat values for several species, including two species of threatened birds. It is likely that some common, urban-adapted native fauna species inhabit or move through the site, based on the presence of PCTs and condition/quality of the vegetation.

Approximately 2 ha of vegetation on the site is part of a BIO Map corridor (OEH, 2015) and is therefore considered to be important for landscape connectivity in the region. The main connectivity from the site to other areas of habitat comprises the riparian corridor associated with the Hawkesbury River. The site is also marginally connected to Castlereagh Nature Reserve to the south along Rickabys Creek.

The development under the Plan will not disrupt these two main habitat connectivity links from the site to the surrounding area, and therefore the habitat values of the site are unlikely to be impacted indirectly by the Plan.

People and communities

Increased populations associated with urban development under the Plan has the potential to disrupt the services provided by the site as a RAAF base due to:

- The potential need to reduce noise impacts from aircraft in new residual areas
- Increased pressure on roads, transport and other infrastructure that service the site

These potential indirect impacts are considered unlikely.

Many existing urban areas surround Site 2, including the University of Western Sydney Hawkesbury campus, and the site already has in place policies and procedures to minimise noise to surrounding urban areas (Department of Defense, 2020c). The majority of the flying training occurs in designated training areas to the north west of the base. These areas are situated predominantly over semi-rural, rural and farming areas of the Blue Mountains region minimising the time that aircraft spend over residential areas (Department of Defense, 2020c). Noise modelling shows the areas most affected by aircraft noise (Australian Noise Exposure Forecast levels > 20) are limited to areas in the vicinity of the site and distant from the nearest urban development in GPEC (Department of Defense, 2020b).

The Plan addresses the issue of increased pressure on roads, transport and other infrastructure that service Site 2 to some extent by supporting the delivery of major transport projects for Western Sydney. It is also expected that future transport and other infrastructure needs will be further provided for through future planning processes.

Commitments and mitigation measures

No commitments or mitigation measures are considered necessary to address the potential indirect impacts on the environment of Site 2 from the development under the Plan.

35.3.3 SITE 3 (PENRITH TRAINING DEPOT)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	Penrith Training Depot
Site ID number	3
Area	3.7 ha
Address	10 The Crescent, Penrith NSW
Folio	10/1159973
General description	This site is the Penrith Training Depot that houses a sub-unit of the 5th Combat Engineer Squadron. The site is located at 10 The Crescent, Penrith NSW. The site is mostly unvegetated and comprises five groups of buildings. A rail corridor borders the southern side of the site. The site is located in the Strategic Assessment Area in Penrith, approximately 50 km north-west of the Sydney CBD
Site map	The location of Site 3 is shown in Map 35-4
DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS	
Site 3 is located approximately 0.8 km from nearest development under the Plan. Site 3 is surrounded by large areas of existing urban and/or commercial development and is not directly connected to any substantial vegetation corridors or habitat patches	
LANDSCAPES AND LANDFORMS	
The site occurs mainly in a flat landscape the Quaternary terraces of the Nepean and Georges River with a small area of the site transitioning to undulating rolling low hills	
SOIL AND SUBSTRATES	
The soil landscape of Site 3 is made up of: • < 1 ha Luddenham soil – Luddenham soils exist in varying forms depending on their location on a slope. Podzolic soils or earthy clays, yellow podzolic soils, and prairie soils are found on crests, upper slopes, and drainage lines respectively (OEH, 2018) • 3.2 ha Richmond soil – Richmond soils consist of orange to red clay loams, clays, and sands that are poorly structured (OEH, 2018)	
WATER	
The site is flat and contains no watercourses or waterbodies (DoI, 2019; DTA, DCA et al., 2019) The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018)	
VEGETATION	
The site is largely unvegetated and isolated from other areas of vegetation. Inspection of aerial photos shows scattered trees along the northern and eastern edges of the site. No Commonwealth-listed TECs are mapped as occurring on site	

Plant Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)				
PCT number	**PCT name**	**NSW TEC name**	**BC Act status**	**Area (ha)**
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	0.3

Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Acacia pubescens (Downy Wattle)	Vulnerable (BC Act & EPBC Act)	0.3	0
Dillwynia tenuifolia	Vulnerable (BC Act)	0.1	0

BIO Map Priority Investment Areas

No BIO Map core or corridor areas have been identified on this site

ANIMAL SPECIES

There are several records of Grey-headed Flying Fox known from the site

Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	0.3	0
Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	0.3	0
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	0.0	14 (wires records)

CONSERVATION AND SPECIAL USE AREAS

There are no conservation or special use areas present on this site

The closest conservation or special use areas are:

- Wianamatta Regional Park/Metro offset site (approximately 2.5km north east)
- Mulgoa Nature Reserve (approximately 4.5km south west)
- Blue Mountains National Park (approximately 4.5km south west)

HERITAGE PLACES AND ITEMS

While not registered as a heritage site under the *Penrith Local Environment Plan 2010*, Site 3 has some heritage values in association with its use as a military depot facility from World War 2 up to the Vietnam War and was the main engineering depot of the Eastern Command from 1943. During much of this time, Thornton Hall, a residence located near the site which was constructed in the 1870's, was used as the Commanding Officer's quarters (OEH, 2020)

It is not known whether the site has any other historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having heritage values

SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES

The site is a multi-user depot that is surplus to Defence capability requirements and is being prepared for sale in the 2020-21 financial year (Department of Defense, 2020a). The site contains 1 large building, 3 medium sized buildings and 10-11 small structures scattered across the site

No mining or petroleum tenements exist on this site (NNTT, 2020)

No Native Title Claims exist over this site (NNTT, 2020)

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 3 due to the Plan.

Indirect and facilitated impacts

Site 3 is located within a high density existing urban/commercial district within Penrith, approximately 0.8 km from the nearest urban capable land. This urban capable land comprises small areas to the north and west of the site separated from the majority of the urban development in GPEC, which occurs approximately 3 km to the south. The site is also located upstream of the nearest urban development and within a separate sub-catchment.

The location of the site relative to the development and within a high density existing urban area means:

- The site is very unlikely to be impacted by impacts associated with construction of the development in GPEC, such as air quality, noise, construction traffic, or the spread of weeds or disease
- The site will not be impacted by soil erosion of sedimentation, changes to surface and groundwater quantity and flows, or water quality impacts associated with the construction and operation of the development
- The heritage values of the site will not be impacted by alterations to the setting of the place inconsistent with its values, such as through changes to the surrounding landscape causing visual or amenity impacts

The site is largely unvegetated (contained scattered trees only) and isolated from other areas of vegetation and has no or little biodiversity value. While records of Grey-headed Flying Fox occur on the site, these are wires records indicating injured individuals have been found in the area, and are unlikely to indicate regular use of the site.

The site does not appear to be currently in use and is being prepared for sale in the 2020-21 financial year (Department of Defense, 2020a). The development is unlikely to disrupt existing land uses, services or infrastructure.

Furthermore, the site is not open to the public, and therefore increased populations associated with the urban development will not lead to disturbance to the heritage values of the site through increased visitor use.

Commitments and mitigation measures

No commitments or mitigation measures are considered necessary to address the potential indirect impacts on the environment of Site 3 from the development under the Plan.

35.3.4 SITE 4 (WESTERN SYDNEY UNIVERSITY – CAMPBELLTOWN CAMPUS)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	Western Sydney University - Campbelltown Campus
Site ID number	4
Area	92.5 ha
Address	Narellan Road and Gilchrist Drive, Campbelltown NSW
Folio	3098/12300
General description	The Campbelltown Campus of the University of Western Sydney is located at Narellan Road and Gilchrist Drive, Campbelltown NSW. It is used for tertiary education purposes. The campus contains 24.3 per cent native vegetation cover that is predominantly associated with drainage lines. Much of the remainder of the site has been developed or is cleared of vegetation. It is located approximately 45 km south-west of the Sydney CBD
Site map	The location of Site 4 is shown in Map 35-5

DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS

Site 4 occurs within the footprint of the eastern end of the Metro Rail Future Extension tunnel

The closest urban development occurs approximately 250 m from the south-western boundary of the site. The landscape between this urban development area and the boundary of Site 4 consists of a railway line and cleared fields, with some thin vegetation corridors predominantly located to the east. Bow Bowing Creek, and its associated riparian corridor, links the proposed urban capable land with the Site 4 boundary to the east

LANDSCAPES AND LANDFORMS

The site occurs in a landscape with gently undulating rises to rolling low hills, which have been predominately cleared or modified for development. The surrounding areas comprise residential land uses, with newer residential developments in the immediate vicinity and established areas of Campbelltown to the north (over Narellan Road), and east and south (over Menangle Road). The Hume Motorway lies to the west, and rural land to the south west

SOIL AND SUBSTRATES

The soil landscape at Site 4 is made up of:

- 89.0 ha of Blacktown soil – Blacktown soils are a hard setting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018)
- 13.4 ha of Luddenham soil – Luddenham soils exist in varying forms depending on their location on a slope. Podzolic soils or earthy clays, yellow podzolic soils, and prairie soils are found on crests, upper slopes, and drainage lines respectively (OEH, 2018)

WATER

The site occurs within the Georges River catchment. The University campus topography is undulating. There are two main drainage lines in the middle of the site that are largely vegetated. These flow into a series of constructed/modified waterbodies that subsequently flow into Bow Bowing Creek (DoI, 2019; DTA, DCA et al., 2019)

VEGETATION

Approximately 28.2 per cent (26.1 ha) of the site is covered by native vegetation, which is predominantly associated with the drainage lines. The remainder of the site is developed or comprises of open fields/grassland

No Commonwealth-listed TECs are mapped as occurring on site. River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria occurs in several patches across the site (note that the mapping of this TEC was based on PCT 835 and is likely to overestimate the extent of the TEC)

The site contains potential habitat for several Commonwealth-listed species, but no species records for the site occur

The vegetated areas are isolated from any substantial areas of vegetation by development, the nearest being approximately 6 km to the east beyond Campbelltown's suburbs connected to Dharawal and Heathcote National

Parks. Vegetation on site is partially connected to the vegetated corridor along the motorway and other vegetated drainage lines in the areas, which together may provide a level of stepping-stone connectivity for fauna				
Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)				
PCT number	**PCT name**	**NSW TEC name**	**BC Act status**	**Area (ha)**
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvium flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	20.4
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	5.7
Threatened ecological communities (TECs)				
TEC name			**EPBC Act status**	**Area (ha)**
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria			Critically Endangered	18.3
Threatened flora species				
Name		**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pomaderris brunnea (Brown Pomaderris)		Endangered (BC Act) Vulnerable (EPBC Act)	15.0	0
Acacia pubescens (Downy Wattle)		Vulnerable (BC Act & EPBC Act)	19.7	0
Marsdenia viridiflora subsp. *viridiflora*		Endangered Population (BC Act)	19.1	0
Pultenaea pedunculata		Endangered (BC Act)	0.0	0
Pomaderris brunnea		Endangered (BC Act) Vulnerable (EPBC Act)	18.0	0
BIO Map Priority Investment Areas				
No BIO Map core or corridor areas have been identified on this site				
ANIMAL SPECIES				
Several records of Cumberland Plain Land Snail occur immediately adjacent to Site 4 at the south-eastern edge of the site, suggesting a notable population may occur in the area (the notes attached to several of the records suggest the individuals recorded were not alive, however, there is potential for the population to occur at the site) Several records of other threatened fauna, including Large-eared Pied Bat, occur immediately adjacent to the site It is likely that some common, urban-adapted native fauna species inhabit or move through the site, based on the presence of PCTs and condition/quality of the vegetation described above				
Threatened fauna species				
Name		**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pteropus poliocephalus (Grey-headed Flying-fox)		Vulnerable (BC Act & EPBC Act)	15.9	0

Botaurus poiciloptilus (Australasian Bittern)	Endangered (BC Act & EPBC Act)	15.0	0
Meridolum corneovirens (Cumberland Plain Land Snail)	Endangered (BC Act)	19.2	1
Cercartetus nanus (Eastern Pygmy-possum)	Vulnerable (BC Act)	11.1	0
Chalinolobus dwyeri (Large-eared Pied Bat)	Vulnerable (BC Act & EPBC Act)	19.2	0
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	20.4	0
Rostratula australis (Australian Painted Snipe)	Endangered (BC Act & EPBC Act)	0.7	0
Petaurus norfolcensis (Squirrel Glider)	Vulnerable (BC Act)	0.2	0
Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	20.4	0
Haliaeetus leucogaster (White-bellied Sea-eagle)	Vulnerable (BC Act)	4.2	0
Myotis macropus (Southern Myotis)	Vulnerable (BC Act)	12.1	0
CONSERVATION AND SPECIAL USE AREAS			
There are no conservation or special use areas present on this site The closest conservation or special use areas are: • Australian Botanic Gardens at Mt Annan (approximately 100m west) • Metro offset site in Claymore (approximately 2km north) • William Howe Regional Park (approximately 2.5km west)			
HERITAGE PLACES AND ITEMS			
It is not known whether the site has any historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having heritage values			
SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES			
The site is a university campus with approximately 6,500 students. Facilities at the site include education facilities, student accommodation, food outlets, library, recreational facilities, religious centres and a range of other services The site is accessed by via Hume Motorway and Narellan Road, and Macarthur Train Station The following tenement exists on this site (NNTT, 2020): Petroleum tenement (PPL4) No Native Title Claims exist over this site (NNTT, 2020)			

IMPACT ASSESSMENT

Direct impacts

Site 4 occurs within the footprint of the eastern end of the Metro Rail Future Extension (MRFE) tunnel and may be directly impacted by construction of the tunnel. There will be no direct impacts to Site 4 due to other development under the Plan (although note the GIS boundary error discussed in Section 35.1, which wrongly suggests there are very small direct impacts). The MRFE tunnel may result in small direct impacts to the land surface generally within the tunnel footprint. In limited circumstances, direct impacts may occur adjacent to the footprint.

It is important to note the MRFE tunnel will greatly reduce the potential for direct impacts to the land surface within the tunnel footprint compared to the rest of the major transport corridors (non-tunnel sections). Direct impacts may only occur to small areas of the tunnel footprint and the vast majority of land surface within the tunnel footprint will not be disturbed.

As for the other major transport corridors, the tunnel footprints are generally wider than needed and the final alignment of the tunnels within the footprint, and potential associated surface impacts, will be subject to future processes of refinement during the strategic planning and detailed design phase of the projects.

Activities associated with tunnels are described in Chapter 36, Section 36.2.2. In summary, disturbance to the land surface due to the MRFE tunnel, including vegetation clearing, may occur due:

- Construction activities
- Ancillary infrastructure, including ventilation systems
- Other infrastructure, such as entry and exit ramps and connection and tie in with existing roads and infrastructure
- Pedestrian and cyclist facilities
- Drainage work, pavement and finishing work

This may result in the following direct impacts:

- Impacts to biodiversity values through clearing of native vegetation and habitat
- Disturbance or destruction of buildings, roads and other infrastructure, and associated disruption of services
- Visual or other impacts to amenity from any permanent infrastructure, including ventilation shafts and the entrance to the tunnel, which is located within Site 4 (as indicated by the current extent of the tunnel footprint)

Direct impacts on these values are discussed below.

Indirect impacts

Site 4 also has the potential to be indirectly impacted by construction and operation of:

- MRFE tunnel, which occurs within the site
- Urban and industrial development and infrastructure, which occurs approximately 250 m to the south of the site

The potential indirect and facilitated impacts associated with these developments and the key whole of environment values of Site 4 that are potentially impacted are shown in Table 35-4.

Indirect impacts on these values are discussed below.

Table 35-4: Potential indirect impacts on Site 4 associated with the development

Potential indirect impact	Extent within site 4	Duration	Values potentially impacted
Construction			
Soil erosion and disturbance from vegetation clearing and earthworks	Vicinity of the tunnel footprint Southern end of the site closest to urban capable land	Generally short term	People and communities Biodiversity values
Changes to water quality from soil erosion or disturbance of contaminated soils			
Air quality, noise impacts, and visual or other impacts to amenity			
Construction traffic causing disruption or reduced accessibility to the site			
Spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat			
Disruption to land uses, services or infrastructure	Whole of site	Generally short term	People and communities

Operation			
Ground settlement and subsidence from tunnels due to the tunnel void or groundwater removal, leading to disturbance to the land surface	Vicinity of the tunnel footprint	Short to long term	People and communities Biodiversity values
Changes to surface water and groundwater quantities and flows due to groundwater drawdown caused by the tunnel void and additional runoff from urban areas	Vicinity of tunnel footprint Bow Bowing Creek	Long term	Water resources Biodiversity values
Disruption to land uses, services or infrastructure	Whole of site	Long term	People and communities

Assessment of direct and indirect impacts

Biodiversity values

The biodiversity values that occur within or in the vicinity of the MRFE tunnel footprint and that will be potentially directly and indirect impacted are identified in the profile above. There is approximately 22 hectares of native vegetation at the site. Only one species record (Cumberland Plain Land Snail) occurs, and there are only relatively small amounts of potential habitat for other species. The most important biodiversity values are:

- River-flat Eucalypt Forest (Commonwealth and NSW-listed) – most of the TEC occurs outside the MRFE tunnel footprint and generally occurs in small, scattered patches in low condition
- Several records of Cumberland Plain Land Snail occur immediately adjacent to the site. However, interrogation of the records indicates the individuals were not alive when recorded

A more detailed assessment of the indirect impacts of the tunnels on biodiversity values is provided in Chapter 36. As identified in Table 35-4, the MRFE tunnel may cause indirect impacts to biodiversity values in Site 4 from the spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat or vegetation. The tunnel also has the potential to cause ground settlement and subsidence due to the tunnel void or groundwater removal leading to disturbance to the land surface, as well as groundwater drawdown, both of which may impact biodiversity values.

The risk of notable direct and indirect impacts from the MRFE tunnel on biodiversity values is considered to be minimal because:

- Total extent of potential impacts is likely to be small. Only a small area of the tunnel footprint is likely to be directly impacted and the vast majority of the land surface within the tunnel footprints will not be disturbed
- The biodiversity values of Site 4 are not notable – River-flat Eucalypt Forest generally occurs in small, scattered patches in low condition, and there is only one species record and relatively small amounts of potential habitat
- The Plan includes commitments to (see below):
    - Avoid and minimise impacts to biodiversity values where disturbance to the land surface within or in the vicinity of the tunnel footprint is necessary, and if impacts are unavoidable, to offset those impacts in accordance with regulatory requirements
    - Mitigate indirect impacts to biodiversity values

Water resources – Bow Bowing Creek

Construction of the tunnel may indirectly impact the water quality of Bow Bowing Creek from soil erosion, disturbance of contaminated soils, or spillage of chemicals and fuels used during construction.

Furthermore, groundwater drawdown from the MRFE tunnel may affect flows to Bow Bowing Creek, as well as the water quality of the waterway due to any need for ongoing disposal of groundwater from the tunnel. Additional runoff from increased hard surfaces associated with the urban and industrial development has the potential to increase surface water flows in Bow Bowing Creek and impact the water quality of the waterway.

These potential impacts on Bow Bowing Creek are considered to be minor. The waterway is already located in an urban environment, and has been subject to previous development including impoundment, clearing of riparian vegetation

and the creation of artificial channels along some sections. Furthermore, the Plan includes commitments that are expected to adequately address these potential impacts on water resources in Site 4 (see below).

People and communities

Construction of the tunnel has the potential to significantly disrupt the university facilities at Site 4 as a result of potential temporary closures to parts of the site to allow construction, or include construction sites, disruption to pedestrian or traffic access to or within the site, and air quality and noise impacts. The Plan includes commitments that are expected to adequately address these potential construction impacts (see below).

The tunnel also has the potential to cause ground settlement and subsidence due to the tunnel void or groundwater removal leading to disturbance to the land surface and associated impacts on university facilities.

If construction of infrastructure within urban capable land in the vicinity of Site 4, there may be minor disruption to road or pedestrian traffic, or noise disturbance. However, the impact to students and others using the site is likely to be minor, as the site is already within an existing urban environment.

The increase in populations in the area facilitated by the urban development is likely to increase the demand for educational services and other infrastructure at the site. This is likely to be overall a positive benefit to the university and is expected to be adequately managed through existing management and operational processes.

Population increases may also lead to increased pressure on roads, transport and other infrastructure that service the university. However, the Plan intends to provide for future transport needs by supporting the delivery of major transport projects for Western Sydney. It is also expected that future transport and infrastructure needs of the university will be provided for through existing local and regional planning processes.

The urban development may also positively impact Site 4 through increased provision of housing, which will increase demand for education services and the availability of housing options close to the university for students and staff.

Commitments and mitigation measures

The Plan includes commitments to avoid and minimise and mitigate direct and indirect impacts from construction and operation of the MRFE tunnel, as well as urban and industrial development and infrastructure.

Metro Rail Future Extension tunnel

The Plan includes commitments to avoid and minimise (Commitment 4) and mitigate (Commitment 6) impacts from the major transport corridors, including the MRFE tunnel, in accordance with assessment and approval processes under the State Significant Infrastructure (SSI) process (or equivalent) and the Biodiversity Assessment Method (BAM) process (or equivalent). These assessment processes will apply to each transport project prior to it proceeding.

Commitment 4 includes a specific commitment (Commitment 4.3) that requires Transport for NSW to avoid and minimise impacts where possible to environmental values within Commonwealth Land sites, including known populations and habitat and TECs and existing infrastructure and services, at:

- Camden Airport (Site 6)
- Western Sydney University (Campbelltown Campus) (Site 4)
- 12 Werombi Road, Grasmere NSW (Site 7)

Commitment 6 requires Transport for NSW to mitigate indirect impacts on TECs, species and their habitat within major transport corridors, including the MRFE tunnel.

The SSI assessment process is described in detail in Chapter 15, Section 15.6.3. The process requires the preparation of an Environmental Impact Statement (EIS) for each tunnel project in accordance with the Planning Secretary's assessment requirements (SEARs). The EIS must identify and assess all relevant environmental impacts of the tunnel projects, identify mitigation measures and commit to performance outcomes for managing these impacts, and identify the detail of ongoing construction and operational management plans and monitoring programs (DPIE, 2020c).

The BAM assessment process provides a robust method and set of requirements for avoiding and minimising direct impacts, including requirements to justify where impacts are unavoidable, and for identifying and implementing mitigation measures to address indirect impacts. It also requires any residual impacts to be offset.

Commitment 4 and Commitment 6 also include a series of actions to support the effective implementation of avoidance and mitigation and offset measures identified through the SSI and BAM assessment processes, including on Commonwealth land. These actions require Transport for NSW to:

- Assess the impacts of the major transport corridors, including the MRFE tunnel, based on detailed design
- Avoid and minimise impacts in accordance with the BAM (or equivalent) during the assessment phase of each transport project, including specific biodiversity values or Commonwealth land sites
- Identify and implement mitigation measures to address indirect impacts based on the outcomes of the assessment in accordance with the requirements of the SSI approval process (or equivalent)
- Offset unavoidable impacts in accordance with the BAM (or equivalent) and EPBC Act Environmental Offsets Policy, 2012 for any EPBC Act matters not covered by the BAM

These commitments and actions ensure avoidance and mitigation and offset measures relating to MNES and whole of environment values are specifically considered and effectively implemented on Commonwealth land.

Commitment 4 and 6 are considered adequate to manage the risks of impacts to whole of environment values of Site 4. These commitments ensure assessment processes will be implemented to avoid and mitigate and where necessary, offset impacts, including specifically requiring avoidance of impacts to whole of environment values at Site 4. The commitments also include governance arrangements to provide assurance that the assessment processes will lead to the effective identification and implementation of avoidance and mitigation measures. Transport for NSW is required to report to the Department and the executive implementation committee on:

- Avoidance achieved within the major transport corridors
- Any additional impacts outside the corridors
- Any offsets to be secured under the SSI approval process and EPBC Act Environmental Offsets Policy, 2012
- Mitigation measures proposed to manage impacts of each major transport corridor project, including proposed techniques, timing, frequency and responsibility for implementing each measure

Furthermore, Commitment 6 establishes monitoring and adaptive management requirements to ensure mitigation measures are adjusted where necessary to ensure their effectiveness. Transport for NSW is required to establish baseline data and monitor high environmental value areas and adjust mitigation measures (where practical) in response to monitoring outcomes. This requirement will ensure risks such as ground subsidence and settlement and associated hydrological impacts due to groundwater drawdown (which will be assessed in accordance with the requirements of the SSI assessment process (or equivalent)) will be effectively managed at Site 6.

Urban and industrial development

The Plan includes a commitment to mitigate indirect impacts from urban and industrial development (Commitment 5).

A Development Control Plan (DCP) will be prepared for each nominated area by either the Department (in the case of Department led precincts) or by the relevant councils in collaboration with the Department. DCPs are non-legally binding planning policies that provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act. DCPs for each nominated area will be prepared in accordance with:

- A DCP template prepared by the Department to support implementation of the Plan
- Standard format for DCPs and a set of model provisions that apply across NSW
- Any processes and guidelines for preparing DCPs specific to each council
- Current best practice standards, guidelines or targets (e.g. water quality standards for urban runoff)

DCPs will incorporate several types of development controls (see Chapter 15, Section 15.6.1), including a broader set of controls that address indirect impacts on environmental values generally. These controls are commonly implemented by planning authorities through the development application process to manage indirect impacts on environmental values, on such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

Examples of these types of controls included in the draft Wilton DCP that are relevant to addressing indirect and facilitated impacts on Site 4 from urban and industrial development are provided in Table 35-5.

Planning authorities will be responsible for making decisions about the specifics of these controls in each DCP and through the development application process based on best practice standards and guidelines.

Table 35-5: Summary examples of broader environmental controls commonly included in DCPs (from draft Wilton DCP)

Control type	Summary of example control in draft Wilton DCP
Water cycle management	• Water management measures must comply with council's requirements for detention, drainage and water sensitive urban design principles • Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise run-off and sediment and pollutants to waterways
Water quality	• Stormwater systems must be constructed/maintained to achieve EES water quality targets
Soil erosion and sedimentation	• Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development • Soil and Water Management Plans must be prepared in accordance with *Managing Urban Stormwater* (Landcom, 2004) and included in development applications
Air quality	• Development must comply with the *Protection of the Environment Operations Act 1997* and supporting regulations. An Odour Impact Assessment must be submitted when required • Provide a barrier to mitigate dispersion of air pollutants, noise or odour where necessary
Noise	• Provide a barrier to mitigate dispersion of air pollutants, noise or odour • Development must include buffers to limit noise impacts on surrounding areas • An acoustic report must be submitted to address the impact of noise generation
Traffic/construction traffic	• Ensure the road networks are designed to control traffic speeds to appropriate limits • Provide a traffic report/statement to address the impact of the development on the local road system and address traffic safety issues

These development controls and the process for implementing them are expected to adequately address the potential indirect and facilitated impacts of the urban and industrial development that will occur adjacent to Site 4.

A detailed description of the process to implement development controls to address indirect impacts, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

Infrastructure

Commitment 5 also includes mitigation of indirect impacts from infrastructure development.

Infrastructure will be subject to future environmental assessment and approval processes under the EP&A Act at the time the projects are proposed. Infrastructure covering the broad types under the Plan (see Part 2) is subject to different environmental assessment processes. These are summarised in Chapter 15, Section 15.6.2.

Commitment 5, Action 2 specifies that mitigation measures will be identified and implement based on the outcomes of the environmental assessment of detailed designs of each infrastructure project in accordance with the requirements of the NSW approval processes under the EP&A Act, as well as published, best practice guidelines.

Public authorities typically incorporate a broad set of mitigation measures through these assessment processes to manage indirect impacts of infrastructure on environmental values generally, including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

It is considered that Commitment 2 will lead to the identification and implementation of a set of mitigation measures that will adequately manage potential indirect impacts on Site 4 from infrastructure.

A detailed description of the processes to implement mitigation measures for infrastructure, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2.

35.3.5 SITE 5 (DEFENCE ESTABLISHMENT ORCHARD HILLS)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	Defence Establishment Orchard Hills
Site ID number	5
Area	1,970.7 ha
Address	2042B The Northern Rd, Mulgoa NSW 2042-2550 The Northern Road, Orchard Hills NSW 2304A The Northern Road, Orchard Hills NSW 18C The Haven, Orchard Hills NSW 66A Wentworth Road, Orchard Hills NSW 1-17 Stockdale Road, Orchard Hills NSW 114-122 Patons Lane, Orchard Hills NSW
Folio	4/238092, 1-3/238092, 6/578629, 9/238092, 2/589479, 1-2/586093, 1/629326, 11/598345, 1-17/242968
General description	Defence Establishment Orchard Hills is an explosive ordnance depot. It is used for the storage of munitions, weapon ranges, firing ranges, firefighting training, and above and below ground fuel storage (Department of Defense, 2017b). It occurs within the Strategic Assessment Area, approximately 50 km west of the Sydney CBD. Approximately 42.0 per cent of the site is covered by native vegetation communities. The site contains areas of high biodiversity value, with parts of the site proposed as an offset site for the new Western Sydney Airport (DIRDC, 2018)
Site map	The location of Site 5 is shown in Map 35-6

DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS

Urban capable land and major transport corridors are located immediately adjacent to Site 5, including:

- Along most of the northern and eastern boundaries of the site
- Small areas of either end of the southern border of the site (i.e. the south-western and south-eastern edges)
- Approximately half of the western boundary of the site

LANDSCAPES AND LANDFORMS

This site occurs in a landscape with gently undulating rises to floodplains, valley flats and drainage depressions

SOIL AND SUBSTRATES

The soil landscape at Site 5 is made up of:

- 1,705.5 ha of Blacktown soil – Blacktown soils are hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018)
- 265.2 ha of Wianamatta (South Creek) soil – Wianamatta (South Creek) soils are deep layered sediments that occur over bedrock or relict soils (minerals/structures that have not undergone metamorphic change while the surrounding rock has) (OEH, 2018)

WATER

The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by the negative effects of historical land uses (e.g. clearing, urbanisation) (GES, 2018)

Watercourses that flow through the site include first to fourth order streams. Blaxland Creek is a fourth order stream into which the majority of the site drains. It diagonally dissects the site, flowing in a south-west to north-east direction (DIRDC, 2018). Blaxland Creek and its tributaries are some of the least disturbed catchment areas remaining in the

Cumberland subregion, and are regarded as one of the most pristine creek systems on Wianamatta Shale in Western Sydney. The creek system has a high diversity of species which are sensitive to disturbance, and provides habitat for species that have largely disappeared from more impacted watercourses in the region. Blaxland Creek at Orchard Hills provides a benchmark to measure disturbance of riparian corridors elsewhere on the Cumberland subregion, and is listed as part of the Commonwealth heritage value of the site (DoEE, 2019)

A tributary of Cosgroves Creek also occurs in the south-east corner of the site (DoEE, 2019; DoI, 2019)

VEGETATION

Native vegetation covers approximately 42 per cent (828.2 ha) of the site and mostly occurs in a large patch within the north-east and part of the south-east of the site that is broadly associated with Blaxland Creek and its tributaries

The site contains the largest and least disturbed remnant of Cumberland Plain Woodland and large and intact areas of River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria, and is regarded as an important area for the conservation of these two TECs in the subregion. The natural values of these vegetation communities are listed as part of the Commonwealth heritage value of the site (DoEE, 2019)

The vegetation at Orchard Hills is located within a largely cleared, agricultural/rural residential landscape, which contains scattered, smaller patches of vegetation, paddock and garden trees, through which vegetated riparian corridors provide important connectivity pathways for native flora and fauna. The main vegetated areas which Orchard Hills is connected to includes vegetated areas to the west (linking the site to the Blue Mountains), and riparian corridors to the north-east linking the site to Wianamatta (South Creek). Dense urban development is located to the north and north-west of the site, which limits habitat connectivity in these directions

Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)

PCT number	PCT name	NSW TEC name	BC Act status	Area (ha)
724	Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Shale Gravel Transition Forest in the Sydney Basin Bioregion	Endangered	0.1
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvium flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	129.3
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	651.5
850	Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	17.9
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	29.4

Commonwealth listed threatened ecological communities (TECs)			
TEC name		**EPBC Act status**	**Area (ha)**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest		Critically Endangered	445.5
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria		Critically Endangered	118.1
Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Dillwynia tenuifolia	Vulnerable (BC Act)	137.7	4
Grevillea juniperina subsp. *juniperina* (Juniper-leaved Grevillea)	Vulnerable (BC Act)	665.8	1,119
Marsdenia viridiflora subsp. *viridiflora*	Endangered Population (BC Act)	815.2	14
Pultenaea parviflora	Endangered (BC Act) Vulnerable (EPBC Act)	1.0	4
Acacia pubescens (Downy Wattle)	Vulnerable (BC Act & EPBC Act)	726.6	0
Pimelea spicata (Spiked Rice-flower)	Endangered (BC Act & EPBC Act)	1,136.0	0
Maundia triglochinoides	Vulnerable (BC Act)	28.7	0
Pilularia novae-hollandiae (Austral Pillwort)	Endangered (BC Act)	11.5	0
Pimelea curviflora var. *curviflora*	Vulnerable (BC Act & EPBC Act)	299.5	0
Pultenaea pedunculata (Matted Bush-pea)	Endangered (BC Act)	481.5	0
Persoonia nutans (Nodding Geebung)	Endangered (BC Act & EPBC Act)	0.1	0
BIO Map Priority Investment Areas			
The site has been identified on BIO Map as containing over 1,100 ha of core areas and 279 ha of corridors			
Type	**Area (ha)**		
Core areas	1,113.5		
State and Regional Biodiversity Corridors	279.3		
ANIMAL SPECIES			
The site contains substantial areas of habitat for native fauna species. There are 68 bird species and 10 reptile species that have been recorded at the site as well as several native marsupial mammals, including Easter Grey Kangaroo (*Macropus giganteus*), Swamp Wallabies (*Wallabia bicolor*), and Common Wallaroos (*Macropus robustus*) (DIRDC, 2018)			

Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	699.9	4
Botaurus poiciloptilus (Australasian Bittern)	Endangered (BC Act & EPBC Act)	85.5	0
Meridolum corneovirens (Cumberland Plain Land Snail)	Endangered (BC Act)	786.5	68
*Cercartetus nanus (*Eastern Pygmy-possum)	Vulnerable (BC Act)	363.4	0
Callocephalon fimbriatum (Gang-gang Cockatoo)	Vulnerable (BC Act)	93.7	0
Petauroides volans (Greater Glider)	Vulnerable (EPBC Act)	356.0	0
Hieraaetus morphnoides (Little Eagle)	Vulnerable (BC Act)	150.9	0
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	828.3	0
*Myotis macropus (*Southern Myotis)	Vulnerable (BC Act)	238.8	0
*Dasyurus maculatus maculatus (*Spot-tailed Quoll)	Vulnerable (BC Act) Endangered (EPBC Act)	760.0	0
Lophoictinia isura (Square-tailed Kite)	Vulnerable (BC Act)	179.1	0
Petaurus norfolcensis (Squirrel Glider)	Vulnerable (BC Act)	780.9	0
Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	828.3	0
*Haliaeetus leucogaster (*White-bellied Sea-eagle)	Vulnerable (BC Act)	179.1	0
Artamus cyanopterus cyanopterus (Dusky Woodswallow)	Vulnerable (BC Act)	0.0	1
*Burhinus grallarius (*Bush Stone-curlew)	Endangered (BC Act)	0.0	2
Climacteris picumnus victoriae (Brown Treecreeper (eastern subspecies))	Vulnerable (BC Act)	00.	1
Chthonicola sagittata (Speckled Warbler)	Vulnerable (BC Act)	0.0	10
Daphoenositta chrysoptera (Varied Sittella)	Vulnerable (BC Act)	0.0	4
Ephippiorhynchus asiaticus (Black-necked Stork)	Endangered (BC Act)	0.0	1
Micronomus norfolkensis (Eastern Coastal Free-tailed Bat)	Vulnerable (BC Act)	0.0	1
Miniopterus orianae oceanensis (Large Bent-winged Bat)	Vulnerable (BC Act)	0.0	2
Petroica boodang (Scarlet Robin)	Vulnerable (BC Act)	0.0	1
*Stagonopleura guttata (*Diamond Firetail)	Vulnerable (BC Act)	0.0	1

CONSERVATION AND SPECIAL USE AREAS
Large parts of the site are proposed to be secured as an offset for the impacts of Stage 1 of Western Sydney Airport (DIRDC, 2018). The offset will comprise restoration and management of at least 900 ha of native vegetation, including Cumberland Plain Woodland, at the site. Other conservation or special use areas near the site include Mulgoa Nature Reserve (approximately 1.5km west) and an offset site in Glenmore Park (approximately 1.5km west)
HERITAGE PLACES AND ITEMS
Approximately 1,370 ha (70 per cent) of the site is listed on the Commonwealth Heritage List and the Register of the National Estate (non-statutory) as *Orchard Hills Cumberland Plain* Woodland, including for its natural values. The site meets four of the nine Commonwealth Heritage listing criteria: • Criterion A: Orchard Hills has evidence of historic canal works from the 1890s. It contains the largest and least disturbed remaining remnant of Cumberland Plain Woodland as well as some of the least disturbed catchment areas. Blaxland Creek supports a higher level of macro-invertebrate diversity than elsewhere in Western Sydney (DoEE, 2019) • Criterion B: Orchard Hills contains threatened species and TECs, and tributaries of Blaxland Creek are considered to have regional conservation significance for invertebrate species (DEWHA, 2007; DoEE, 2019). • Criterion C: Tributaries of Blaxland Creek provide a benchmark to measure disturbance of riparian areas elsewhere on the Cumberland Plain. The lack of fire at Orchard Hills for 50 years also provides valuable research into the regeneration of Cumberland Plain Woodland (DoEE, 2019) • Criterion D: Orchard Hills demonstrates the principle characteristics of Cumberland Plain Woodland, Sydney River Flat Forest in the Penrith area, and examples of some of the most outstanding remaining Forest Red gum trees. It also contains numerous indigenous sites along the main steam (DoEE, 2019) It is not known whether the site has any other historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having any other heritage values
SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES
The site is an explosive ordnance depot managed for defence capability purposes, defence training activities and the use and safe storage of explosives. Site facilities include munitions storage, weapon ranges, firing ranges, fire-fighting training areas, and fuel storage and distribution from above ground and underground storage tanks. The site also contains a sewage treatment plant. Two historical landfills also exist, containing non-putrescible refuse, including building rubble and asbestos containing materials. The majority of the site provides a buffer zone for the safe use and storage of explosives to nearby residential and rural residential land uses (Department of Defense, 2017a) No mining or petroleum tenements exist on this site (NNTT, 2020) No Native Title Claims exist over this site (NNTT, 2020)

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 5 due to development under the (although note the GIS boundary error discussed in section 35.1, which wrongly suggests there are very small direct impacts).

Indirect and facilitated impacts

Site 5 has the potential to be indirectly impacted by construction and operation of:

- The OSO, which occurs adjacent to the eastern boundary of the site
- Urban and industrial, and infrastructure development, which occurs along the boundaries of all sides of the site, particularly the northern, eastern and western boundaries

The potential indirect and facilitated impacts associated with these developments and the key values of the environment of Site 5 that are potentially impacted are shown in Table 35-6.

Table 35-6: Potential indirect impacts on Site 5 associated with the development

Potential indirect impact	Extent within Site 5	Duration	Values potentially impacted
Construction			
Soil erosion and disturbance from vegetation clearing and earthworks	Boundaries of the site	Generally short term	People and communities Biodiversity values/heritage values (natural)
Changes to water quality from soil erosion or disturbance of contaminated soils			
Air quality, noise impacts, and visual or other impacts to amenity			
Construction traffic causing disruption or reduced accessibility to the site			
Spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat			
Clearing of habitat during construction of the development that links the site to other areas of habitat, leading to impacts on biodiversity values	Whole of site	Long term	Biodiversity values/heritage values (natural)
Disruption to land uses, services or infrastructure	Whole of site	Generally short term	People and communities
Operation			
Changes to surface water flows due to additional runoff from urban areas	Vicinity of tunnel footprint Bow Bowing Creek	Long term	Water resources Biodiversity values/heritage values (natural)
Disruption to land uses, services or infrastructure	Whole of site	Long term	People and communities

Biodiversity values/heritage values (natural)

Construction of urban, industrial, and infrastructure development and the OSO adjacent to the boundaries of the site may cause indirect impacts to biodiversity values from the spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat or vegetation.

The site is of very high conservation value. The site is listed on the Commonwealth Heritage List, including for its natural values. It contains very large areas of good condition native vegetation, including TECs and known populations of several threatened flora and fauna species. The site has also been identified on BIO Map as containing large areas of core areas and corridors, and is located within the Cumberland Conservation Corridor, which is a community led, government-recognised proposal to help address the conservation of biodiversity values and especially connectivity of habitat in the Cumberland subregion (DIRDC, 2018).

The most important biodiversity values within Site 5 that may be indirectly impacted are:

- Cumberland Plain Woodland and River-flat Eucalypt Forest – indirect impacts to these TECs may be notable, as the site contains large and intact areas of these TECs
- Records and habitat of *Marsdenia viridiflora* subsp. *viridiflora*, *Pultenaea parviflora* and Cumberland Plain Land Snail, as well as several other threatened flora and fauna species

Two large areas in the northern and southern parts of the site are proposed to be secured as an offset for Stage 1 of Western Sydney Airport (DIRDC, 2018). The offset will comprise restoration and management of at least 900 ha of native vegetation and include large areas of Cumberland Plain Woodland, River-flat Eucalypt Forest, and records and habitat

for *Marsdenia viridiflora* subsp. *viridiflora* and several other threatened flora and fauna species. The offset site also includes large parts of the riparian corridor of Blaxland Creek (DIRDC, 2018).

It is expected that the establishment and management of the offset site would adequately mitigate any key risks to the most important biodiversity values on the site from indirect impacts of the development under the Plan. Under the offset proposal, the Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) would provide funds for the intensive management of the offset site for biodiversity conservation and restoration for a period of up to 20 years. This would include the management of weeds and other landscape scale threats to the biodiversity values of the site. Management actions would be undertaken in accordance with an Offset Plan prepared under an agreement with the Department of Defence, who would be responsible for managing the site. Furthermore, the Plan includes commitments that are expected to adequately minimise the risk of potential impacts on biodiversity values in Site 5 resulting from construction and operation of the development (see below).

Clearing of habitat that links the site to other areas of habitat has the potential to lead to impacts on the biodiversity values of the site due to a reduction in habitat connectivity to and from the site.

The key areas of habitat connectivity associated with the site are:

- Riparian corridors and small patches of native vegetation and scattered paddock trees to the north and east of the site that link to a larger riparian corridor associated with Wianamatta (South Creek)
- Larger patches of native vegetation and scattered paddock trees to the south-west of the site that provide some connectivity to riparian corridors and large areas of habitat associated with the Blue Mountains

The development has the potential to result in a reduction in habitat connectivity from the loss of small patches of native vegetation and scattered paddock trees to the north and east of the site. Habitat connectivity in this area, particularly associated with the riparian corridor along Wianamatta (South Creek), will also be potentially impacted by the OSO, which may lead to a reduction in connectivity to the site. The Plan includes a commitment to avoid and minimise impacts of the major transport corridors in riparian corridors (see below), and this is expected to adequately address this risk.

The larger patches of native vegetation and scattered paddock trees to the south-west of the site will not be impacted by the development. Furthermore, riparian corridors that connect to the site have been avoided as part of the design of the urban capable land (see Chapter 14) and will not be impacted by the development.

Water resources

Construction and operation of the urban, industrial, and infrastructure development adjacent to the southern and western boundaries of the site has the potential to cause changes to surface water flows and impact the water quality of Blaxland Creek and its tributaries that occur within the site due to:

- Soil erosion, disturbance of contaminated soils, or spillage of chemicals and fuels used during construction
- Increased urban run-off during operation as a result of increased hard surfaces from urban areas

Potential impacts to Blaxland Creek and its tributaries are notable as this system within the site contains some of the least disturbed catchment areas remaining in the Cumberland subregion, has a high diversity of species which are sensitive to disturbance, and provides habitat for species that have largely disappeared from other watercourses in the region. The creek system at the site provides a benchmark to measure disturbance of riparian corridors elsewhere in Cumberland subregion, and is listed as part of the Commonwealth heritage value of the site (DoEE, 2019)

Urban, industrial, and infrastructure development to the east and north of the site and construction of the OSO to the east of the site are unlikely to impact Blaxland Creek and its tributaries within the site as these areas are generally inn separate sub-catchments and surface run-off generally occurs south west to north east across the site.

Processes to manage changes to surface water flows and water quality impacts will implemented under the Plan (see below). The Plan also includes a specific commitment to manage these impacts at Blaxland Creek. These measures are expected to adequately address the potential impacts on water resources in Site 5 (see below).

People and communities

Construction of the urban, industrial, infrastructure and transport development is considered unlikely to disrupt services at the site. The majority of the site includes buffer zones to mitigate risks associated with the use and storage of

explosives on adjacent residual areas (Department of Defense, 2017a). These buffers are likely to mitigate any potential disruption to services from many construction activities, such as through air or noise impacts.

The Plan includes commitments that are expected to adequately address other potential impacts associated with construction, such as disruption to site access associated with construction traffic (see below).

Increased populations associated with urban development under the Plan has the potential to disrupt the services provided by the site as a defence base due to:

- Risks associated with the use and storage of explosives
- Increased pressure on roads, transport and other infrastructure that service the site

These potential indirect impacts are considered unlikely.

Existing urban areas already occur in the vicinity of the site, including low density rural residual areas immediately adjacent to and surrounding the majority of the site, as well as higher density urban areas to the west and north east of the site. The site already has in place measures to mitigate the risks associated with the use and storage of explosive on adjacent residual areas, including buffer zones that comprise the majority of the site (Department of Defense, 2017a), and it is therefore not expected that the development will disrupt the use of the site for this purpose.

The Plan addresses the issue of increased pressure on roads, transport and other infrastructure that service Site 5 to some extent by supporting the delivery of major transport projects for Western Sydney. It is also expected that future transport and other infrastructure needs will be adequately provided for through future planning processes.

Commitments and mitigation measures

The Plan includes commitments to mitigate indirect impacts from construction and operation associated with the major transport corridors, urban and industrial development, and infrastructure. These commitments and processes to deliver these comments are different for each type of development.

Major transport corridors

The certified – major transport corridors will be subject to future assessment and approval processes under the State Significant Infrastructure (SSI) process (or equivalent) prior to them proceeding.

The SSI assessment process is described in detail in Chapter 15, Section 15.6.3. The process requires the preparation of an Environmental Impact Statement (EIS) for each tunnel project in accordance with the Planning Secretary's assessment requirements (SEARs). The EIS must identify and assess all relevant environmental impacts of the tunnel projects, identify mitigation measures and commit to performance outcomes for managing these impacts, and identify the detail of ongoing construction and operational management plans and monitoring programs (DPIE, 2020c).

The Plan includes commitments to avoid and minimise (Commitment 3) and mitigate (Commitment 6) impacts from the major transport corridors, including the OSO. Commitment 3 includes a specific requirement to avoid areas of potential habitat connectivity within riparian corridors where possible, particularly for the following species:

- Eastern Pygmy Possum
- Green and Golden Bell-Frog
- Spotted-tailed Quoll
- Squirrel Glider
- Yellow-bellied Glider

This commitment is expected to adequately address the risk of indirect impacts from the OSO on Site 5 associated with a potential reduction in habitat connectivity to the site.

Commitment 6 also include a series of actions to support the effective implementation of mitigation measures identified through the SSI assessment process. These actions require Transport for NSW to:

- Assess the impacts of the major transport corridors based on detailed design
- Identify and implement mitigation measures to address indirect impacts based on the outcomes of the assessment in accordance with the requirements of the SSI approval process (or equivalent)

Commitment 3 and 6 are considered adequate to manage the risks of impacts to whole of environment values of Site 5. The commitments also include governance arrangements to provide assurance that the SSI assessment process will lead to the effective identification and implementation of avoidance and mitigation measures. Transport for NSW is required to report to the Department and the executive implementation committee on:

- Avoidance achieved within the major transport corridors
- Any additional impacts outside the corridors
- Mitigation measures proposed to manage impacts of each major transport corridor project, including proposed techniques, timing, frequency and responsibility for implementing each measure

Urban and industrial development

The Plan includes a commitment to mitigate indirect impacts from urban and industrial development (Commitment 5).

A Development Control Plan (DCP) will be prepared for each nominated area by either the Department (in the case of Department led precincts) or by the relevant councils in collaboration with the Department. DCPs are non-legally binding planning policies that provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act. DCPs for each nominated area will be prepared in accordance with:

- A DCP template prepared by the Department to support implementation of the Plan
- Standard format for DCPs and a set of model provisions that apply across NSW
- Any processes and guidelines for preparing DCPs specific to each council
- Current best practice standards, guidelines or targets (e.g. water quality standards for urban runoff)

DCPs will incorporate several types of development controls (see Chapter 15, Section 15.6.1), including a broader set of controls that address indirect impacts on environmental values generally. These controls are commonly implemented by planning authorities through the development application process to manage indirect impacts on environmental values, on such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

Examples of these types of controls included in the draft Wilton DCP that are relevant to addressing indirect and facilitated impacts on Site 5 from urban and industrial development are provided in Table 35-7.

Planning authorities will be responsible for making decisions about the specifics of these controls in each DCP and through the development application process based on best practice standards and guidelines.

Appendix E of the Plan, which is required to be implemented through Commitment 5, also includes a specific measure to put in place development controls though the relevant DCP to ensure development adjacent to the southern and western boundaries of the site mitigates impacts to surface water flows and the water quality of Blaxland Creek.

Table 35-7: Summary examples of broader environmental controls commonly included in DCPs (from draft Wilton DCP)

Control type	Summary of example control in draft Wilton DCP
Water cycle management	• Water management measures must comply with council's requirements for detention, drainage and water sensitive urban design principles • Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise run-off and sediment and pollutants to waterways
Water quality	• Stormwater systems must be constructed/maintained to achieve EES water quality targets
Soil erosion and sedimentation	• Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development • Soil and Water Management Plans must be prepared in accordance with *Managing Urban Stormwater* (Landcom, 2004) and included in development applications
Air quality	• Development must comply with the *Protection of the Environment Operations Act 1997* and supporting regulations. An Odour Impact Assessment must be submitted when required • Provide a barrier to mitigate dispersion of air pollutants, noise or odour where necessary

Control type	Summary of example control in draft Wilton DCP
Noise	• Provide a barrier to mitigate dispersion of air pollutants, noise or odour • Development must include buffers to limit noise impacts on surrounding areas • An acoustic report must be submitted to address the impact of noise generation
Traffic/construction traffic	• Ensure the road networks are designed to control traffic speeds to appropriate limits • Provide a traffic report/statement to address the impact of the development on the local road system and address traffic safety issues

These development controls and the process for implementing them are expected to adequately address the potential indirect and facilitated impacts of the urban and industrial development that will occur adjacent to Site 5.

A detailed description of the process to implement development controls to address indirect impacts, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

Infrastructure

Commitment 5 also includes mitigation of indirect impacts from infrastructure development.

Infrastructure will be subject to future environmental assessment and approval processes under the EP&A Act at the time the projects are proposed. Infrastructure covering the broad types under the Plan (see Part 2) is subject to different environmental assessment processes. These are summarised in Chapter 15, Section 15.6.2.

Commitment 5, Action 2 specifies that mitigation measures will be identified and implement based on the outcomes of the environmental assessment of detailed designs of each infrastructure project in accordance with the requirements of the NSW approval processes under the EP&A Act, as well as published, best practice guidelines.

Public authorities typically incorporate a broad set of mitigation measures through these assessment processes to manage indirect impacts of infrastructure on environmental values generally, including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

It is considered that Commitment 2 will lead to the identification and implementation of a set of mitigation measures that will adequately manage potential indirect impacts on Site 5 from infrastructure.

A detailed description of the processes to implement mitigation measures for infrastructure, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2.

35.3.6 SITE 6 (CAMDEN AIRPORT)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	Camden Airport
Site ID number	6
Area	186.7 ha
Address	766 Aerodrome Road, Cobbitty NSW
Folio	102/112144
General description	Camden airport is located at 766 Aerodrome Road Hanger, Camden, NSW. The site is a general aviation airport that facilitates the operation of small aircrafts in the commercial, private, sports and recreational aviation areas (CAL, 2015a). Approximately 26.3 per cent of the site is covered by native vegetation. It occurs within the Strategic Assessment Area, approximately 50 km south-west of the Sydney CBD
Site map	The location of Site 6 is shown in Map 35-7
DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS	
The site occurs within the footprint of the tunnel section of the OSO from Cobbitty to Cawdor. The nearest urban capable land occurs approximately 9 km to the west within GMAC	
LANDSCAPES AND LANDFORMS	
This site occurs in a flat landscape on Tertiary and Quaternary floodplains and terraces of the Nepean River	
SOIL AND SUBSTRATES	
The soil landscape at site 6 is made up of: • 8.3 ha of Blacktown soil – Blacktown soils are a hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018) • 177.6 ha of Theresa Park soil – Theresa Park soils occur on Tertiary and Quaternary floodplains and terraces • < 1 ha of unknown soil	
WATER	
The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018) The site is flat and contains one minor, non-perennial drainage line in the north-eastern part of the site and is bordered on the east, south and western sides by the Nepean River	
VEGETATION	
Vegetation covers approximately 26.3 per cent (49.2 ha) of the Camden Airport site. These vegetated areas occur on the banks of the Nepean River that runs along the edge of the site	

Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)

PCT number	PCT name	NSW TEC name	BC Act status	Area (ha)
0	Cleared	N/A	N/A	137.5

835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvium flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	49.1
850	Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	<0.1

Commonwealth listed threatened ecological communities (TECs)		
TEC name	**EPBC Act status**	**Area (ha)**
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria	Critically Endangered	49.1

Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Eucalyptus benthamii (Camden White Gum)	Vulnerable (BC Act & EPBC Act)	49.2	130
Pomaderris brunnea (Brown Pomaderris)	Endangered (BC Act) Vulnerable (EPBC Act)	71.5	22
Acacia bynoeana (Bynoe's Wattle)	Vulnerable (BC Act) Endangered (EPBC Act)	1.4	0
Pultenaea parviflora	Endangered (BC Act) Vulnerable (EPBC Act)	0.4	0
Persicaria elatior (Tall Knotweed)	Vulnerable (BC Act & EPBC Act)	20.7	0

BIO Map Priority Investment Areas	
The site has been identified on BIO Map as containing 51 ha of corridors	
Type	**Area (ha)**
Core areas	0.0
State and Regional Biodiversity Corridors	50.6

ANIMAL SPECIES			
Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	48.8	0
Botaurus poiciloptilus (Australasian Bittern)	Endangered (BC Act & EPBC Act)	3.0	0
Petauroides volans (Greater Glider)	Vulnerable (EPBC Act)	33.4	0

Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	49.2	0
Rostratula australis (Australian Painted Snipe)	Endangered (BC Act & EPBC Act)	1.6	0
Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	49.2	1
Meridolum corneovirens (Cumberland Plain Land Snail)	Endangered (BC Act)	0.0	1
Micronomus norfolkensis (Eastern Coastal Free-tailed Bat)	Vulnerable (BC Act)	0.0	2
Miniopterus orianae oceanensis (Large Bent-winged Bat)	Vulnerable (BC Act)	0.0	1
Petroica boodang (Scarlet Robin)	Vulnerable (BC Act)	0.0	1
Scoteanax rueppellii (Greater Broad-nosed Bat)	Vulnerable (BC Act)	0.0	2

CONSERVATION AND SPECIAL USE AREAS

The 49 ha of native vegetation on the site is protected as a Registered Property Agreement administered by the BCT

HERITAGE PLACES AND ITEMS

The Camden Airport Environment Strategy (CAL, 2015b) identifies the heritage values present on the property

With regards to indigenous heritage, an Aboriginal Archaeological Survey of the site in 2009 identified an artefact scatter which contained flaked stone artefacts along an access track leading to the Nepean River. This site was registered on the NSW Aboriginal Heritage Information Management System (AHIMS). The stone artefacts have since been relocated off the access track to another on-Airport location under an Aboriginal Heritage Impact Permit (AHIP). While the access track provides tangible evidence of previous Aboriginal occupation, it is noted that Aboriginal representatives have indicated the site does not have specific cultural significance which would require ongoing protection (CAL, 2015b)

With regards to non-indigenous heritage, the site was first developed in the 1930's, with the original airport hangar still in use today. The site was used during World War II by the Royal Australian Air Force (RAAF), with structures from that period still present on site today. No structures on site pre-date the 1930's (CAL, 2015b)

The site is listed for heritage purposes within the *Camden Local Environment Plan 2010,* and on the Register of the National Estate (RNE), which is a non-statutory list which closed in 2007 (CAL, 2015b)

SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES

The site is a general aviation airport, hosting small commercial, private and recreational aircraft operations

Aviation facilities at the site include

- Taxiways and aprons
- Lighting
- Air traffic control
- Navaids
- Refuelling

Passenger facilities at the site include:

- Parking
- Ground transportation

No mining or petroleum tenements exist on this site (NNTT, 2020)

No Native Title Claims exist over this site (NNTT, 2020)

IMPACT ASSESSMENT

Direct impacts

Site 6 occurs within the footprint of the OSO tunnel and may be directly impacted by construction of the tunnel. There will be no direct impacts to Site 6 due to other development under the Plan. The OSO tunnel may result in small direct impacts to the land surface generally within the tunnel footprint. In limited circumstances, direct impacts may occur adjacent to the footprint.

It is important to note the OSO tunnel will greatly reduce the potential for direct impacts to the land surface within the tunnel footprint compared to the rest of the major transport corridors (non-tunnel sections). Direct impacts may only occur to small areas of the tunnel footprint and the vast majority of land surface within the tunnel footprint will not be disturbed.

As for the other major transport corridors, the tunnel footprints are generally wider than needed and the final alignment of the tunnels within the footprint, and potential associated surface impacts, will be subject to future processes of refinement during the strategic planning and detailed design phase of the projects.

Activities associated with tunnels are described in Chapter 36, Section 36.2.2. In summary, disturbance to the land surface due to the OSO tunnel, including vegetation clearing, may occur due:

- Construction activities
- Ancillary infrastructure, including ventilation systems
- Other infrastructure, such as entry and exit ramps and connection and tie in with existing roads and infrastructure
- Pedestrian and cyclist facilities
- Drainage work, pavement and finishing work

This may result in the following direct impacts:

- Impacts to biodiversity values through clearing of native vegetation and habitat
- Disturbance or destruction of buildings, roads and other infrastructure, and associated disruption of services
- Visual or other impacts to amenity from any permanent infrastructure, including ventilation shafts

Direct impacts on these values are discussed below.

It is unlikely that the development of the OSO tunnel would impact sites of heritage significance, as indigenous heritage items have previously been removed from their original position on the site for protection, and non-indigenous heritage items on site include site infrastructure such as airport hangars, which are unlikely to be directly impacted.

Indirect impacts

Site 6 has the potential to be indirectly impacted by construction and operation of the OSO tunnel.

The potential indirect and facilitated impacts associated with this development and the key values of the environment of Site 6 that are potentially impacted are shown in Table 35-8.

Indirect impacts on these values are discussed below.

It is considered unlikely that heritage values of Site 6 will be indirectly impacted by the OSO tunnel. Indigenous heritage items have previously been removed from the site for protection purposes, whilst non-indigenous heritage items are of an industrial nature (and includes infrastructure such as airport hangars). It is therefore considered that addition of potential infrastructure associated with the OSO tunnel (such as air vents) would not be inconsistent with the visual amenity and general characteristics of the site. This is not considered further below.

The nearest proposed urban and industrial development and infrastructure under the Plan is too distant (over 9 km) to impact Site 6 due to construction of the development. However, there may be indirect impacts on Site 6 from increased populations in the area associated with the new urban development.

Table 35-8: Potential indirect impacts on Site 6 associated with the development

Potential indirect impact	Extent within Site 6	Duration	Values potentially impacted
Construction			
Soil erosion and disturbance from vegetation clearing and earthworks	Vicinity of the tunnel footprint	Generally short term	People and communities Biodiversity values
Changes to water quality from soil erosion or disturbance of contaminated soils			
Air quality, noise impacts, and visual or other impacts to amenity			
Construction traffic causing disruption or reduced accessibility to the site			
Spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat			
Disruption to land uses, services or infrastructure	Whole of site	Generally short term	People and communities
Operation			
Ground settlement and subsidence from tunnels due to the tunnel void or groundwater removal, leading to disturbance to the land surface	Vicinity of the tunnel footprint	Short to long term	People and communities Biodiversity values
Changes to surface water and groundwater quantities and flows due to groundwater drawdown caused by the tunnel void	Vicinity of tunnel footprint Riparian corridor within Nepean River	Long term	Water resources Biodiversity values
Disruption to land uses, services or infrastructure	Whole of site	Long term	People and communities

Assessment of direct and indirect impacts

Biodiversity values

The biodiversity values that occur within or in the vicinity of the OSO tunnel footprint and that will be potentially directly and indirect impacted are identified in the profile above. Almost all native vegetation and other biodiversity values within Site 6 occur around the western, southern and eastern edges of the site end within the Registered Property Agreement site. The most important biodiversity values are:

- River-flat Eucalypt Forest (Commonwealth and NSW-listed) – some patches of the TEC are in intact condition and are well connected to other native vegetation along the Nepean River. Most patches occur within the Registered Property Agreement site but outside the OSO tunnel footprint
- Records and habitat of *Eucalyptus benthamii* and *Pomaderris brunnea* – large important populations of each species occur within and in the vicinity of the tunnel footprint
- Riparian corridor of Nepean River – Site 6 occurs within parts of the riparian corridor of the Nepean River. The corridor contains native vegetation that provides habitat and records of *Eucalyptus benthamii* and *Pomaderris brunnea* as well as likely providing habitat for several common species. It also provides a narrow habitat corridor link across the landscape from Site 6, including to several other larger patches of habitat nearby

A more detailed assessment of the indirect impacts of the tunnels on biodiversity values is provided in Chapter 36. As identified in Table 35-8, the OSO tunnel may cause indirect impacts to biodiversity values in Site 6 from the spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat or vegetation. The tunnel also has the

potential to cause ground settlement and subsidence due to the tunnel void or groundwater removal leading to disturbance to the land surface, as well as groundwater drawdown, both of which may impact biodiversity values.

There is a risk of notable direct and indirect impacts from the OSO tunnel on biodiversity values. However, the total extent of potential impacts is likely to be small. Only a small area of the tunnel footprint is likely to be directly impacted and the vast majority of the land surface within the tunnel footprints will not be disturbed, and this considerably reduces the risk of notable impacts. The Plan also includes commitments to (see below):

- Avoid and minimise impacts to biodiversity values where disturbance to the land surface within or in the vicinity of the tunnel footprint is necessary, and if impacts are unavoidable, to offset those impacts in accordance with regulatory requirements
- Mitigate indirect impacts to biodiversity values

These commitments are considered adequate to manage the risks of impacts on biodiversity values at Site 6.

People and communities

Construction of the tunnel has the potential to significantly disrupt the aviation and passenger facilities at Site 6 as a result of potential temporary closures to parts of the site to allow construction or provide for construction sites, disruption to pedestrian or traffic access to or within the site, and air quality and noise impacts. The Plan includes commitments that are expected to adequately address these potential construction impacts (see below).

The increase in populations in the area facilitated by the urban development is likely to increase the demand for aviation services and passenger facilities at the site. This is likely to be overall a positive benefit to the airport and is expected to be adequately managed through existing management and operational processes.

Population increases may also lead to increased pressure on roads, transport and other infrastructure that service the university. However, the Plan intends to provide for future transport needs by supporting the delivery of major transport projects for Western Sydney. It is also expected that future transport and infrastructure needs of the airport will be provided for through existing local and regional planning processes.

Commitments and mitigation measures

The Plan includes commitments to avoid and minimise (Commitment 4) and mitigate (Commitment 6) impacts from the major transport corridors, including the OSO tunnel, in accordance with assessment and approval processes under the State Significant Infrastructure (SSI) process (or equivalent) and the Biodiversity Assessment Method (BAM) process (or equivalent). These assessment processes will apply to each transport project prior to it proceeding.

Commitment 4 includes a specific commitment (Commitment 4.3) that requires Transport for NSW to avoid and minimise impacts where possible to environmental values within Commonwealth Land sites, including known populations and habitat and TECs and existing infrastructure and services, at:

- Camden Airport (Site 6)
- Western Sydney University (Campbelltown Campus) (Site 4)
- 12 Werombi Road, Grasmere NSW (Site 7)

Commitment 6 requires Transport for NSW to mitigate indirect impacts on TECs, species and their habitat within major transport corridors, including the OSO tunnel.

The SSI assessment process is described in detail in Chapter 15, Section 15.6.3. The process requires the preparation of an Environmental Impact Statement (EIS) for each tunnel project in accordance with the Planning Secretary's assessment requirements (SEARs). The EIS must identify and assess all relevant environmental impacts of the tunnel projects, identify mitigation measures and commit to performance outcomes for managing these impacts, and identify the detail of ongoing construction and operational management plans and monitoring programs (DPIE, 2020c).

The BAM assessment process provides a robust method and set of requirements for avoiding and minimising direct impacts, including requirements to justify where impacts are unavoidable, and for identifying and implementing mitigation measures to address indirect impacts. It also requires any residual impacts to be offset.

Commitment 4 and Commitment 6 also include a series of actions to support the effective implementation of avoidance and mitigation and offset measures identified through the SSI and BAM assessment processes, including on Commonwealth land. These actions require Transport for NSW to:

- Assess the impacts of the major transport corridors, including the OSO tunnel, based on detailed design
- Avoid and minimise impacts in accordance with the BAM (or equivalent) during the assessment phase of each transport project, including specific biodiversity values or Commonwealth land sites
- Identify and implement mitigation measures to address indirect impacts based on the outcomes of the assessment in accordance with the requirements of the SSI approval process (or equivalent)
- Offset unavoidable impacts in accordance with the BAM (or equivalent) and EPBC Act Environmental Offsets Policy, 2012 for any EPBC Act matters not covered by the BAM

These commitments and actions ensure avoidance and mitigation and offset measures relating to MNES and whole of environment values are specifically considered and effectively implemented on Commonwealth land.

Commitment 4 and 6 are considered adequate to manage the risks of impacts to whole of environment values of Site 6. These commitments ensure assessment processes will be implemented to avoid and mitigate and where necessary, offset impacts, including specifically requiring avoidance of impacts to whole of environment values at Site 6. The commitments also include governance arrangements to provide assurance that the assessment processes will lead to the effective identification and implementation of avoidance and mitigation measures. Transport for NSW is required to report to the Department and the executive implementation committee on:

- Avoidance achieved within the major transport corridors
- Any additional impacts outside the corridors
- Any offsets to be secured under the SSI approval process and EPBC Act Environmental Offsets Policy, 2012
- Mitigation measures proposed to manage impacts of each major transport corridor project, including proposed techniques, timing, frequency and responsibility for implementing each measure

Furthermore, Commitment 6 establishes monitoring and adaptive management requirements to ensure mitigation measures are adjusted where necessary to ensure their effectiveness. Transport for NSW is required to establish baseline data and monitor high environmental value areas and adjust mitigation measures (where practical) in response to monitoring outcomes. This requirement will ensure risks such as ground subsidence and settlement and associated hydrological impacts due to groundwater drawdown (which will be assessed in accordance with the requirements of the SSI assessment process (or equivalent)) will be effectively managed at Site 6.

35.3.7 SITE 7

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	N/A
Site ID number	7
Area	4.7 ha
Address	12 Werombi Road, Grasmere NSW
Folio	5/221387
General description	The site located at 12 Werombi Road, Grasmere NSW. It is understood the site is a space weather monitoring site run by the Bureau of Meteorology. It occurs within the Strategic Assessment Area, approximately 53 km south-west of the Sydney CBD
Site map	The location of Site 7 is shown in Map 35-8
DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS	
The site occurs within the footprint of the tunnel section of the OSO from Cobbitty to Cawdor. The nearest urban capable land occurs approximately 9 km to the west within GMAC	
LANDSCAPES AND LANDFORMS	
This site occurs in a landscape of gently undulating rises on Wianamatta Group shales	
SOIL AND SUBSTRATES	
The soil landscape at Site 7 is Blacktown soil. Blacktown soils are a hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018)	
WATER	
The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018) A minor non-perennial watercourse intersects the north-west corner of the site. The Nepean River occurs approximately 600 m north east of the site	
VEGETATION	
Native vegetation covers the whole site. The vegetation that occurs on the site is Cumberland Plain Woodland, a Commonwealth and NSW-listed TEC. The TEC is in thinned condition. The vegetation is relatively isolated, and is bounded by Werombi Road to the south, and existing urban development to the west and east. There is some connectivity to the north of the site with the riparian corridor of the Nepean River	

Plant Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)

PCT number	PCT name	NSW TEC name	BC Act status	Area (ha)
0	Cleared	N/A	N/A	0.1
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	1.0

850	Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	3.5
Commonwealth listed threatened ecological communities (TECs)				
TEC name			**EPBC Act status**	**Area (ha)**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest			Critically Endangered	4.5
Threatened flora species				
Name		**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pimelea spicata (Spiked Rice-flower)		Endangered (BC Act & EPBC Act)	4.4	0
Pomaderris brunnea (Brown Pomaderris)		Endangered (BC Act) Vulnerable (EPBC Act)	1.9	0
BIO Map Priority Investment Areas				
No BIO Map core or corridor areas have been identified on this site				
ANIMAL SPECIES				
There are no threatened fauna records known from the site				
Threatened fauna species				
Name		**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pommerhelix duralensis (Dural Land Snail)		Endangered (BC Act & EPBC Act)	4.3	0
*Pteropus poliocephalus (*Grey-headed Flying-fox)		Vulnerable (BC Act & EPBC Act)	4.4	0
Anthochaera phrygia (Regent Honeyeater)		Critically Endangered (BC Act & EPBC Act)	4.5	0
Lathamus discolor (Swift Parrot)		Endangered (BC Act) Critically Endangered (EPBC Act)	4.5	0
CONSERVATION AND SPECIAL USE AREAS				
There are no conservation or special use areas on the site. A Registered Property Agreement protecting biodiversity values occurs at Camden Airport (approximately 700 m north of the site on the other side of the Nepean River)				
HERITAGE PLACES AND ITEMS				
It is not known whether the site has any historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having heritage values				
SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES				
The site is understood to be currently used for space weather monitoring and includes one building The following tenements exist on this site (NNTT, 2020): • Mining tenement (AUTH281) • Petroleum tenement (PPL1) No Native Title Claims exist over this site (NNTT, 2020)				

IMPACT ASSESSMENT

Direct impacts

Site 7 occurs wholly within the footprint of the OSO tunnel and may be directly impacted by construction of the tunnel. There will be no direct impacts to Site 7 due to other development under the Plan. The OSO tunnel may result in small direct impacts to the land surface generally within the tunnel footprint. In limited circumstances, direct impacts may occur adjacent to the footprint.

It is important to note the OSO tunnel will greatly reduce the potential for direct impacts to the land surface within the tunnel footprint compared to the rest of the major transport corridors (non-tunnel sections). Direct impacts may only occur to small areas of the tunnel footprint and the vast majority of land surface within the tunnel footprint will not be disturbed.

As for the other major transport corridors, the tunnel footprints are generally wider than needed and the final alignment of the tunnels within the footprint, and potential associated surface impacts, will be subject to future processes of refinement during the strategic planning and detailed design phase of the projects.

Activities associated with tunnels are described in Chapter 36, Section 36.2.2. In summary, disturbance to the land surface due to the OSO tunnel, including vegetation clearing, may occur due:

- Construction activities
- Ancillary infrastructure, including ventilation systems
- Other infrastructure, such as entry and exit ramps and connection and tie in with existing roads and infrastructure
- Pedestrian and cyclist facilities
- Drainage work, pavement and finishing work

This may result in the following direct impacts:

- Impacts to biodiversity values through clearing of native vegetation and habitat
- Disturbance or destruction of buildings, roads and other infrastructure, and associated disruption of services

Direct impacts on these values are discussed below.

Indirect impacts

Site 7 also has the potential to be indirectly impacted by construction and operation of the OSO tunnel.

The nearest urban and industrial and infrastructure development is too distant (over 9 km) to be impacted by construction of the development. However, there may be indirect impacts on the site from increased populations in the area associated with urban development.

The potential indirect and facilitated impacts associated with this development and the key values of the environment of Site 7 that are potentially impacted are shown in Table 35-9.

Indirect impacts on these values are discussed below.

Table 35-9: Potential indirect impacts on Site 7 associated with the development

Potential indirect impact	Extent within Site 7	Duration	Values potentially impacted
Construction			
Soil erosion and disturbance from vegetation clearing and earthworks	Whole of site	Generally short term	People and communities Biodiversity values
Changes to water quality from soil erosion or disturbance of contaminated soils			

Potential indirect impact	Extent within Site 7	Duration	Values potentially impacted
Air quality, noise impacts, and visual or other impacts to amenity			
Construction traffic causing disruption or reduced accessibility to the site			
Spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat			
Disruption to land uses, services or infrastructure	Whole of site	Generally short term	People and communities
Operation			
Ground settlement and subsidence from tunnels due to the tunnel void or groundwater removal, leading to disturbance to the land surface	Whole of site	Short to long term	People and communities Biodiversity values

Assessment of direct and indirect impacts

Biodiversity values

The biodiversity values that occur within or in the vicinity of the OSO tunnel footprint and that will be potentially directly and indirect impacted are identified in the profile above. The site contains small amounts of Cumberland Plain Woodland, which is in thinned condition and is relatively isolated from other nearby native vegetation.

Construction of the tunnel may cause indirect impacts to biodiversity values in Site 7 from the spread of weeds, disease, and inadvertent impacts on adjacent habitat or vegetation. The tunnel also has the potential to cause ground settlement and subsidence due to the tunnel void or groundwater removal leading to disturbance to the land surface, as well as groundwater drawdown, both of which may impact biodiversity values.

The risk of notable direct and indirect impacts from the OSO tunnel on biodiversity values is considered to be minimal because:

- Total extent of potential impacts is likely to be small. Only a small area of the tunnel footprint is likely to be directly impacted and the vast majority of the land surface within the tunnel footprints will not be disturbed
- The biodiversity values of Site 7 are not notable
- The Plan includes commitments to (see below):
    - Avoid and minimise impacts to biodiversity values where disturbance to the land surface within or in the vicinity of the tunnel footprint is necessary, and if impacts are unavoidable, to offset those impacts in accordance with regulatory requirements
    - Mitigate indirect impacts to biodiversity values

People and communities

Construction of the tunnel has the potential to disrupt the services provided at Site 7 – space weather monitoring – as a result of potential temporary closures to parts of the site to allow construction or provide for construction sites, disruption to traffic access to or within the site, and air quality and noise impacts. The Plan includes commitments that are expected to adequately address these potential construction impacts (see below).

Commitments and mitigation measures

The Plan includes commitments to avoid and minimise (Commitment 4) and mitigate (Commitment 6) impacts from the major transport corridors, including the OSO tunnel, in accordance with assessment and approval processes under the State Significant Infrastructure (SSI) process (or equivalent) and the Biodiversity Assessment Method (BAM) process (or equivalent). These assessment processes will apply to each transport project prior to it proceeding.

Commitment 4 includes a specific commitment (Commitment 4.3) that requires Transport for NSW to avoid and minimise impacts where possible to environmental values within Commonwealth Land sites, including known populations and habitat and TECs and existing infrastructure and services, at:

- Camden Airport (Site 6)
- Western Sydney University (Campbelltown Campus) (Site 4)
- 12 Werombi Road, Grasmere NSW (Site 7)

Commitment 6 requires Transport for NSW to mitigate indirect impacts on TECs, species and their habitat within major transport corridors, including the OSO tunnel.

The SSI assessment process is described in detail in Chapter 15, Section 15.6.3. The process requires the preparation of an Environmental Impact Statement (EIS) for each tunnel project in accordance with the Planning Secretary's assessment requirements (SEARs). The EIS must identify and assess all relevant environmental impacts of the tunnel projects, identify mitigation measures and commit to performance outcomes for managing these impacts, and identify the detail of ongoing construction and operational management plans and monitoring programs (DPIE, 2020c).

The BAM assessment process provides a robust method and set of requirements for avoiding and minimising direct impacts, including requirements to justify where impacts are unavoidable, and for identifying and implementing mitigation measures to address indirect impacts. It also requires any residual impacts to be offset.

Commitment 4 and Commitment 6 also include a series of actions to support the effective implementation of avoidance and mitigation and offset measures identified through the SSI and BAM assessment processes, including on Commonwealth land. These actions require Transport for NSW to:

- Assess the impacts of the major transport corridors, including the OSO tunnel, based on detailed design
- Avoid and minimise impacts in accordance with the BAM (or equivalent) during the assessment phase of each transport project, including specific biodiversity values or Commonwealth land sites
- Identify and implement mitigation measures to address indirect impacts based on the outcomes of the assessment in accordance with the requirements of the SSI approval process (or equivalent)
- Offset unavoidable impacts in accordance with the BAM (or equivalent) and EPBC Act Environmental Offsets Policy, 2012 for any EPBC Act matters not covered by the BAM

These commitments and actions ensure avoidance and mitigation and offset measures relating to MNES and whole of environment values are specifically considered and effectively implemented on Commonwealth land.

Commitment 4 and 6 are considered adequate to manage the risks of impacts to whole of environment values of Site 7. These commitments ensure assessment processes will be implemented to avoid and mitigate and where necessary, offset impacts, including specifically requiring avoidance of impacts to whole of environment values at Site 7. The commitments also include governance arrangements to provide assurance that the assessment processes will lead to the effective identification and implementation of avoidance and mitigation measures. Transport for NSW is required to report to the Department and the executive implementation committee on:

- Avoidance achieved within the major transport corridors
- Any additional impacts outside the corridors
- Any offsets to be secured under the SSI approval process and EPBC Act Environmental Offsets Policy, 2012
- Mitigation measures proposed to manage impacts of each major transport corridor project, including proposed techniques, timing, frequency and responsibility for implementing each measure

Furthermore, Commitment 6 establishes monitoring and adaptive management requirements to ensure mitigation measures are adjusted where necessary to ensure their effectiveness. Transport for NSW is required to establish baseline data and monitor high environmental value areas and adjust mitigation measures (where practical) in response to monitoring outcomes. This requirement will ensure risks such as ground subsidence and settlement and associated hydrological impacts due to groundwater drawdown (which will be assessed in accordance with the requirements of the SSI assessment process (or equivalent)) will be effectively managed at Site 7.

35.3.8 SITE 8 (WESTERN SYDNEY (NANCY-BIRD WALTON) INTERNATIONAL AIRPORT)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	Western Sydney (Nancy-Bird Walton) International Airport
Site ID number	8
Area	1,745.5 ha
Address	Badgerys Creek Road, Badgerys Creek NSW
Folio	101/123631, 11/226448, 9/226448, 3/611519, 7/3050, 8/3050, 2/C/1451, 11/1239207, 98/1236319, 99/1236319, 102/123631, 103/123631, 9/1233751, 14/1233751, 13/1233751, 8/1233751, 5/1233751, 32/259698, 108/123631, 107/123631, 23/259698, 17/258581, 6/1233751, 1/1233751, 3/1233751, 4/1233751, 1/129674
General description	Site 8 comprises the new Western Sydney (Nancy-Bird Walton) International Airport at Badgerys Creek. Construction of the airport is currently underway. The site has historically been used for agricultural purposes, consisting of stock grazing, cropping, orchards, dairying, and market gardening (DIRD, 2016a). Prior to commencement of airport construction works, native vegetation covered 25.0 per cent of the site. The site is located approximately 42 km west of the Sydney CBD
Site map	The location of Site 8 is shown in Map 35-9
DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS	
Site 8 shares its northern, western and south-western border with urban capable land in WSA	
LANDSCAPES AND LANDFORMS	
This site occurs in a landscape of gently undulating to rolling low hills and floodplains, valley flats and drainage depressions. As part of airport construction works, extensive landscaping will be undertaken on site to flatten the runway regions and provide suitable surfaces for airport infrastructure	
SOIL AND SUBSTRATES	
The soil landscape at Site 8 is made up of: • 1,477.9 ha Blacktown soil landscape – Blacktown soils are a hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018) • 78.7 ha Luddenham soil – Luddenham soils exist in varying forms depending on their location on a slope. Podzolic soils or earthy clays, yellow podzolic soils, and prairie soils are found on crests, upper slopes, and drainage lines respectively (OEH, 2018) • 189.0 ha Wianamatta (South Creek) soil – Wianamatta (South Creek) soils are deep layered sediments that occur over bedrock or relict soils (minerals/structures that have not undergone metamorphic change while the surrounding rock has) (OEH, 2018)	
WATER	
Site 8 occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018). The site is located on the Bringelly Shale aquifer (DIRD, 2016d) There are several waterways within Site 8, including Badgerys Creek, Cosgroves Creek, Oaky Creek, and Duncans Creek. These will be significantly modified by the new airport (DIRD, 2016d)	
VEGETATION	
Most native vegetation that exists within the site will be removed for the new airport. While some areas of low vegetation (such as grass) will likely be retained within the airport layout (such as adjacent to the runways), such vegetation will be subject to ongoing management (such as mowing) and has little biodiversity value	

Environmental protection zones will be established along the riparian corridor of Badgerys Creek, and on the small site to the west of The Northern Road which is separated from the rest of Site 8. Existing vegetation within these areas will be protected from impacts associated with the airport development. Ecological communities within these areas include (DIRD, 2016b)

- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain
- Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain
- Exotic grassland

BIO Map Priority Investment Areas

No BIO Map core or corridor areas have been identified on this site

ANIMAL SPECIES

Prior to the completion of the airport development, available fauna habitat on Site 8 included grassland, cropped areas, native woodland, riparian forest, and wetlands, and the site was known to support 173 fauna species known to occur at the site, including a number of threatened fauna species (DIRD, 2016b)

Following completion of the airport development, fauna habitat types at Site 8 will primarily include riparian forest and grassland and it is expected that fewer fauna species will have suitable habitat available on-site

CONSERVATION AND SPECIAL USE AREAS

Environmental protection zones will be established along the riparian corridor of Badgerys Creek, and on the small site to the west of The Northern Road which is separated from the rest of Site 8

HERITAGE PLACES AND ITEMS

Surveys were conducted for the Western Sydney Airport EIS that identified existing and new historic and indigenous heritage items (DIRD, 2016a, 2016c).

Identified indigenous heritage sites include numerous surface artefacts (including a grinding groove site), a modified tree, and subsurface artefacts. Higher artefact densities were found in close proximity to permanent water. The site was identified to be important as a place of cultural significance and continuing cultural connection by indigenous stakeholders consulted as part of the EIS process for Western Sydney Airport.

European heritage items reflect the historical development of the locality, including early efforts to develop agricultural economies and settled village communities. Examples of heritage items include early residential and commercial buildings, remains of early churches and associated graveyards, and infrastructure including historical wells.

As part of the airport development process, numerous strategies have been prepared and implemented to record, preserve and (where required) salvage heritage items on site to ensure that these items are protected from the impacts of the airport development

SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES

Site 8 is the future site for the new Western Sydney (Nancy-Bird Walton) International Airport, which is currently being constructed. The site will include

- Runways
- Taxiways and aprons
- Aviation rescue and fire-fighting services
- Air traffic control
- Airport terminals
- Utilities
- Road and rail access

The following tenement exists on this site (NNTT, 2020):

- Mining tenement (EL8429) – exploration lease
- Mining tenement (ML1771) – mining lease

No Native Title Claims exist over this site (NNTT, 2020)

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 8 due to the Plan (although note the GIS boundary error discussed in section 35.1, which wrongly suggests there are very small direct impacts).

Indirect and facilitated impacts

Site 8 has the potential to be indirectly impacted by construction and operation of the urban and industrial development and infrastructure, which occurs adjacent to the northern, western and southern boundaries of the site.

The potential indirect and facilitated impacts associated with these developments and the key values of the environment of Site 8 that are potentially impacted are shown in Table 35-10.

Table 35-10: Potential indirect impacts on Site 8 associated with the development

Potential indirect impact	Extent within Site 8	Duration	Values potentially impacted
Construction			
Soil erosion and disturbance from vegetation clearing and earthworks	Boundaries of the site	Generally short term	People and communities Biodiversity values
Changes to water quality from soil erosion or disturbance of contaminated soils			
Air quality, noise impacts, and visual or other impacts to amenity			
Construction traffic causing disruption or reduced accessibility to the site			
Spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat			
Disruption to land uses, services or infrastructure	Whole of site	Generally short term	People and communities
Operation			
Changes to surface water flows due to additional runoff from urban areas	Waterways within the site	Long term	Water resources Biodiversity values
Disruption to land uses, services or infrastructure	Whole of site	Long term	People and communities

Biodiversity values

There is potential for indirect impacts from construction and operation of urban, industrial, and infrastructure development on the environmental protection zones to the west of The Northern Road, including spread of weeds and disease, fauna disturbance and inadvertent impacts on adjacent habitat, as well as potentially increased risk of human disturbance from public access. This area contains approximately 12 ha of mostly good condition Forest Red Gum - Rough-barked Apple grassy woodland, 4.9 ha of mostly poor condition Grey Box - Forest Red Gum grassy woodland, with the remainder of the site (approximately 3.5 ha) containing exotic grassland (DIRD, 2016b).

The OSO to the west of the site has the potential to reduce the connectivity of the environmental protection zones adjacent to The Northern Road. This area is currently connected to the riparian corridor of Duncan's Creek, which connects to patches of habitat and riparian corridors that link to the Nepean River to the west. The potential impacts of the OSO on the riparian corridor at Duncan's Creek may reduce the habitat values of the site for native species, and may decrease the viability of the vegetation communities on site.

The Plan includes commitments that are expected to adequately address these potential impacts on biodiversity values in Site 8 resulting from construction and operation of the development (see below).

Water resources

There is potential for runoff from urban industrial, and infrastructure development to impact surface water flows and water quality in Badgerys Creek, as this development is located adjacent to upstream tributaries of the creek. The Plan includes commitments that are expected to adequately address these potential impacts (see below).

The riparian corridor along Badgerys Creek is not considered to be at risk of other indirect impacts (such as noise or light) as a result of the Plan, as urban development is not planned to occur adjacent to the creek.

People and communities

Construction of the development has the potential to disrupt the airport services and facilities at Site 8 once the site is operating, as a result of potential temporary closures to parts of the site to allow construction or provide for construction sites, disruption to pedestrian or traffic access to the site, and air quality and noise impacts. The Plan includes commitments that are expected to adequately address these potential construction impacts (see below).

The urban and industrial development, infrastructure, and intensive plant agriculture development within the vicinity of Site 8 will directly complement the use of the site as a major airport facility. The development will provide commercial and residential and intensive plant agriculture facilities in close proximity to the airport. This will allow for:

- The development of new commercial precincts in association with economic activity generated by the airport
- The provision of accessible and affordable housing close to the airport site to provide for employees of the airport and related commercial enterprises

The urban development and transport development under the Plan will therefore complement the operation of the airport at Site 8 and will subsequently produce a range of social and economic benefits.

Commitments and mitigation measures

The Plan includes commitments to mitigate indirect impacts from construction and operation associated with urban and industrial and infrastructure development. These commitments and processes to deliver these comments are different for each type of development.

Urban and industrial development

The Plan includes a commitment to mitigate indirect impacts from urban and industrial development (Commitment 5).

A Development Control Plan (DCP) will be prepared for each nominated area by either the Department (in the case of Department led precincts) or by the relevant councils in collaboration with the Department. DCPs are non-legally binding planning policies that provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act. DCPs for each nominated area will be prepared in accordance with:

- A DCP template prepared by the Department to support implementation of the Plan
- Standard format for DCPs and a set of model provisions that apply across NSW
- Any processes and guidelines for preparing DCPs specific to each council
- Current best practice standards, guidelines or targets (e.g. water quality standards for urban runoff)

DCPs will incorporate several types of development controls (see Chapter 15, Section 15.6.1), including a broader set of controls that address indirect impacts on environmental values generally. These controls are commonly implemented by planning authorities through the development application process to manage indirect impacts on environmental values, on such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

Examples of these types of controls included in the draft Wilton DCP that are relevant to addressing indirect and facilitated impacts on Site 8 from urban and industrial development are provided in Table 35-11.

Planning authorities will be responsible for making decisions about the specifics of these controls in each DCP and through the development application process based on best practice standards and guidelines.

Table 35-11: Summary examples of broader environmental controls commonly included in DCPs (from draft Wilton DCP)

Control type	Summary of example control in draft Wilton DCP
Water cycle management	• Water management measures must comply with council's requirements for detention, drainage and water sensitive urban design principles • Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise run-off and sediment and pollutants to waterways
Water quality	• Stormwater systems must be constructed/maintained to achieve EES water quality targets
Soil erosion and sedimentation	• Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development • Soil and Water Management Plans must be prepared in accordance with *Managing Urban Stormwater* (Landcom, 2004) and included in development applications
Air quality	• Development must comply with the *Protection of the Environment Operations Act 1997* and supporting regulations. An Odour Impact Assessment must be submitted when required • Provide a barrier to mitigate dispersion of air pollutants, noise or odour where necessary
Noise	• Provide a barrier to mitigate dispersion of air pollutants, noise or odour • Development must include buffers to limit noise impacts on surrounding areas • An acoustic report must be submitted to address the impact of noise generation
Traffic/construction traffic	• Ensure the road networks are designed to control traffic speeds to appropriate limits • Provide a traffic report/statement to address the impact of the development on the local road system and address traffic safety issues

These development controls and the process for implementing them are expected to adequately address the potential indirect and facilitated impacts of the urban and industrial development that will occur adjacent to Site 8.

A detailed description of the process to implement development controls to address indirect impacts, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

Infrastructure

Commitment 5 also includes mitigation of indirect impacts from infrastructure development.

Infrastructure will be subject to future environmental assessment and approval processes under the EP&A Act at the time the projects are proposed. Infrastructure covering the broad types under the Plan (see Part 2) is subject to different environmental assessment processes. These are summarised in Chapter 15, Section 15.6.2.

Commitment 5, Action 2 specifies that mitigation measures will be identified and implement based on the outcomes of the environmental assessment of detailed designs of each infrastructure project in accordance with the requirements of the NSW approval processes under the EP&A Act, as well as published, best practice guidelines.

Public authorities typically incorporate a broad set of mitigation measures through these assessment processes to manage indirect impacts of infrastructure on environmental values generally, including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

It is considered that Commitment 2 will lead to the identification and implementation of a set of mitigation measures that will adequately manage potential indirect impacts on Site 8 from infrastructure.

A detailed description of the processes to implement mitigation measures for infrastructure, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2.

35.3.9 SITE 9 (RAAF TELECOMMUNICATIONS UNIT)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	RAAF Telecommunications Unit
Site ID number	9
Area	114.9 ha
Address	215 Badgerys Creek Road, Bringelly NSW
Folio	10/1235662
General description	The site is located 215 Badgerys Creek Road, Bringelly NSW. The site contains 16.2 per cent native vegetation cover. The site occurs in the Strategic Assessment Area, approximately 45 km south-west of the Sydney CBD
Site map	The location of Site 9 is shown in Map 35-10

DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS

The site is located approximately 2 km from nearest development under the Plan – urban and industrial development, infrastructure and intensive plant agriculture in WSA. The land surrounding the site consists of low density, rural residential and commercial areas

LANDSCAPES AND LANDFORMS

This site occurs in a landscape of gently undulating rise and floodplains, valley flats and drainage depressions

SOIL AND SUBSTRATES

The soil landscape at Site 9 is made up of:

- 84.5 ha Blacktown soil – Blacktown soils are a hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018)
- 30.4 ha Wianamatta (South Creek) soil – Wianamatta (South Creek) soils are deep layered sediments that occur over bedrock or relict soils (minerals/structures that have not undergone metamorphic change while the surrounding rock has) (OEH, 2018)

WATER

The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018)

The site is relatively flat. Moore Gully waterway passes through the southern part of the site. Two naturally occurring ponds are connected to this waterway. Five other drainage lines flow into Thompsons Creek and originate from varying locations on the site (DoI, 2019; DTA, DCA et al., 2019)

VEGETATION

Approximately 16.2 per cent (18.6 ha) of the site is covered by native vegetation. The eastern edge of the site borders on a narrow riparian corridor that follows Thompsons Creek in a south-north direction

The native vegetation on the site, with the exception of the riparian corridor, is isolated from other substantial areas of vegetation and is in thinned (low) condition

Plant Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)

PCT number	PCT name	NSW TEC name	BC Act status	Area (ha)
0	Cleared	N/A	N/A	96.3

835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvium flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	4.1
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	5.6
850	Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	8.9

Commonwealth listed threatened ecological communities (TECs)		
TEC name	**EPBC Act status**	**Area (ha)**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	7.3
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria	Critically Endangered	4.1

Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Acacia bynoeana (Bynoe's Wattle)	Vulnerable (BC Act) Endangered (EPBC Act)	0.3	0
Acacia pubescens (Downy Wattle)	Vulnerable (BC Act & EPBC Act)	4.6	0
Eucalyptus benthamii (Camden White Gum)	Vulnerable (BC Act & EPBC Act)	2.0	0
Pimelea spicata (Spiked Rice-flower)	Endangered (BC Act & EPBC Act)	14.8	0
Pultenaea parviflora	Endangered (BC Act) Vulnerable (EPBC Act)	15.7	0
Pimelea curviflora var. *curviflora*	Vulnerable (BC Act & EPBC Act)	2.7	0

BIO Map Priority Investment Areas
No BIO Map core or corridor areas have been identified on this site
ANIMAL SPECIES
There is one record of Cumberland Land Snail known from the site

Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pommerhelix duralensis (Dural Land Snail)	Endangered (BC Act & EPBC Act)	16.7	0

Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	17.0	0
Botaurus poiciloptilus (Australasian Bittern)	Endangered (BC Act & EPBC Act)	1.4	0
Petauroides volans (Greater Glider)	Vulnerable (EPBC Act)	0.4	0
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	18.6	0
*Lathamus discolor (*Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	18.6	0

CONSERVATION AND SPECIAL USE AREAS

There are no conservation or special use areas present on this site

The closest conservation or special use areas are:

- Area under a conservation agreement in Badgerys Creek (approximately 7.5km north)
- Kemps Creek Nature Reserve (approximately 5.5km northeast)
- Metro offset site (approximately 7km northeast)
- Biobanking agreement site in Mulgoa (approximately 8.5km north west)
- A number of biobanking agreement sites (approximately 8 northeast)
- A biobanking agreement site in Leppington (approximately 8.5km south east)
- Bents Basin and Gulguer Nature Reserves (approximately 8-10km west)
- A number of Metro offset sites (approximately 9km south)
- Edmondson Regional Park (approximately 10km south east)
- A Metro offset site (approximately 10.5km east)

HERITAGE PLACES AND ITEMS

It is not known whether the site has any historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having any heritage values

SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES

The site is an RAAF telecommunications unit. The telecommunications unit is no longer in use. The site is part of the future Aerotropolis Town Centre, within the South West Sydney Growth Centre

No Native Title Claims exist over this site (NNTT, 2020)

The following tenement exists on this site (NNTT, 2020): Mining tenement (EL8429)

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 9 due to the Plan.

Indirect and facilitated impacts

Site 9 occurs approximately 1.9 km from the nearest development under the Plan – urban and industrial, infrastructure and intensive plant agriculture development within WSA. The land surrounding Site 9 consists of low density, rural residential and commercial areas. The site is also located upstream of the nearest development and within a separate sub-catchment. The location of the site relative to the development and nature of the areas surrounding the site means:

- The site is very unlikely to be impacted by impacts typically associated with construction of the development in WSA such as air quality, noise, construction traffic, or the spread of weeds or disease
- The site will not be impacted by soil erosion of sedimentation, changes to surface and groundwater quantity and flows, or water quality impacts associated with the construction and operation of the development

Furthermore, the site no longer appears to be in use. If this is the case, the development would not disrupt any services or site operations or affect the health or safety of any person associated with the site.

The potential indirect or facilitated impacts associated with the development in WSA and the key values of the environment of Site 9 that are potentially impacted are shown in Table 35-12.

Table 35-12: Potential indirect impacts on Site 9 associated with the development

Potential indirect impact	Extent within site 1	Duration	Values of site potentially impacted
Construction			
Clearing of habitat during construction of the development that links the site to other areas of habitat, leading to impacts on biodiversity values	Whole of site	Long term	Biodiversity values

Biodiversity values

There are some areas of vegetation present on Site 9 which provide some habitat values for a number of native species. The habitat on Site 9 is primarily connected to the surrounding environment via a vegetated riparian corridor which continues to the north-east and south-west of the site.

The connectivity of this riparian corridor to the surrounding area will not be directly impacted by development under the Plan, and therefore the habitat values of the site are unlikely to be impacted indirectly by the Plan.

Commitments and mitigation measures

No commitments or mitigation measures are considered necessary to address the potential indirect impacts on the environment of Site 9 from the development under the Plan.

35.3.10 SITE 10

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	N/A
Site ID number	10
Area	10.5 ha
Address & Folio	221 Greendale Road, Greendale NSW
Folio	15/229293
General description	The site located at 221 Greendale Road, Greendale NSW. The site appears to have been purchased by the Commonwealth Government between the period 1986 to 1991 as part of several land purchases for the Western Sydney airport (RPS, 2015, Western Sydney Airport Environmental Impact Statement: Appendix N Planning and Landuse). The site appears to be a large lot rural residential property comprising two residential buildings, a number of small sheds, several farm dams, and several paddocks that may be used for grazing. Approximately 19.1 per cent of the site is covered by native vegetation. The site occurs within the Strategic Assessment Area, approximately 45 km south-west of the Sydney CBD
Site map	The location of Site 10 is shown in Map 35-11
DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS	
The site is directly impacted by the footprint of the OSO under the Plan. The area of impact is approximately 4 ha, and occurs along the north-eastern corner of the site	
LANDSCAPES AND LANDFORMS	
This site occurs in a landscape of gently undulating rises to rolling low hills on Wianamatta Group shales	
SOIL AND SUBSTRATES	
The soil landscape at Site 10 is made up of: • 10.1 ha of Blacktown soil – Blacktown soils are a hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018) • 0.4 ha of Luddenham soil – Luddenham soils exist in varying forms depending on their location on a slope. Podzolic soils or earthy clays, yellow podzolic soils, and prairie soils are found on crests, upper slopes, and drainage lines respectively (OEH, 2018)	
WATER	
The site occurs within the Hawkesbury-Nepean catchment. Water quality is variable throughout the area. The majority of the upper reaches of streams and rivers are healthy, while downstream reaches are affected by historical land uses (e.g. clearing, urbanisation) (GES, 2018) The site contains a number of dams, which appear likely to be stock dams based on aerial imagery. The site is located at the headwaters of two drainage lines, which feed into Duncans Creek, and from there enter the Nepean River	
VEGETATION	
Native vegetation primarily occurs on the southern half of the site, with some scattered paddock trees occurring in the northern half of the site. Areas with trees occupy approximately 2 ha of the site The remainder of the site is cleared and may be used for grazing cattle The site is located within a wider agricultural landscape, which includes completely cleared areas, paddocks with scattered paddock trees and small vegetation patches, and larger, more connected areas of vegetation which tend to be associated with riparian corridors. Overall, the landscape is significantly fragmented, with riparian corridors and small patches of vegetation serving as 'stepping stones' through otherwise cleared paddocks	

Plant Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)				
PCT number	**PCT name**	**NSW TEC name**	**BC Act status**	**Area (ha)**
0	Cleared	N/A	N/A	8.5
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	0.4
850	Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	1.6

Commonwealth listed threatened ecological communities (TECs)		
TEC name	**EPBC Act status**	**Area (ha)**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	1.3

Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Acacia pubescens (Downy Wattle)	Vulnerable (BC Act & EPBC Act)	1.7	0
Pimelea spicata (Spiked Rice-flower)	Endangered (BC Act & EPBC Act)	0.5	0

BIO Map Priority Investment Areas
No BIO Map core or corridor areas have been identified on this site

ANIMAL SPECIES
There are no threatened fauna records known from the site

Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pommerhelix duralensis (Dural Land Snail)	Endangered (BC Act & EPBC Act)	1.8	0
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	1.8	0
Petauroides volans (Greater Glider)	Vulnerable (EPBC Act)	1.3	0
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	2.0	0
Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	2.0	0

CONSERVATION AND SPECIAL USE AREAS
There are no conservation or special use areas present on this site The closest conservation or special use areas are: • Biobanking agreement site in Mulgoa (approximately 5.5km north) • Bents Basin and Gulguer Nature Reserves (approximately 3.5-4.5km south west)
HERITAGE PLACES AND ITEMS
It is not known whether the site has any historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having any heritage values
SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES
The site appears to have been purchased by the Commonwealth Government between the period 1986 to 1991 as part of several land purchases for the Western Sydney airport (RPS, 2015, Western Sydney Airport Environmental Impact Statement: Appendix N Planning and Landuse). The site appears to be a large lot rural residential property comprising two residential buildings, a number of small sheds, several farm dams, and several paddocks that may be used for grazing. The following tenement exists on this site (NNTT, 2020): Mining tenement (EL8429) No Native Title Claims exist over this site (NNTT, 2020)

IMPACT ASSESSMENT

Direct impacts

The OSO will directly impact up to 4.2 ha of Site 10 (39.8 per cent of the site).

Impacts to Site 10 will occur in the north-eastern corner of the site. The features of the site that will be direct impacted include a number of small sheds, a small farm dam, several paddocks that may be used for grazing, scattered paddock trees and a small area (approximately 0.1 ha) of Cumberland Plain Woodland. Note that the transport corridor footprint is located close to (within about 50-100 m) of two residential properties on the site. The south-west of the site, which contains approximately 2 ha of Cumberland Plain Woodland, will not be directly impacted.

Biodiversity values

The transport corridor will directly impact a very small area (approximately 0.1 ha) of Cumberland Plain Woodland The loss of this area is not considered notable. The landscape surrounding the site is significantly fragmented and the native vegetation on the site is isolated and provides little connectivity value to nearby areas of habitat.

Disruption to land uses, services or infrastructure

The OSO will substantially disrupt the existing uses of the site, which appears to be a large lot rural residual property comprising two residential buildings, several paddocks and a number of small sheds.

Indirect and facilitated impacts

Site 10 has the potential to be indirectly impacted by construction and operation of the OSO.

The nearest urban and industrial and infrastructure development is too distant (over 9 km) for the site to be impacted by the construction of this development.

The potential indirect and facilitated impacts associated with this development and the key values of the environment of Site 10 that are potentially impacted are shown in Table 35-13.

Table 35-13: Potential indirect impacts on Site 10 associated with the development

Potential indirect impact	Extent within Site 11	Duration	Values potentially impacted
Construction			
Soil erosion and disturbance from vegetation clearing and earthworks	Whole of site	Generally short term	People and communities Biodiversity values
Air quality, noise impacts, and visual or other impacts to amenity			
Construction traffic causing disruption or reduced accessibility to the site			
Spread of weeds, disease, fauna disturbance and inadvertent impacts on adjacent habitat			
Disruption to land uses, services or infrastructure	Whole of site	Generally short term	People and communities
Operation			
Air quality, noise impacts, and visual or other impacts to amenity	Whole of site	Short to long term	People and communities

Biodiversity values

Construction of the OSO may cause indirect impacts to biodiversity values from the spread of weeds, disease, and inadvertent impacts on adjacent habitat or vegetation.

The most important biodiversity values within the tunnel footprint of Site 10 that may be indirectly impacted are small amounts of Cumberland Plain Woodland. The potential for notable impacts to this TEC is low (see above).

The Plan includes commitments that are expected to adequately address these potential impacts on biodiversity values in Site 10 resulting from construction and operation of the tunnel (see below).

People and communities

The OSO is likely to substantially disrupt any existing uses of the site from impacts such as air quality, noise impacts, and visual or other impacts to amenity associate with construction and operation, as well as construction traffic causing disruption or reduced accessibility to the site. The site appears to be a large lot rural residual property comprising two residential buildings, several paddocks and a number of small sheds.

Commitments and mitigation measures

No commitments or mitigation measures are considered necessary to address any specific notable direct or indirect impacts on the environment of Site 10 from the development under the Plan. However, as discussed for other Commonwealth land sites, the Plan includes commitments to avoid and minimise impacts from the major transport corridors (strategically assessed) (Commitment 4) and mitigate indirect impacts from major transport corridors (Commitment 6) and these are expected to adequately minimise impacts on the environment of Site 10.

35.3.11 SITE 11 (HOLSWORTHY DEFENCE BASE)

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	Holsworthy Defence Base
Site ID number	11
Area	18,826.0 ha
Address	Heathcote Road, Moorebank/Holsworthy NSW
Folio	100/104950, 1/1197707, 4/1130937, 2/1197707, 3/1197707, 4/1197707, 122/119451, 2/1186495, 2/1216308, 1/1216308
General description	Holsworthy Defence Base is located on Heathcote Rd, Moorebank in the Strategic Assessment Area. It is bounded on the south east by Heathcote National Park and by Georges River in the west. Native vegetation covers 95.8 per cent of the site. The site is part of two Commonwealth Heritage Listed sites and five areas listed on the NSW heritage list. The site contains high biodiversity values, supporting a range of threatened species and TECs. Holsworthy is located approximately 35 km south-west of the Sydney CBD
Site map	The location of Site 11 is shown in Map 35-12

DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS

The nearest development under the Plan to Site 11 is urban capable land at the northern end of GMAC (near Glenfield), which is located approximately 1.4 km from the boundary of the site. The land in between the urban capable land and Site 11 in this area consists of existing urban development

In the middle section of GMAC (between Glen Alpine and Rosemeadow), the urban capable land is located approximately 2.5 km from the boundary of Site 11 at its closest point to the site. The land between the urban capable land and Site 11 in this area consists of areas of urban development in the north west, agricultural fields in the south west and riparian vegetation associated with the Georges River in the east

In the southern section of GMAC (between Gilead and Appin), the urban capable land is located approximately 4 km from the boundary of Site 11 at its closest point to the site. The land in between the urban capable land and Site 11 in this area consists of agricultural fields, low density rural residential areas and native vegetation

LANDSCAPES AND LANDFORMS

Site 11 is a large site that occurs across numerous of different landscape types. It occurs in a landscape of undulating rolling rises and low hills through to rugged, rolling to very steep hills on Hawkesbury Sandstone. It contains areas of disturbed terrain, most likely as a result of military activity on the site

SOIL AND SUBSTRATES

The soil landscape at Site 11 is made up of:

- 685.0 ha Berkshire Park soil – Berkshire Park soil consists of heavy clays and clayey sands that are made up of less than a third of soil aggregates (OEH, 2018)
- 448.2 ha Blacktown soil – Blacktown soils are a hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018)
- 220.2 ha Bundeena soil – no soil landscape report available
- 19.3 ha Disturbed Terrain – areas where the original soil has been highly disturbed, buried or removed (OEH, 2018)
- 252.9 ha Faulconbridge soil – Faulconbridge soils are shallow (<50 cm) earthy sands and yellow earths with some siliceous sands associated with rock outcrops (OEH, 2018)

- 510.3 ha Gymea soil – Gymea soils are approximately 30-100 cm deep. The particular soil characteristic depends on the location. Gymea soils are made up of yellow earths and earthy sands, shallow siliceous sands, water logged and yellow podzolic sands, and siliceous and leached sands of < 100 cm in depth (OEH, 2018)
- 6,763.3 ha Hawkesbury soil – Hawkesbury soils are shallow (<50 cm). Rock outcrops, earthy sands, and shale lenses are associated with different aspects of Hawkesbury soils (OEH, 2018)
- 9,806.1 ha Lucas Heights soil – Lucas Heights soils are moderately deep (50-150 cm). The soils are hardsetting and consist of yellow podzolic and yellow soloth soils
- 120.3 ha Richmond soil – Richmond soils consist of orange to red clay loams, clays, and sands that are poorly structured (OEH, 2018)

WATER

Site 11 occurs within the Georges River catchment. The site has an undulating to dissected topography and is bounded on the west by the Georges River and on the east by the Woronora River. All waterways on the site are tributaries of these two rivers (DoI, 2019; DTA, DCA et al., 2019)

VEGETATION

Site 11 is heavily vegetated with 95.8 per cent (18,027.7 ha) of the site covered by native vegetation. The site includes large areas of several Commonwealth-listed TECs, including Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, Castlereagh Scribbly Gum and Agnes Banks Woodlands and Cooks River/Castlereagh Ironbark Forest.

The site is well connected to large areas of habitat and protected lands. Three national parks occur adjacent to the boundaries of the site, including Dharawal National Park (adjacent to the southern boundary), Heathcote National Park (adjacent to the eastern boundary) and Georges River National Park (adjacent to the north eastern boundary). The site connects Heathcote National Park in the east to Dharawal National Park and other large areas of habitat in the west, particularly habitat in the vicinity of the Georges River, and the Nepean River further west

Plant Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)

PCT number	PCT name	NSW TEC name	BC Act status	Area (ha)
0	Cleared	N/A	N/A	798.3
724	Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Shale Gravel Transition Forest in the Sydney Basin Bioregion	Endangered	501.8
725	Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Endangered	65.3
781	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	4.8
		Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Endangered	
835	Forest Red Gum – Rough-barked	River-Flat Eucalypt Forest on Coastal Floodplains of the New	Endangered	32.9

	Apple grassy woodland on alluvium flats of the Cumberland Plain, Sydney Basin Bioregion	South Wales North Coast, Sydney Basin and South East Corner Bioregions		
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	185.2
881	Hairpin Banksia – Kunzea ambigua – Allocasuarina distyle heath on coastal sandstone plateaux, Sydney Basin Bioregion	N/A	N/A	10.9
883	Hard-leaved Scribbly Gum – Parramatta Red Gum healthy woodland of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	Vulnerable	193.8
		Castlereagh Swamp Woodland Community	Endangered	
920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	0.1
941	Mountain Blue Gum – Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	181.6
1067	Parramatta Red Gum on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Swamp Woodland Community	Endangered	34.4
1234	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	1.5
1250	Sydney Peppermint – Smooth-barked	N/A	N/A	2,002.7

	Apple – Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion			
1292	Water Gum – Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion	N/A	N/A	201.2
1395	Narrow-leaved Ironbark – Broad-leaved Ironbark – Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Critically Endangered	165.7
1777	Red Bloodwood – Scribbly Gum – Silvertop Ash open forests on sandstone ridges of the Woronora Plateau	N/A	N/A	2,531.9
1780	Sydney Peppermint / Coachwood – Water Gum open forest in protected sandstone gullies around Sydney and the Central Coast	N/A	N/A	145.1
1787	Red Bloodwood – Scribbly Gum – Stringybark open forest on sandstone ridges along the western side of the Woronora and Hornsby plateaus	N/A	N/A	2,651.9
1789	Smooth-barked Apple – Blackbutt – Red Bloodwood open forest in enriched sandstone gullies of the western Woronora plateau	N/A	N/A	3,591.3
1790	Red Bloodwood – Grey Gum – Stringybark open forest on enriched sandstone ridges of	N/A	N/A	1,319.4

	the western Woronora plateau and lower Blue Mountains			
1798	Flax-leaved Paperbark open to closed mesic forest on alluvial riverflats in the Sydney region	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Endangered	5.4
1803	Banksia – Needlebush – Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin	Coastal Upland Swamp in the Sydney Basin Bioregion	Endangered	222.4
1804	Needlebush – Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin	N/A	N/A	21.2
1808	Common Reed on the margins of estuaries and brackish lagoons along the New South Wales coastline	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	0.0
1824	Mallee – Banksia – Tea-tree – Hakea heath-woodland of the coastal sandstone plateaus of the Sydney basin	N/A	N/A	772.6
1826	Dwarf Apple – Banksia – Tea-tree – Hakea heath-woodland on the hinterland sandstone plateaus from southern Sydney to Mangrove Mountain	N/A	N/A	3,184.6
Commonwealth listed threatened ecological communities (TECs)				
TEC name			**EPBC Act status**	**Area (ha)**
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion			Endangered	116.2
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion			Critically Endangered	49.5
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest			Critically Endangered	501.9
Shale Sandstone Transition Forest of the Sydney Basin Bioregion			Critically Endangered	17.7

River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria		Critically Endangered	27.6
Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Acacia bynoeana (Bynoe's Wattle)	Vulnerable (BC Act) Endangered (EPBC Act)	10,162.4	23
Acacia pubescens (Downy Wattle)	Vulnerable (BC Act & EPBC Act)	3,909.7	44
Allocasuarina diminuta subsp. *mimica* population in the Sutherland Shire and Liverpool City local government areas	Endangered Population (BC Act)	0.0	15
Callistemon linearifolius (Netted Bottle Brush)	Vulnerable (BC Act)	0.0	1
Dillwynia tenuifolia	Vulnerable (BC Act)	0.0	2
Grevillea parviflora subsp. *parviflora* (Small-flower Grevillea)	Vulnerable (BC Act & EPBC Act)	833.5	1,012
Hibbertia fumana	Critically Endangered (BC Act)	0.0	969
Hibbertia puberula	Endangered (BC Act)	0.0	993
Leucopogon exolasius (Woronora Beard-heath)	Vulnerable (BC Act & EPBC Act)	17.8	5
Leucopogon fletcheri subsp. *fletcheri*	Endangered (BC Act)	0.0	2
Melaleuca deanei (Deane's Melaleuca)	Vulnerable (BC Act & EPBC Act)	165.3	24
Persoonia hirsuta (Hairy Geebung)	Endangered (BC Act & EPBC Act)	4,601.7	2
Persoonia nutans (Nodding Geebung)	Endangered (BC Act & EPBC Act)	1,117.8	306
Prostanthera saxicola population in Sutherland and Liverpool local government areas	Endangered Population (BC Act)	0.0	2
Pterostylis saxicola (Sydney Plains Greenwood)	Endangered (BC Act & EPBC Act)	123.8	3
Pultenaea aristata (Prickly Bush-pea)	Vulnerable (BC Act & EPBC Act)	0.0	3
Pultenaea pedunculata (Matted Bush-pea)	Endangered (BC Act)	0.0	1
Eucalyptus benthamii (Camden White Gum)	Vulnerable (BC Act & EPBC Act)	1.0	0
Micromyrtus minutiflora	Endangered (BC Act) Vulnerable (EPBC Act	299.0	0
Pimelea curviflora var. curviflora	Vulnerable (BC Act & EPBC Act)	625.4	0
Pimelea spicata (Spiked Rice-flower)	Endangered (BC Act & EPBC Act)	203.0	0
Pomaderris brunnea (Brown Pomaderris)	Endangered (BC Act) Vulnerable (EPBC Act)	3,396.0	0

Pultenaea parviflora	Endangered (BC Act) Vulnerable (EPBC Act)	749.8	0
Allocasuarina glareicola	Endangered (BC Act & EPBC Act)	338.7	0
Deyeuxia appressa	Endangered (BC Act)	2.4	0
Genoplesium baueri (Yellow Gnat-orchid)	Endangered (BC Act & EPBC Act)	20.9	0
Persicaria elatior (Tall Knotweed)	Vulnerable (BC Act & EPBC Act)	4.6	0

BIO Map Priority Investment Areas	
The site has been identified on BIO Map as containing over 1,115 ha of core areas and 59 ha of corridors	
Type	**Area (ha)**
Core areas	1,114.9
State and Regional Biodiversity Corridors	58.6

ANIMAL SPECIES			
The site contains records and habitat for a wide range of threatened fauna species, and is likely to contain habitat and populations of many common native fauna species (Eco Logical Australia, 2012; ERM, 2012)			
Threatened fauna species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Pommerhelix duralensis (Dural Land Snail)	Endangered (BC Act & EPBC Act)	895.1	0
Pteropus poliocephalus (Grey-headed Flying-fox)	Vulnerable (BC Act & EPBC Act)	7,883.4	33
Botaurus poiciloptilus (Australasian Bittern)	Endangered (BC Act & EPBC Act)	9.2	0
Hoplocephalus bungaroides (Broad-headed Snake)	Endangered (BC Act) Vulnerable (EPBC Act)	261.9	4
Heleioporus australiacus (Giant Burrowing Frog)	Vulnerable (BC Act & EPBC Act)	170.6	19
Petauroides volans (Greater Glider)	Vulnerable (EPBC Act)	722.1	1
Chalinolobus dwyeri (Large-eared Pied Bat)	Vulnerable (BC Act & EPBC Act)	1,084.8	2
Litoria aurea (Green and Golden Bell Frog)	Endangered (BC Act) Vulnerable (EPBC Act)	148.3	0
Macquaria australasica (Macquarie Perch)	Endangered (BC Act & EPBC Act)	7.6	0
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered (BC Act & EPBC Act)	1,142.4	0
Rostratula australis (Australian Painted Snipe)	Endangered (BC Act & EPBC Act)	3.9	0
Dasyurus maculatus maculatus (Spot-tailed Quoll)	Vulnerable (BC Act) Endangered (EPBC Act)	937.9	4

Lathamus discolor (Swift Parrot)	Endangered (BC Act) Critically Endangered (EPBC Act)	1,142.4	6
Artamus cyanopterus cyanopterus (Dusky Woodswallow)	Vulnerable (BC Act)	0.0	7
Burhinus grallarius (Bush Stone-curlew)	Endangered (BC Act)	0.0	2
Callocephalon fimbriatum (Gang-gang Cockatoo)	Vulnerable (BC Act)	0.0	3
Calyptorhynchus lathami (Glossy Black-Cockatoo)	Vulnerable (BC Act)	0.0	5
Cercartetus nanus (Eastern Pygmy-possum)	Vulnerable (BC Act)	0.0	4
Climacteris picumnus victoriae (Brown Treecreeper)	Vulnerable (BC Act)	0.0	2
Daphoenositta chrysoptera (Varied Sittella)	Vulnerable (BC Act)	0.0	19
Dasyornis brachypterus (Eastern Bristlebird)	Endangered (BC Act & EPBC Act)	0.0	2
Epthianura albifrons (White-fronted Chat)	Vulnerable (BC Act)	0.0	2
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	Vulnerable (BC Act)	0.0	24
Glossopsitta pusilla (Little Lorikeet)	Vulnerable (BC Act)	0.0	41
Haliaeetus leucogaster (White-bellied Sea-eagle)	Vulnerable (BC Act)	0.0	1
Hieraaetus morphnoides (Little Eagle)	Vulnerable (BC Act)	0.0	3
Hirundapus caudacutus (White-throated Needletail)	Vulnerable (EPBC Act)	0.0	4
Litoria aurea (Green and Golden Bell Frog)	Endangered (BC Act) Vulnerable (EPBC Act)	0.0	3
Litoria littlejohni (Littlejohn's Tree Frog)	Vulnerable (BC Act)	0.0	1
Lophoictinia isura (Square-tailed Kite)	Vulnerable (BC Act)	0.0	3
Meridolum corneovirens (Cumberland Plain Land Snail)	Endangered (BC Act)	0.0	48
Micronomus norfolkensis (Eastern Coastal Free-tailed Bat)	Vulnerable (BC Act)	0.0	9
Miniopterus australis (Little Bent-winged Bat)	Vulnerable (BC Act)	0.0	1
Miniopterus orianae oceanensis (Large Bent-winged Bat)	Vulnerable (BC Act)	0.0	9
Myotis macropus (Southern Myotis)	Vulnerable (BC Act)	0.0	10
Neophema pulchella (Turquoise Parrot)	Vulnerable (BC Act)	0.0	1
Ninox connivens (Barking Owl)	Vulnerable (BC Act)	0.0	1

Ninox strenua (Powerful Owl)	Vulnerable (BC Act)	0.0	12
Pachycephala olivacea (Olive Whistler)	Vulnerable (BC Act)	0.0	1
Petaurus australis (Yellow-bellied Glider)	Vulnerable (BC Act)	0.0	1
Petaurus norfolcensis (Squirrel Glider)	Vulnerable (BC Act)	0.0	2
Petrogale penicillata (Brush-tailed Rock-wallaby)	Endangered (BC Act) Vulnerable (EPBC Act)	0.0	1
Petroica boodang (Scarlet Robin)	Vulnerable (BC Act)	0.0	11
Petroica phoenicea (Flame Robin)	Vulnerable (BC Act)	0.0	1
Phascolarctos cinereus (Koala)	Vulnerable (BC Act & EPBC Act)	966.0	335
Pseudomys novaehollandiae (New Holland Mouse)	Vulnerable (EPBC Act)	0.0	9
Pseudophryne australis (*Red*-crowned Toadlet)	Vulnerable (BC Act)	0.0	40
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	Vulnerable (BC Act)	0.0	20
Scoteanax rueppellii (Greater Broad-nosed Bat)	Vulnerable (BC Act)	0.0	22
Stagonopleura guttata (Diamond Firetail)	Vulnerable (BC Act)	0.0	2
Tyto novaehollandiae (Masked Owl)	Vulnerable (BC Act)	0.0	1
Varanus rosenbergi (Rosenberg's Goanna)	Vulnerable (BC Act)	0.0	4

CONSERVATION AND SPECIAL USE AREAS

The Moorebank Intermodal Terminal Biobanking Agreement site occurs in the north of the site.

The closest conservation or special use areas are:

- Dharawal National Park (adjacent to the southern boundary of the site)
- Heathcote National Park (adjacent to the eastern boundary of the site)
- Georges River National Park (adjacent to the north eastern boundary of the site)

HERITAGE PLACES AND ITEMS

The site partially contains two areas listed on the Commonwealth Heritage List for their outstanding cultural and natural value (DoEE, 2019):

- Old Army/ Internment Camp Group Holsworthy
- Cubbitch Barta National Estate Area

The site also contains areas listed by local government and state agencies on the NSW heritage list (OEH, 2019b):

- Cubbitch Barta National Estate Area
- Holsworthy (former) Corporals Club
- Holsworthy (former) Officer's Mess
- Holsworthy Group (Old Army/ Internment Camp Holsworthy)
- Holsworthy Powder Magazine (Former Detention Block)

Holsworthy Defence base contains two areas on the Register of the National Estate Area (non-statutory):

- Cubbitch Barta National Estate Area – registered for its indigenous value
- Defence National Storage and Distribution Centre – listed on the interim list for its historic value

It is not known whether the site has any other historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having any other heritage values
SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES
The site is a defence base, including a training area and artillery range, for the Australian Army. Activities carried out on the base include the use of firing ranges, chemical weapons testing, fire training, vehicle maintenance, and bulk chemical storage and distribution from numerous above ground and underground storage tanks. Holsworthy Military Airport is also located in the site. The site exists under the Native Title Claim of the South Coast of NSW by the South Coast People (Tribunal file no. NC2017/003) (NNTT, 2020). The following tenements exist on this site (NNTT, 2020): • Mining tenement (AUTH6) • Mining tenement (AUTH432CCL724)

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 11 due to the Plan.

Indirect and facilitated impacts

At the closest point, Site 11 occurs approximately 1.4 km from the nearest development under the Plan – a relatively small area of urban capable land in the northern part of GMAC. The land in between this urban capable land and Site 11 consists of existing high density residential areas.

The location of the site relative to the development and near existing high density residual areas means:

- The site is very unlikely to be impacted by impacts typically associated with construction of the development in GMAC, such as air quality, noise, construction traffic, or the spread of weeds or disease
- The heritage values of the site will not be impacted by alterations to the setting of the place inconsistent with its values, such as through changes to the surrounding landscape causing visual or amenity impacts

The potential indirect and facilitated impacts associated with these developments and the key values of the environment of Site 11 that are potentially impacted are shown in Table 35-14.

Table 35-14: Potential indirect impacts on Site 11 associated with the development

Potential indirect impact	Extent within Site 11	Duration	Values potentially impacted
Construction			
Changes to water quality from soil erosion or disturbance of contaminated soils	Waterways within the site	Generally short term	Water resources
Clearing of habitat during construction of the development that links the site to other areas of habitat, leading to impacts on biodiversity values	Whole of site	Long term	Biodiversity values
Operation			
Changes to surface water flows due to additional runoff from urban areas		Long term	Water resources
Disruption to land uses, services or infrastructure	Whole of site	Long term	People and communities

Biodiversity values

Site 11 has been identified on BIO Map as containing large areas of core areas and corridors and is therefore a significant site for habitat connectivity across the subregion.

Clearing of habitat in GMAC associated with urban capable land has the potential to lead to impacts on the biodiversity values of the site due to a reduction in habitat connectivity to and from the site.

The site is well connected to large areas of habitat and protected lands, including Dharawal National Park, Heathcote National Park and Georges River National Park. The site connects Heathcote National Park in the east to Dharawal National Park and other large areas of habitat in the west in the vicinity of the Georges River and Nepean River.

The development under the Plan will not disrupt these habitat connectivity links from the site to the surrounding area, and therefore the habitat values of the site are unlikely to be impacted indirectly by the Plan. While development in GMAC will reduce habitat connectivity across the nominated area to some extent, large habitat corridors that occur along riparian corridors and gullies, including BIO Map core areas and corridors, will generally be maintained.

Water resources

Construction and operation of urban, industrial and infrastructure development in GMAC may result in changes to surface water flows and impact the water quality of the Georges River, which forms the western boundary of Site 11.

These impacts are discussed in relation to the different areas of urban capable land within GMAC that may affect the Georges River, as these different areas are likely to have different risks. The Plan includes commitments that are expected to adequately address these potential impacts on water resources (see below). The areas and potential impacts are:

- Development in northern section (near Glenfield) - Development in the northern section of GMAC will be partially located in the catchment of Bunbury Curran Creek and Glenfield Creek, both of which discharge into the Georges River. These potential impacts are considered to be minor. Both these catchments, as well as the Georges River catchment, are already subject to significant levels of urban development, which reduces the consequence of any water quality impacts
- Middle section (development between Glen Alpine and Rosemeadow) - The majority of this section of urban development under the Plan is located within the catchment of the Nepean River, with only a small area (approximately 19 ha) located within the upstream tributary catchments of Bow Bowing Creek, which discharges into Bunbury Curran Creek and then the Georges River. The length of watercourse between the development site and the discharge point into the Georges River is approximately 20 km. The catchment of Bow Bowing Creek and Bunbury Curran Creek is already heavily developed, with the vast majority of the catchment area covered by urban development. Bow Bowing Creek has also been developed, including an area of impoundment and development of the creek corridor to form drainage channels. Overall, the environmental values of this catchment are very limited. Therefore, it is not considered that the comparatively small area of urban development within this catchment under the Plan will significantly degrade the water quality of the Georges River
- Southern section (development between Gilead and Appin) - The southern section of urban development within GMAC is located within the Nepean Catchment, and therefore there is no risk that urban development in this area will result in a decline in water quality of the Georges River

People and communities

Population increases associated with urban development in GMAC may lead to increased pressure on roads, transport and other infrastructure that service the army base. However, the Plan intends to provide for future transport needs by supporting the delivery of major transport projects for Western Sydney. It is also expected that future transport and infrastructure needs of the army base will be provided for through existing local and regional planning processes.

As Site 11 is a military facility that is not open to the public, there is no risk that population increases associated with urban development will result in increased pressures associated with visitation or use of the site by the public.

Commitments and mitigation measures

The Plan includes commitments to mitigate indirect impacts from construction and operation associated with urban and industrial development, and infrastructure development. These commitments and processes to deliver these comments are different for each type of development.

Urban and industrial development

The Plan includes a commitment to mitigate indirect impacts from urban and industrial development (Commitment 5).

A Development Control Plan (DCP) will be prepared for each nominated area by either the Department (in the case of Department led precincts) or by the relevant councils in collaboration with the Department. DCPs are non-legally binding planning policies that provide detailed planning and design guidelines, including development controls. DCPs are made under Division 3.6 of the EP&A Act. DCPs for each nominated area will be prepared in accordance with:

- A DCP template prepared by the Department to support implementation of the Plan
- Standard format for DCPs and a set of model provisions that apply across NSW
- Any processes and guidelines for preparing DCPs specific to each council
- Current best practice standards, guidelines or targets (e.g. water quality standards for urban runoff)

DCPs will incorporate several types of development controls (see Chapter 15, Section 15.6.1), including a broader set of controls that address indirect impacts on environmental values generally. These controls are commonly implemented by planning authorities through the development application process to manage indirect impacts on environmental values, on such as impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

Examples of these types of controls included in the draft Wilton DCP that are relevant to addressing indirect and facilitated impacts on Site 11 from urban and industrial development are provided in Table 35-15.

Planning authorities will be responsible for making decisions about the specifics of these controls in each DCP and through the development application process based on best practice standards and guidelines.

Table 35-15: Summary examples of broader environmental controls commonly included in DCPs (from draft Wilton DCP)

Control type	Summary of example control in draft Wilton DCP
Water cycle management	• Water management measures must comply with council's requirements for detention, drainage and water sensitive urban design principles • Water management measures must be designed to prevent damage by stormwater to the natural environment and minimise run-off and sediment and pollutants to waterways
Water quality	• Stormwater systems must be constructed/maintained to achieve EES water quality targets
Soil erosion and sedimentation	• Development must incorporate measures to minimise soil erosion and sedimentation during construction and following completion of development • Soil and Water Management Plans must be prepared in accordance with *Managing Urban Stormwater* (Landcom, 2004) and included in development applications
Air quality	• Development must comply with the *Protection of the Environment Operations Act 1997* and supporting regulations. An Odour Impact Assessment must be submitted when required • Provide a barrier to mitigate dispersion of air pollutants, noise or odour where necessary
Noise	• Provide a barrier to mitigate dispersion of air pollutants, noise or odour • Development must include buffers to limit noise impacts on surrounding areas • An acoustic report must be submitted to address the impact of noise generation
Traffic/construction traffic	• Ensure the road networks are designed to control traffic speeds to appropriate limits • Provide a traffic report/statement to address the impact of the development on the local road system and address traffic safety issues

These development controls and the process for implementing them are expected to adequately address the potential indirect and facilitated impacts of the urban and industrial development that will occur adjacent to Site 11.

A detailed description of the process to implement development controls to address indirect impacts, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.1.

Mitigation measures for infrastructure

Commitment 5 also includes mitigation of indirect impacts from infrastructure development.

Infrastructure will be subject to future environmental assessment and approval processes under the EP&A Act at the time the projects are proposed. Infrastructure covering the broad types under the Plan (see Part 2) is subject to different environmental assessment processes. These are summarised in Chapter 15, Section 15.6.2.

Commitment 5, Action 2 specifies that mitigation measures will be identified and implement based on the outcomes of the environmental assessment of detailed designs of each infrastructure project in accordance with the requirements of the NSW approval processes under the EP&A Act, as well as published, best practice guidelines.

Public authorities typically incorporate a broad set of mitigation measures through these assessment processes to manage indirect impacts of infrastructure on environmental values generally, including impacts relating to hydrology and water quality, soil erosion, contaminated land, air quality, noise and traffic.

It is considered that Commitment 2 will lead to the identification and implementation of a set of mitigation measures that will adequately manage potential indirect impacts on Site 11 from infrastructure.

A detailed description of the processes to implement mitigation measures for infrastructure, including Department oversight and assurance mechanisms, is provided in Chapter 15, Section 15.6.2.

35.3.12 SITE 12

PROFILE

SITE DETAILS	
Owner	The Commonwealth of Australia
Site name	N/A
Site ID number	12
Area	0.2 ha
Address	Whittle Road, Edmondson Park NSW
Folio	134/123070
General description	The site located at the intersection of Whittle Road and Mckechnie Road. The site does not contain any native vegetation. The site occurs within the Strategic Assessment Area, approximately 35 km south-west of the Sydney CBD
Site map	The location of Site 12 is shown in Map 35-13

DISTANCE FROM URBAN CAPABLE LANDS/ TRANSPORT CORRIDORS
The site is located approximately 1.8 km from the nearest development under the Plan – urban capable land in GMAC. The land between Site 12 and the nearest development primarily consists of existing urban development

LANDSCAPES AND LANDFORMS
The site is located in a suburban area and does not appear to have any landforms

SOIL AND SUBSTRATES
The soil landscape at Site 12 is made up of 0.2 ha of Blacktown soil – Blacktown soils are a hardsetting soils that have a shallow to moderately deep depth of > 100 cm (OEH, 2018)

WATER
The site occurs within the Georges River catchment A minor non-perennial watercourse passes through the southern half of the site

VEGETATION
No native vegetation occurs on the site. However, a small area of potential habitat for three threatened flora species occurs on site.

Plant Community Types (PCTs)/ NSW listed threatened ecological communities (TECs)				
PCT number	**PCT name**	**NSW TEC name**	**BC Act status**	**Area (ha)**
0	Cleared	N/A	N/A	0.2

Threatened flora species			
Name	**EPBC Act or BC Act status**	**Area of habitat (ha)**	**Number of BioNet records**
Acacia pubescens (Downy Wattle)	Vulnerable (BC Act & EPBC Act)	0.2	0
Micromyrtus minutiflora	Endangered (BC Act) Vulnerable (EPBC Act	0.2	0
Pimelea spicata (Spiked Rice-flower)	Endangered (BC Act & EPBC Act)	0.1	0

BIO Map Priority Investment Areas
No BIO Map core or corridor areas have been identified on this site

ANIMAL SPECIES
No fauna species have been recorded on site
CONSERVATION AND SPECIAL USE AREAS
There are no conservation or special use areas present on this site The closest conservation or special use areas are: • Metro offset (approximately 1 km south and 2 km north east) • Edmondson Regional Park (approximately 2 km south west)
HERITAGE PLACES AND ITEMS
It is not known whether the site has any historic or indigenous heritage values. The site is not listed in the Australian Heritage Database as having any heritage values
SERVICES AND INFRASTRUCTURE/PEOPLE AND COMMUNITIES
This site is a vacant block with no visible buildings or other infrastructure No tenement exists on this site (NNTT, 2020) No Native Title Claims exist over this site (NNTT, 2020)

IMPACT ASSESSMENT

Direct impacts

There will be no direct impacts to Site 12 due to the Plan.

Indirect and facilitated impacts

Site 12 is located within an existing, heavily developed urban area, approximately 1.8 km from the nearest urban capable land associated with the Plan – urban capable land in GMAC. The land between Site 12 and the nearest development primarily consists of existing urban development. The site is also located upstream of the nearest urban development and within a separate sub-catchment.

The location of the site relative to the development and within a high density existing urban area means:

- The site is very unlikely to be impacted by impacts associated with construction of the development in GMAC, such as air quality, noise, construction traffic, or the spread of weeds or disease
- The site will not be impacted by soil erosion of sedimentation, changes to surface and groundwater quantity and flows, or water quality impacts associated with the construction and operation of the development

Furthermore, the site is unvegetated and has no or little biodiversity value and has no known heritage values. The site contains no buildings or other infrastructure and appears to be unused.

There are no potential indirect or facilitated impacts associated with the development considered relevant to the site.

Commitments and mitigation measures

No commitments or mitigation measures are considered necessary to address the potential indirect impacts on the environment of Site 12 from the development under the Plan.

35.4 ADDRESSING THE RISKS ASSOCIATED WITH PFAS

35.4.1 INTRODUCTION

The manufactured chemical group per-and polyfluoroalkyl substances (PFAS) is an environmental management priority for environmental regulators in Australia. Found in firefighting foams, stain repellents, pesticides, and a variety of consumer products including paper, non-stick cookware, food packaging and stain protectant, PFAS compounds infiltrate soil and water resources causing a potential risk to the impacted environment and human health (DoH, 2021; HEPA, 2020). The more prominent PFAS compounds are PFOS, PFHxS, and PFOA, all of which are stable PFAS that do not break down, persisting in the environment for long periods of time. PFAS compounds are highly water soluble, leaching from soil to surface and groundwater resources and dispersing to adjoining land areas (HEPA, 2020).

PFAS can accumulate in animals, humans and the environment, and remain present for many years (DoH, 2021). It is evident that a number of factors define the level of risk to human health, including but not limited to the nature, level, type, leachability, and concentration of PFAS present, along with the land use, environmental values, and the degree of exposure. Further research is required to realise the behaviour of PFAS in the environment, and resulting implications on organisms and ecological processes (HEPA, 2020). Studies to date have found possible links between PFAS and a range of health conditions including immune function, reproductive systems, development, liver health and tumours in animals- although there are no definitive results. PFAS is also considered likely to behave differently in humans compared to animals, further research is required to accurately quantify the implications of PFAS for human health (DoH, 2021).

The PFAS National Environmental Management Plan (NEMP) (HEPA, 2020) is a national guide to regulation, management and preventative measures for PFAS in Australia. There are currently two PFAS groups listed as persistent organic pollutants under the Stockholm Convention on Persistent Organic Pollutants; PFOS and its related compounds, and PFOA and its related compounds (HEPA, 2020).

The Environment Protection Authority (EPA) is leading the NSW state response to PFAS contamination. The EPA PFAS investigation process involves 5 stages to quantify risks associated with PFAS contamination on sites identified to be higher risks of contamination. Sites at higher risk of contamination are those where there is a higher likelihood of large quantities of PFAS use in the past, specifically sites where PFAS-containing fire-fighting foams have been used. Sites where fire training exercises have been conducted are of specific concern. Sites of interest are typically managed by Rural Fire Service, NSW Fire and Rescue, and airport sites including those managed by Airservices Australia (NSW EPA, 2020).

35.4.2 SITE 6: CAMDEN AIRPORT

The only known Commonwealth land site of concern in relation to development under the Plan potentially increasing the risk of PFAS contamination is Site 6 (Camden Airport). The other sites are either:

- Do not occur within the vicinity of development under the Plan, or
- Appear to have a low likelihood of PFAS contamination

Site 6 has been identified as a site of concern for PFAS identification by the NSW EPA. Sydney Metro Airports (SMA) are investigating PFAS contamination at Camden Airport. Although historic information suggests that firefighting foams containing PFAS have not been used at Camden Airport, surface water sampling in drainage channels have detected PFAS at two locations. Investigation into PFAS contamination at Camden Airport is ongoing (NSW EPA, 2019).

Site 6 occurs within the footprint of the tunnel section of the OSO from Cobbitty to Cawdor. It will be important that the risks associated with PFAS are addressed at the time the project is assessed under State planning laws (currently the State Significant Infrastructure (SSI) process under the EP&A Act).

The SSI assessment process is described in detail in Chapter 15. The process requires the preparation of an Environmental Impact Statement (EIS) for each tunnel project in accordance with the Planning Secretary's assessment requirements (SEARs). The EIS must identify and assess all relevant environmental impacts of the tunnel projects, identify mitigation measures and commit to performance outcomes for managing these impacts, and identify the detail of ongoing construction and operational management plans and monitoring programs (DPIE, 2020c). Given the potential risk of PFAS in Camden airport under current investigation, the SEARs will likely identify PFAS to be addressed as a requirement of the EIS. PFAS may be assessed as a consideration for human health risk and/or contamination (to soil or groundwater resources).

36 Summary of transport program impacts

36.1 INTRODUCTION

This Chapter provides:

- A summary of the transport development
- A summary of the impacts of the transport program on MNES under the EPBC Act including:
  - Avoidance outcomes and commitments
  - Direct impacts and commitments to address these impacts
  - Indirect impacts and commitments to address these impacts
- An assessment of the direct and indirect impacts of the two transport corridor tunnels on MNES
- A conclusion about the overall outcome in relation to the major transport corridors under the Plan

The summary draws on the detailed analysis of the impacts of the Plan and the adequacy of the commitments under the Plan to address these impacts on each MNES presented in Chapters 29 to 31.

These detailed impact assessments on each Commonwealth listed species and TEC have shown that the direct, indirect and cumulative impacts of the transport (and urban) development under the Plan on MNES are acceptable and that the commitments under the Plan will adequately protect and conserve these matters in the context of these impacts.

Part 7 provides an evaluation of the overall adequacy and acceptability of the Plan in the context of the impacts of the development under the Plan and in accordance with the regulatory requirements of the BC Act and EPBC Act.

The transport program is described in Chapter 7.

Indicative locations of the major transport corridors are shown in Figure 36-1.

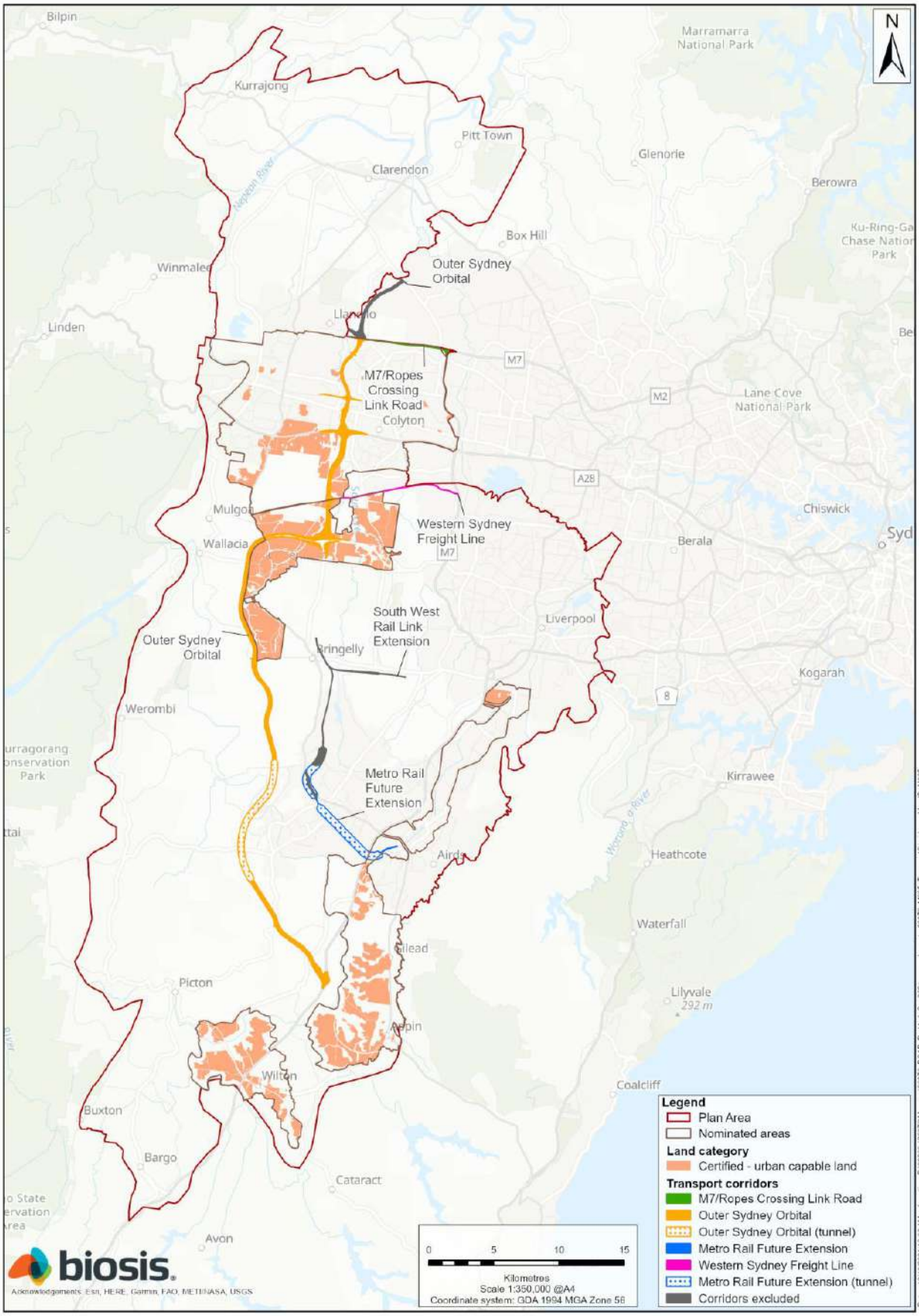

Figure 36-1: Indicative locations of major transport corridors within the Strategic Assessment Area

36.2 SUMMARY OF THE TRANSPORT DEVELOPMENT

36.2.1 MAJOR TRANSPORT CORRIDORS

The Plan includes the design, construction and operation of several major road and rail transport projects that will generally be located within the transport corridors shown in Figure 36-1. The transport projects are listed in Table 36-1.

Table 36-1: Transport projects covered under the Plan

Project	Description	Timing
Metro Rail future extension from Western Sydney Aerotropolis to Macarthur (except for those areas within the existing South West Growth Area)	Provides for a future extension of the metro rail south from the Aerotropolis (Bringelly) to Macarthur	0 to 10 years
Western Sydney Freight Line corridor	Provides for a future freight rail line to connect Port Botany and Western Sydney	10 to 20 years
Outer Sydney Orbital between Box Hill and the Hume Motorway near Menangle	Provides for a future north-south motorway and freight rail line	
M7/Ropes Crossing Link Road	Provides for a future east-west motorway linking the M7 to the future Outer Sydney Orbital at Ropes Crossing	20 or more years

Development under the transport class of action includes all activities associated with the design, construction, and operation of the major road or rail projects. This includes any development on land within the major transport corridors shown in the Plan (see Figure 36-1) or on any other land required for the transport project along these general alignments, as identified under the NSW environmental assessment and approval process for each project current at the time the project is brought forward (this is currently the State Significant Infrastructure approval process).

The transport activities included under the Plan include, but are not limited to:

- Vegetation clearing
- Earthworks
- Utility works
- Landscaping
- Erosion and sediment control
- Laydown areas
- Road and rail construction
- Tunnel construction
- Construction of supporting infrastructure such as stations, car parks and pedestrian access
- Electricity infrastructure
- Site offices and access roads
- Dust and noise suppression
- Stormwater management (including detention basins, ponds and dams)
- Vehicle and train movements
- Maintenance and upgrade activities
- Installation and maintenance of traffic control and safety infrastructure

As each transport project is brought forward for investigation, the project will be subject to:

- A process of strategic planning and detailed design, which will determine the final alignment of each transport project that will generally occur within each transport corridor
- NSW environmental assessment and approval process for each project current at the time the project is brought forward (this is currently the State Significant Infrastructure approval process under the EP&A Act)

The transport projects included in the Plan have not finalised implementing a process to avoid biodiversity values as the alignment for the corridors are not currently certain. Additional areas will be avoided during strategic planning and detailed design of the transport projects. The Plan includes commitments for further avoidance and minimisation of impacts to biodiversity values related to the major transport corridors (see section 36.3).

36.2.2 TUNNELS

Development under the transport class of action includes tunnel construction and operation. Sections of two of the major transport corridors are proposed to include tunnels. These are:

- Outer Sydney Orbital (OSO) tunnel – Cobbitty to Cawdor
- Metro Rail Future Extension (MRFE) tunnel – Oran Park to Narellan, and Narellan to Macarthur

The location of the tunnels are shown in Figure 36-1.

The activities associated with tunnelling may include but are not limited to the matters shown in Table 36-2.

Table 36-2: Construction activities and operational infrastructure associated with transport corridor tunnels

Project phase	Activities
Construction activities	• Site establishment and enabling work, including but not limited to utility work, fencing and hoarding, construction ancillary facilities and access, demolition of buildings and structures and clearance of vegetation where required • Erection of acoustic sheds (where relevant) over the temporary access tunnels and to contain noise and dust from tunnelling operations • Construction of temporary access tunnels • Construction of main tunnels, including but not limited to entry and exit ramps and associated tunnelled infrastructure • Spoil management and haulage • Finishing work in tunnel and provision of permanent tunnel services, including but not limited to mechanical and electrical fit out • Drainage work, including permanent water treatment facilities
Operational infrastructure	• Utilities infrastructure (including adjustments to, or relocation of, existing utilities infrastructure), electronic tolling facilities, signage, ventilation systems, emergency systems, systems for the control and management of roads, and tunnel control centre facilities • Entry and exit ramps (tunnel portals) • Connection to power, including construction of or connection to electrical substations • Connection and tie in with existing surface roads and infrastructure • Pedestrian and cyclist facilities • Drainage work, pavement and finishing work (including landscaping and urban design treatments)

As for the other parts of the major transport corridors, development for the tunnels will generally occur within the footprints of the tunnels shown in Figure 36-1. In limited cases, development activities may be necessary adjacent to the footprint.

36.3 AVOIDANCE OF IMPACTS

36.3.1 SUMMARY OF AVOIDANCE PROCESSES

Avoidance and minimisation of impacts from the major transport corridors is being undertaken in two stages:

- Processes to locate the major transport corridors – this has already been undertaken
- Strategic planning and detailed design of each transport project within the major transport corridors

Details of the processes to locate the major transport corridors are provided in Chapter 14.

The future process to further avoid and minimise impacts through detailed design is summarised below.

36.3.2 COMMITMENTS FOR FURTHER AVOIDANCE

The major transport corridors included in the Plan have not completed the process to avoid and minimise impacts to biodiversity values as the alignments of the transport projects within each corridor are not currently certain (see Part 2).

The Plan includes commitments for further avoidance and minimisation of impacts to biodiversity values related to the major transport corridors. This will be undertaken through:

- A process of strategic planning and detailed design, which will determine the final alignment of each transport project that will generally occur within each transport corridor
- NSW environmental assessment and approval process for each project current at the time the project is brought forward (this is currently the State Significant Infrastructure approval process)

For the parts of the major transport corridors within the nominated areas, the Plan commits to avoiding and minimising impacts to TECs, species and habitat (Commitment 3). This includes avoiding where possible:

- Areas of high biodiversity value (defined by the Plan's 'avoidance criteria' – see Chapter 14)
- Areas of potential habitat connectivity, particularly vegetation in riparian corridors, for specific species
- Known flora populations for specific species in specific locations

For the parts of the major transport corridors outside the nominated areas, the Plan commits to avoiding and minimising impacts to species and TECs in accordance with the major infrastructure corridors class of action description and the BC Act, including the BAM (Commitment 4). This includes avoiding where possible:

- Known flora populations for specific species in specific locations
- Other specific locations of high biodiversity value
- Commonwealth land at three sites

The commitments for future avoidance relating to the major transport corridors are considered adequate to ensure the corridors avoid and minimise the risk of unacceptable impacts on biodiversity values. The commitments ensure:

- Avoidance outcomes are achieved consistent with the Plan's 'avoidance criteria' (see Chapter 14) or are assessed in assessed and determined in accordance with the BAM (for the major transport corridors outside the nominated areas)
- Impacts to known key biodiversity values within the corridors are avoided and minimised where possible, including specific species and habitat, and/or specific locations of high biodiversity value
- Avoidance of biodiversity values as well as the costs of offsets is taken into account in the evaluation of the route options (e.g. multi-criteria analysis) during the planning phase of each project

36.4 DIRECT IMPACTS

36.4.1 SUMMARY OF IMPACTS

The direct impacts that may occur due to the major transport corridors are associated with construction and are:

- Habitat loss
- Habitat fragmentation and loss of habitat connectivity

The direct impacts of the major transport corridors on MNES are assessed in Chapters 29 to 35.

A summary of the direct impacts on Commonwealth-listed species and TECs is provided in:

- Table 36-4 – transport impacts to threatened fauna
- Table 36-5 – transport impacts to threatened flora
- Table 36-6 – transport impacts to TECs

These tables identify impacts in relation to each transport corridor, as well as the total impact of the major transport corridors and the contribution of the transport program to the total impacts of the development under the Plan.

Impacts are calculated on a worst-case scenario basis by assuming the entirety of each transport corridor will be impacted (as described above, in practice, these impacts will be reduced through future avoidance processes).

Table 36-3 provides the meaning of the acronyms used in the impact tables.

Table 36-3: Acronyms used in impact tables

Transport project acronym	Description
Metro	Sydney Metro Greater West south from Western Sydney Aerotropolis to Macarthur (except for those areas within the existing South West Growth Area)
WSFL	Western Sydney Freight Line corridor
OSO	Outer Sydney Orbital between Box Hill and the Hume Motorway near Menangle
M7 Link	M7/Ropes Crossing Link Road

The major transport corridors will not have notable direct impacts on other MNES, including:

- Migratory species (see Chapter 32)
- Ramsar wetlands (see Chapter 33)
- World and National Heritage (see Chapter 34)

There are direct impacts from the major transport corridors on one Commonwealth land site – this comprises 4.2 ha on Site 10 at 221 Greendale Rd, Greendale NSW. This impact is not considered notable. The use of the site is unknown, although it appears to be used for grazing, and impacts on biodiversity values are minor (see Chapter 35).

There may also be direct impacts on Commonwealth land from the tunnels. These impacts are assessed in section 36.6.

THREATENED FAUNA

The following outlines the magnitude of impact to each threatened fauna species solely with regards to development of the transport program. Chapter 30 provides a detailed assessment of each species as a result of all development (transport in addition to urban capable development) under the Plan, and produces a risk ranking for each fauna species with regards to their magnitude of direct impacts under the Plan. It is noted that the risk ranking relates to both urban capable and transport development, rather than just transport, and so it is possible for a species to have low transport impacts yet a high risk rating as a result of impacts due to urban capable development (and vice versa).

The major transport corridors will directly impact potential habitat for 11 of the 19 fauna species, including: Regent Honeyeater (low risk), Australasian Bittern (low risk), Swift Parrot (medium risk), Australian Painted Snipe (very low risk), Large-eared Pied Bat (low risk), Spot-tailed Quoll (low risk), Greater Glider (very low risk), Grey-headed Flying Fox (low risk), Green and Golden Bell Frog (very low risk) and the Dural Land Snail (very low risk).

The most notable direct impacts occur to:

- Regent Honeyeater (low risk) and Swift Parrot (medium risk) in habitat along Wianamatta (South Creek), in Wianamatta Regional Park and in Cobbitty due to the OSO
- Grey-headed Flying-fox (low risk) in habitat along Wianamatta (South Creek), in Wianamatta Regional Park and in Cobbitty due to the OSO

The largest impacts to potential habitat will occur to:

- Wide ranging species such as the Grey-headed Flying-fox (low risk) (347.1 ha of impact) and Spot-tailed Quoll (low risk) (238.4 ha of impact)
- Species with broad associations with woodland habitats primarily for foraging, such as the Swift Parrot (443.3 ha of impact) and the Regent Honeyeater (low risk) (443.3 ha of impact)

The species most impacted in terms of the percentage of total habitat in the Strategic Assessment Area is the Australasian Bittern (low risk), which will have 3.0 per cent of its potential habitat impacted.

The major transport corridors will directly impact known important populations of some fauna species, including:

- Grey-headed Flying-fox (low risk) (1 population)
- Spot-tailed Quoll (low risk) (1 population)

THREATENED FLORA

The following outlines the magnitude of impact to each threatened flora species solely with regards to development of the transport program. Similar to fauna, Chapter 29 provides a detailed assessment of each species as a result of all development (transport in addition to urban capable development) under the Plan, and produces a risk ranking for each flora species with regards to their magnitude of direct impacts under the Plan. It is noted that the risk ranking relates to both urban capable and transport development, rather than just transport, and so it is possible for a species to have low transport impacts yet a high risk rating as a result of impacts due to urban capable development (and vice versa).

The major transport corridors will directly impact potential habitat for 14 of the 23 flora species. These include: *Acacia bynoeana* (very low risk), *Acacia pubescens* (very low risk), *Allocasuarina glareicola* (very low risk), *Cynanchum elegans* (medium risk), *Eucalyptus benthamii* (low risk), *Grevillea parviflora* subsp. *parviflora* (low risk), *Micromyrtus minutiflora* (very low risk), *Persicaria elatior* (very low risk), *Persoonia bargoensis* (low risk), *Persoonia hirsuta* (very low risk), *Persoonia nutans* (medium risk), *Pimelea curviflora* var. *curviflora* (very low risk), *Pimelea spicata* (high risk), *Pomaderris brunnea* (low risk), *Pultenaea parviflora* (high risk).

The most notable direct impacts occur to:

- *Pimelea spicata* (high risk) in habitat along Wianamatta (South Creek), near Orchard Hills, Shanes Park near Horsley Park due to the OSO, eastern end of the M7 link and WSFL
- *Acacia pubescens* (very low risk) in habitat along Wianamatta (South Creek), near Orchard Hills and near Horsley Park due to the OSO and WSFL

The largest impacts to potential habitat will occur to:

- *Pimelea spicata* (high risk) (238.2 ha of impact)
- *Acacia pubescens* (very low risk) (281.5 ha of impact)
- *Pomaderris brunnea* (low risk) (168.8 ha of impact)
- *Pultenaea parviflora* (high risk) (184.5 ha of impact)

The species most impacted in terms of the percentage of total habitat in the Strategic Assessment Area is *Persicaria elatior* (very low risk), which will have 3.6 per cent of its potential habitat impacted.

The major transport corridors will directly impact known important populations of some flora species, including:

- *Persoonia nutans* (medium risk) (1 population)
- *Pultenaea parviflora* (3 populations, including 2 populations in GPEC and one outside nominated areas

THREATENED ECOLOGICAL COMMUNITIES

The following outlines the magnitude of impact to each TEC with solely with regards to development of the transport program. Chapter 31 provides a detailed assessment of each species as a result of all development (transport in addition to urban capable development) under the Plan. The following outlines the area of each TEC impacted by transport development under the Plan, with the total impact of all development under the Plan (transport in addition to urban development) provided in brackets to provide additional context.

The major transport corridors will directly impact 4 of the TECs. These include:

- River-flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria: 123.4 ha impacted by transport (159.2 ha impacted in total by the Plan)
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest: 52.7 ha impacted by transport (180.3 ha impacted in total by the Plan)

- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion: 18.6 ha impacted by transport (30.9 ha impacted in total by the Plan)
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community: 5.8 ha impacted by transport (8 ha impacted in total by the Plan)

The most notable direct impacts occur to:

- River-flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria along Wianamatta (South Creek) due to the OSO
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest in habitat in Cobbitty and Shanes Park due to the OSO and M7/Ropes Crossing Link Road

The TEC most impacted by transport development in terms of the percentage of total TEC in the Strategic Assessment Area is River-flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria (1.9 per cent) and Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (2.3 per cent).

Table 36-4: Transport impacts to potential habitat for Commonwealth listed threatened fauna

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS BY TRANSPORT PROJECTS				TOTAL IMPACTS			
				Metro (ha)	WSFL (ha)	OSO (ha)	M7 Link (ha)	Total transport impacts (ha)	Total transport impacts to important populations	Total transport impacts as % of habitat in SAA	Transport % of total Plan impacts
BIRDS											
Anthochaera phrygia	Regent Honeyeater	CE	59,369.2	1.2	14.0	394.5	33.5	**443.2**	**0**	**0.7%**	**34.9%**
Botaurus poiciloptilus	Australasian Bittern	E	2,534.5	0.4	2.0	73.5	0.0	**75.9**	**0**	**3.0%**	**77.6%**
Calidris canutus	Red Knot	E, Migratory	182.3					**0.0**	**0**	**0.0%**	**0.0%**
Calidris ferruginea	Curlew Sandpiper	CE, Migratory	182.3					**0.0**	**0**	**0.0%**	**0.0%**
Charadrius leschenaultii	Greater Sand-plover	V, Migratory	182.3					**0.0**	**0**	**0.0%**	**0.0%**
Lathamus discolor	Swift Parrot	CE	59,369.2	1.2	14.0	394.5	33.5	**443.2**	**0**	**0.7%**	**34.9%**
Limosa lapponica	Bar-tailed Godwit	V, Migratory	182.3					**0.0**	**0**	**0.0%**	**0.0%**
Numenius madagascariensis	Eastern Curlew	CE, Migratory	182.3					**0.0**	**0**	**0.0%**	**0.0%**
Rostratula australis	Australian Painted Snipe	E	2,230.7	0.0	0.2	16.2	0.0	**16.4**	**0**	**0.7%**	**32.5%**
MAMMALS											
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V	25,451.4	1.0	0.0	3.5	0.0	**4.5**	0	**0.0%**	**1.6%**

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS BY TRANSPORT PROJECTS				TOTAL IMPACTS			
				Metro (ha)	WSFL (ha)	OSO (ha)	M7 Link (ha)	Total transport impacts (ha)	Total transport impacts to important populations	Total transport impacts as % of habitat in SAA	Transport % of total Plan impacts
Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (south eastern mainland population)	E	32,445.4	0.0	1.1	227.5	9.8	**238.4**	1	**0.7%**	**37.3%**
Petauroides volans	Greater Glider	V	25,609.8	0.0	4.8	57.5	0.0	**62.3**	0	**0.2%**	**49.0%**
Phascolarctos cinereus	Koala (combined populations of Qld, NSW and the ACT)	V	15,091.2					**0.0**	0	**0.0%**	**0.0%**
Pteropus poliocephalus	Grey-headed Flying-fox	V	26,868.8	0.5	11.8	307.9	26.9	**347.1**	1	**1.3%**	**46.2%**
REPTILES											
Hoplocephalus bungaroides	Broad-headed Snake	V	6,695.2	0.0	0.0	0.0	0.0	**0.0**	0	**0.0%**	**0.0%**
AMPHIBIANS											
Heleioporus australiacus	Giant Burrowing Frog	V	4,064.2					**0.0**	0	**0.0%**	**0.0%**
Litoria aurea	Green and Golden Bell Frog	V	5,500.3	0.0	0.1	2.3	0.5	**3.0**	0	**0.1%**	**21.3%**

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS BY TRANSPORT PROJECTS				TOTAL IMPACTS			
				Metro (ha)	WSFL (ha)	OSO (ha)	M7 Link (ha)	Total transport impacts (ha)	Total transport impacts to important populations	Total transport impacts as % of habitat in SAA	Transport % of total Plan impacts
INVERTEBRATES											
Pommerhelix duralensis	Dural Land Snail	E	25,498.5	0.0	2.4	32.5	10.7	**45.7**	0	**0.2%**	**100.0%**
FISH											
Macquaria australasica	Macquarie Perch	E	20.5	0.0	0.0	0.0	0.0	**0.0**	0	**0.0%**	**0.0%**

Note: The White-throated Needletail (*Hirundapus caudacutus*) is not included in this table, as it was not possible to produce a meaningful habitat map for this species as it is predominantly an aerial species. Refer to Chapter 30 for further information.

Table 36-5: Transport impacts to potential habitat for Commonwealth listed threatened flora

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS BY TRANSPORT PROJECT				TOTAL IMPACTS			
				Metro (ha)	WSFL (ha)	OSO (ha)	M7 Link (ha)	Total transport impacts (ha)	Total transport impacts to important populations	Total transport impacts as % of habitat in SAA	Transport % of total Plan impacts
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	V	31,541.6	0.0	0.4	21.9	0.1	**22.3**		**0.1%**	**5.1%**
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	V	36,224.2	1.1	34.5	219.2	26.7	**281.5**		**0.8%**	**20.4%**
Allocasuarina glareicola		E	4,431.9	0.0	0.0	0.1	4.4	**4.5**		**0.1%**	**25.9%**
Commersonia prostrata	Dwarf Kerrawang	E	61.9	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Cynanchum elegans	White-flowered Wax Plant	E	3,322.2	0.0	0.0	19.6	0.0	**19.6**		**0.6%**	**100.0%**
Deyeuxia appressa		E	19.3	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Eucalyptus benthamii	Camden White Gum, Nepean River Gum	V	4,797.9	0.0	0.5	46.8	0.0	**47.3**		**1.0%**	**100.0%**
Genoplesium baueri	Yellow Gnat-orchid	E	768.3	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	7,468.0	0.0	0.0	0.0	3.9	**3.9**		**0.1%**	**24.4%**
Hibbertia puberula subsp. *glabrescens*		CE	43.7	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS BY TRANSPORT PROJECT				TOTAL IMPACTS			
				Metro (ha)	WSFL (ha)	OSO (ha)	M7 Link (ha)	Total transport impacts (ha)	Total transport impacts to important populations	Total transport impacts as % of habitat in SAA	Transport % of total Plan impacts
Leucopogon exolasius	Woronora Beard-heath	V	267.2	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Melaleuca deanei	Deane's Melaleuca	V	14,395.2	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Micromyrtus minutiflora		V	36,704.5	0.0	0.0	146.8	4.4	**151.2**		**0.4%**	**88.9%**
Persicaria elatior	Knotweed	V	1,310.7	0.0	0.5	46.4	0.0	**46.9**		**3.6%**	**93.2%**
Persoonia bargoensis	Bargo Geebung	V	12,293.0	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Persoonia glaucescens	Mittagong Geebung	V	2,378.2	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	E	11,416.8	0.0	5.2	0.0	0.9	**6.2**		**0.1%**	**100.0%**
Persoonia nutans	Nodding Geebung	E	15,043.3	0.0	0.7	75.9	10.2	**86.8**	1	**0.6%**	**60.9%**
Pimelea curviflora var. *curviflora*		V	13,011.3	0.0	0.0	24.4	15.0	**39.4**		**0.3%**	**71.2%**
Pimelea spicata	Spiked Rice-flower	E	34,815.5	4.6	38.4	160.1	35.2	**238.2**		**0.7%**	**24.5%**
Pomaderris brunnea	Rufous Pomaderris	V	26,076.2	0.9	1.1	165.7	1.0	**168.8**		**0.6%**	**81.6%**
Pterostylis saxicola	Sydney Plains Greenhood	E	11,727.8	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS BY TRANSPORT PROJECT				TOTAL IMPACTS			
				Metro (ha)	WSFL (ha)	OSO (ha)	M7 Link (ha)	Total transport impacts (ha)	Total transport impacts to important populations	Total transport impacts as % of habitat in SAA	Transport % of total Plan impacts
Pultenaea parviflora		V	20,270.9	0.0	15.9	143.6	27.2	**186.8**	3	**0.9%**	**85.4%**

Table 36-6: Transport impacts to Commonwealth listed threatened ecological communities

TEC Name	Cth status	Total TEC in SAA (ha)	IMPACTS BY TRANSPORT PROJECT				TOTAL IMPACTS		
			Metro (ha)	WSFL (ha)	OSO (ha)	M7 Link (ha)	Total transport impacts (ha)	Total transport impacts as % of TEC in SAA	Transport % of total Plan impacts
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	E	2,769.3	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	E	269.3	0.0	0.0	5.8	0.0	**5.8**	**2.2%**	**72.7%**
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CE	794.4	0.0	0.0	18.5	0.1	**18.6**	**2.3%**	**60.2%**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	9,954.3	0.0	0.8	41.4	10.5	**52.7**	**0.5%**	**29.2%**
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	CE	9.4	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**
River-flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria	CE	6,667.0	0.3	4.6	113.2	5.3	**123.4**	**1.9%**	**77.5%**
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	CE	8,301.5	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	CE	44.4	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	CE	968.1	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**

36.4.2 COMMITMENTS TO ADDRESS DIRECT IMPACTS

The Plan includes commitments to address the direct impacts of the major transport corridors on Commonwealth listed species and TECs. The key commitments apply to both the transport and other impacts of the Plan, and include to:

- Secure a minimum of 5,325 hectares of native vegetation in the Cumberland subregion (Commitment 8) to conserve biodiversity values in perpetuity, including specific amounts of habitat for Commonwealth-listed species and TECs
- Undertake ecological restoration of up to 25% of the offset target for native vegetation in areas secured for conservation within the Cumberland subregion (Commitment 13)
- Secure priority Koala corridors within the Cumberland subregion, to support habitat connectivity (Commitment 12)

Note that these commitments cover the impacts of the major transport corridors within the entire corridor footprint (excluding the tunnels). As described in section 36.3, not all these areas will be directly impacted and the Department will track impacts and adjust offset requirements through the Plan's reconciliation accounting process (see Part 2).

36.5 INDIRECT IMPACTS

36.5.1 SUMMARY OF IMPACTS

Potential indirect impacts are assessed in detail for each Commonwealth listed matter in Chapters 29, 30 and 31, and for other protected matters in Chapters 32, 33, 34 and 35. Chapter 15 summarises the commitments and mitigation measures and processes to implement them for the transport development.

Species and TECs with specific mitigation measures related to the transport development, and that are therefore considered most likely to be impacted by this development, are:

- Fauna:
  - Greater Glider
  - Green and Golden Bell Frog
  - Spotted-tailed Quoll
- Flora:
  - *Cynanchum elegans*
  - *Dillwynia tenuifolia*
  - *Grevillea juniperina* subsp. *juniperina*
  - *Persoonia nutans*
  - *Pultenaea parviflora*
  - *Eucalyptus benthamii*
  - *Pimelea spicata*
  - *Pomaderris brunnea*
- TECs:
  - Cooks River/Castlereagh Ironbark Forest

The major transport corridors tunnels have the potential to indirectly impact several Commonwealth land sites (see Chapter 35). The commitment under the Plan (Commitment 6 relating to specific flora and fauna populations that are at risk of impacts) and the process to mitigate indirect impacts are considered to adequately manage this risk.

The transport development will not have notable indirect impacts on other EPBC Act protected matters, including:

- Migratory species (see Chapter 32)
- Ramsar wetlands (see Chapter 33)
- World and National Heritage (see Chapter 34)

36.5.2 COMMITMENTS TO ADDRESS INDIRECT IMPACTS

The Plan includes a commitment to mitigate indirect and prescribed impacts from major transport corridors on species and habitat (Commitment 6). This includes implementing mitigation measures as prescribed in Appendix E of the Plan to address indirect impacts on biodiversity values.

The commitment to manage indirect impacts of the major transport corridors will be delivered through NSW environmental assessment and approval processes. As described in Part 2, each transport project will be subject to future strategic planning and detailed design and a process of environmental assessment and approval:

- For the major transport corridors within the nominated areas (where biodiversity impacts under both the EPBC Act and BC Act have already been assessed in this Assessment Report – see Part 1), this process will involve assessment under the State Significant Infrastructure approval process (or equivalent)
- For the major transport corridors outside the nominated areas (where biodiversity impacts have not been assessed under the BC Act - see Part 1), this process will involve assessment under both:
    - State Significant Infrastructure approval process (or equivalent)
    - BC Act and BAM (or equivalent)

The process under the BC Act and BAM will address potential indirect impacts on biodiversity values. The process under the State Significant Infrastructure approval process (or equivalent) will assess the other environmental impacts and matters that need to be considered prior to construction and operation of the transport project. This will include an assessment of risks to the environment and the identification of mitigation measures to manage these risks, such as impacts related to hydrological disturbance, noise, air quality, and construction activities.

36.6 ASSESSMENT OF IMPACTS OF TUNNELS ON MNES

This section assesses the likelihood of impacts on MNES due to the tunnel sections of the major transport corridors.

The impacts of the rest of the major transport corridors (non-tunnel sections) on MNES is provided for each MNES in Chapters 29 to 31. The impacts of the tunnels were assessed separately because only small areas of the tunnel footprints will be disturbed and it is not appropriate to assume all the footprint would be impacted (which was the approach taken for the rest of the major transport corridors) as this would greatly overestimate impacts.

Where the assessment on MNES in this section identified a risk of notable direct or indirect impacts from the tunnels on MNES, this has been noted in the assessments in Chapters 29 to 31.

Because only small areas of the tunnel footprints will be impacted, these impacts have not been included in the impact statistics for major transport corridors in this Chapter or in the assessments for each MNES in Chapters 29 to 31.

36.6.1 IMPACTS OF THE TUNNELS ON COMMONWEALTH LAND

Some of the tunnel sections occur within three Commonwealth land sites, including:

- Site 4 - Western Sydney University - within the MRFE tunnel footprint
- Site 6 - Camden Airport - within the OSO tunnel footprint
- Site 7 - 12 Werombi Road, Grasmere – within the OSO tunnel footprint

The direct and indirect impacts of the tunnels on the whole of the environment of Commonwealth land are assessed in Chapter 35. In summary, the assessment concludes that the commitments to avoid and minimise direct impacts and to mitigate the indirect impacts of the tunnels on these three sites are expected to adequately address these impacts and lead to acceptable outcomes for the whole of the environment values of these sites.

36.6.2 POTENTIAL DIRECT IMPACTS TO MNES

NATURE AND EXTENT OF DIRECT IMPACTS

Activities associated with tunnels are described in Section 36.2.2. In summary, disturbance to the land surface due to the tunnels, including vegetation clearing, may occur due:

- Construction activities

- Ancillary infrastructure, including ventilation systems
- Other infrastructure, such as entry and exit ramps and connection and tie in with existing roads and infrastructure
- Pedestrian and cyclist facilities
- Drainage work, pavement and finishing work

The tunnels may result in small direct impacts to the land surface generally within the tunnel footprints shown in Figure 36-1. In limited circumstances, direct impacts may occur adjacent to the footprint.

The tunnels will greatly reduce the potential for direct impacts to the land surface within the tunnel footprints compared to the rest of the major transport corridors (non-tunnel sections). Direct impacts may only occur to small areas of the tunnel footprints and the vast majority of land surface within the tunnel footprints will not be disturbed.

As for the other major transport corridors, the tunnel footprints are generally wider than needed and the final alignment of the tunnels within the footprint, and potential associated surface impacts, will be subject to future processes of refinement during the strategic planning and detailed design phase of the projects.

ASSESSMENT OF POTENTIAL DIRECT IMPACTS

Table 36-7 identifies the MNES values within the tunnel footprints that may be directly impacted by the tunnels.

The MNES values within the vicinity of the tunnels are shown in Map 36-1.

Table 36-7: MNES values within the tunnel footprints

TEC or species name	Area of TEC or potential habitat (ha) within tunnel footprint			Description
	MRFE tunnel	OSO tunnel	Total	
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	39.5	58.6	98.1	Several patches of the TEC occur in the tunnel footprints. Most patches are relatively small, generally isolated and in low condition (thinned or scattered trees). Several large (>20 ha) and intact condition patches of the TEC occur within and in the vicinity of the tunnel footprints in the Mater Dei BioBank site and Metro Offset site. These patches are relatively well connected to each other across these protected lands and represent some of the largest and best quality patches of the TEC in the surrounding area
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria	8.7	25.7	34.4	Several patches of the TEC occur in the tunnel footprints. Most patches are relatively small and/or narrow and in low condition (thinned or scattered trees). A large (>20 ha) and intact condition patch of the TEC occurs at the Registered Property Agreement site within the OSO footprint at Camden Airport. A smaller patch occurs in the vicinity of the MRFE tunnel footprint at Western Sydney University
Acacia bynoeana	3.2	0.6	3.8	Only very small amounts of potential habitat occur within the tunnel footprints and no populations are known to occur within the footprints or vicinity. Core areas for the species in the Cumberland subregion occur north and east of GPEC and WSA
Acacia pubescens	56.3	11.5	67.8	Only small amounts of potential habitat occur within the tunnel footprints and no populations are known to occur within the footprints or vicinity. The species is concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon (OEH, 2019a)
Australasian Bittern	4.6	8.2	12.8	No areas known to support the species (freshwater or brackish swamps that are shallow and vegetated, with a preference for the presence of sedges, rushes, and reeds (Garnett, Szabo et al., 2011) occur within or in the vicinity of the tunnel footprints and no populations are known to occur. Only very small areas mapped as potential habitat occur within the tunnel footprints
Australian Painted Snipe	6.2	5.7	11.9	There are no records for the species within or in the vicinity of the tunnels. Only very small amounts of potential foraging habitat occur, and the Strategic Assessment Area is not recognised as a key location for the species (see Chapter 30)
Cynanchum elegans		0.4	0.4	Only very small amounts of potential habitat occur within the tunnel footprints and no populations are known to occur within the footprints or vicinity
Dural land snail	19.4	60.3	79.7	No populations are known to occur within or in the vicinity of the tunnel footprints. The core area for the species within the Cumberland subregion occurs north of GPEC

TEC or species name	Area of TEC or potential habitat (ha) within tunnel footprint			Description
	MRFE tunnel	OSO tunnel	Total	
Eucalyptus benthamii	1.5	44.2	45.7	Part of a large important population of the species occurs within the OSO tunnel footprint. The vast majority of records within and in the vicinity of the footprint occur within the Registered Property Agreement site at Camden Airport. The species has a restricted distribution and individuals at Camden are important for genetic diversity of the species (DoE, 2014a)
Greater Glider	30.6	54.0	84.6	There are no records for the species within the tunnel footprints or vicinity and only small amounts of potential habitat occur. The species is associated with larger areas of eucalypt forest and woodlands and is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC, 2016c)
Grey-headed Flying Fox	59.7	88.2	147.9	No known camps occur within or in the vicinity of the tunnel footprints. Potential foraging habitat occurs within the footprints primarily within areas of native vegetation within protected lands. The species is highly mobile, feeds on fruit and nectar from a variety of vegetation communities and has access to large areas of intact vegetation surrounding the Strategic Assessment Area
Large-eared Pied Bat	24.0	0.0	24.0	The area is unlikely to support breeding habitat for the species (the site is not within one kilometre of areas likely to contain caves, crevices and cliffs - see Chapter 24) and only a small amount of potential foraging habitat occurs within and in the vicinity of the tunnel footprints. There is one recent record (recorded in 2016) in the vicinity of the tunnel footprints at the Mater Dei BioBank site (and an older record (from 2001) to the east of the OSO tunnel in an urban area)
Micromyrtus minutiflora	224.2	0.0	224.2	There are no records for the species within the tunnel footprints or vicinity. The core area for the species within the Cumberland subregion occurs in the Londonderry area north of GPEC
Persoonia bargoensis	0.1		0.1	Almost no potential habitat occurs in the tunnel footprints. The core area for the species within the Cumberland subregion occurs around Wilton, and south of Wilton
Pimelea spicata	295.7	84.7	380.4	While no records occur within the tunnel footprints, a very large population (of between 300 to over 1000 individuals) occurs adjacent to the MRFE tunnel footprint at Camden Golf Club. The population at this location is of particular significance as it is one of the largest known populations and is covered by a conservation agreement between DAWE and Camden Golf Club (DEC, 2005)
Pomaderris brunnea	64.1	62.5	126.6	Part of a large important population of the species occurs within the OSO tunnel footprint. The vast majority of records within and in the vicinity of the footprint occur within the Registered Property Agreement site at Camden Airport. Only 10 to 14 populations of the species are known to occur in NSW (Sutter, 2011)

TEC or species name	Area of TEC or potential habitat (ha) within tunnel footprint			Description
	MRFE tunnel	OSO tunnel	Total	
Pultenaea parviflora		0.4	0.4	No populations are known to occur within or in the vicinity of the tunnel footprints. The core area for the species within the Cumberland subregion occurs north of the tunnels around WSA and GPEC, and particularly north of GPEC
Regent Honeyeater	67.4	108.2	175.6	There is no known breeding habitat or key areas identified in the species Recovery Plan or Conservation for the species within the tunnel footprints or vicinity. Foraging habitat that occurs comprises more fragmented and degraded remnants unlikely to provide the ecological elements preferred by the species. There is one old (1984) record in the general vicinity of the tunnels (east of the MRFE tunnel). There are no areas mapped as important habitat by EES within the major transport corridors (or nominated areas) (see Chapter 30)
Spot-tailed Quoll	23.5	42.6	66.1	There are no records for the species within or in the vicinity of the tunnels and only small amounts of potential habitat occur. The species may disperse along creek lines within the Strategic Assessment Area (Bruce Mullins, pers com), and may use the riparian corridor along the Nepean River.
Swift Parrot	67.4	108.2	175.6	There are two records of the species recorded in 2014 and 2016 located within protected lands (the Mater Dei BioBank site and Camden Airport Registered Property Agreement site) in the vicinity of the OSO tunnel footprint near Camden Airport. However, the higher number of records in coastal habitat to the east indicates a relatively lower reliance on the Cumberland subregion, and the scale of potential impacts on potential foraging habitat is very small.

The risk of notable direct impacts from the tunnels on MNES values is considered to be minimal because:

- Total extent of potential direct impacts on MNES is likely to be small due to the limited surface impacts
- Most of the tunnel footprints do not contain important MNES values potentially subject to notable impacts
- The Plan includes commitments to avoid and minimise impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary, and if impacts are unavoidable, to offset those impacts in accordance with regulatory requirements

Total extent of potential direct impacts on MNES is likely to be small

The potential extent of direct impacts to the land surface and MNES values within or in the vicinity of the tunnel footprints is likely to be small. Only a small area of the tunnel footprints is likely to be directly impacted and the vast majority of the land surface within the tunnel footprints will not be disturbed.

Furthermore, most of the tunnel footprints comprise cleared or existing urban land and there is significant opportunity to ensure any land surface impacts are located to avoid and minimise impacts on MNES values (see Map 36-1).

Most of the tunnel footprints do not contain important MNES values

As described in Table 36-7 and shown in Map 36-1 most of the tunnel footprints do not contain important MNES values potentially subject to notable impacts. The vast majority of MNES values within the tunnel footprints occur within six discrete areas, and particularly in three protected lands already recognised for their environmental values.

These six areas are:

- Three protected lands within both tunnel footprints (these cover a total of 120 ha). These are:
  - Mater Dei BioBank site within the OSO footprint near Camden
  - Registered Property Agreement site within the OSO footprint at Camden Airport
  - Metro Offset site within the OSO and MRFE footprints near Harrington Park
- Nepean River and associated riparian corridor within the OSO footprint
- Camden Golf Club at Narellan adjacent to the MRFE footprint
- Mount Annan Botanic Gardens within the MRFE footprint

Threatened ecological communities

The total extent of each TEC within the tunnel footprints is relatively small and most TEC patches within and in the vicinity of the tunnel footprints are small, relatively isolated and in low condition.

The most important patches of TECs potentially subject to notable impacts are:

- Several patches of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest within and in the vicinity of the tunnel footprints in the Mater Dei BioBank site and Metro Offset site
- A patch of River-flat Eucalypt Forest on Coastal Floodplains at the Registered Property Agreement site. The patch mostly occurs outside the OSO footprint

The relatively small total extent of TECs and their generally small size and low condition considerably reduces the risk of notable direct impacts from the tunnels on TECs. Furthermore, the location of important areas of TECs within a small number of discrete areas within the protected lands, and the likely small extent of total disturbance to the land surface within and in the vicinity of the tunnel footprints, further reduces the risk of notable direct impacts.

Furthermore, the Plan includes a specific commitment (see below) to avoid and minimise impacts on TECs within the Mater Dei BioBank site, Metro Offset site and Registered Property Agreement site, and to offset any unavoidable impacts on TECs. This commitment further reduces the risk of notable direct impacts to these TECs in these locations.

Species

The extent of potential habitat for most species within the tunnel footprints is small, and for most species, no populations are known to occur within or in the vicinity of the tunnel footprints. As for the TECs, the most important potential habitat for species generally occurs within the protected lands.

The most important occurrences of species and habitat potentially subject to notable impacts are:

- *Eucalyptus benthamii* and *Pomaderris brunnea* mainly within the Registered Property Agreement site
- *Pimelea spicata* adjacent to the MRFE tunnel footprint at Camden Golf Club

The location of important areas of potential species habitat and populations within a small number of discrete areas and the likely small extent of total disturbance to the land surface within and in the vicinity of the tunnel footprints, considerably reduces the risk of notable direct impacts to these three species.

Furthermore, the Plan includes a specific commitment (see below) to avoid and minimise impacts on species within the Registered Property Agreement site and at Camden Golf Club where possible and to offset any unavoidable impacts. This commitment further reduces the risk of notable direct impacts to these three species in these locations.

Commitments to address direct impacts

The Plan includes commitments to avoid and minimise impacts to MNES values where disturbance to the land surface within or in the vicinity of the tunnel footprints is necessary. Furthermore, if impacts are unavoidable, the Plan commits to offsetting those impacts in accordance with regulatory requirements.

For the major transport corridors (strategically assessed only) outside the nominated areas, the Plan commits to avoiding and minimising impacts to TECs, species and habitat, including the OSO and MRFE tunnel sections, in accordance with:

- Major transport corridors class of action description, including the NSW State Significant Infrastructure (SSI) (or equivalent) approvals process
- Biodiversity Assessment Method under the BC Act (or equivalent) (Commitment 4)

Commitment 4 also includes a requirement to avoid and minimise impacts where possible within and adjacent to the OSO and MRFE tunnel sections (Commitment 4.2). Commitment 4.2 specifically addresses the three species identified above as potentially subject to notable direct impacts and the protected lands where the most important MNES values within the vicinity of the tunnel footprints occur. The commitment requires avoidance of:

- Known populations and habitat of:
  - *Eucalyptus benthamii*
  - *Pomaderris brunnea*
  - *Pimelea spicata*
- Known populations and habitat and TECs within:
  - Mater Dei BioBank site within the OSO tunnel footprint near Camden
  - Registered Property Agreement site within the OSO tunnel footprint at Camden Airport
  - Metro Offset site within the OSO and MRFE tunnel footprints near Harrington Park
  - Nepean River and associated riparian corridor within the OSO tunnel footprint
  - Camden Golf Club at Narellan adjacent to the MRFE tunnel footprint
  - Mount Annan Botanic Gardens within the MRFE tunnel footprint

The SSI assessment process is described in detail in Chapter 15. The process requires the preparation of an Environmental Impact Statement (EIS) for each tunnel project in accordance with the Planning Secretary's assessment requirements (SEARs). The EIS must identify and assess all relevant environmental impacts of the tunnel projects, identify mitigation measures and commit to performance outcomes for managing these impacts, and identify the detail of ongoing construction and operational management plans and monitoring programs (DPIE, 2020c).

The BAM assessment process provides a robust method and set of requirements for avoiding and minimising impacts, including requirements to justify where impacts are unavoidable. It also requires any residual impacts to be offset. The BAM process will apply to any impacted MNES values that are also listed under the BC Act.

In addition to requiring the SSI and BAM assessment processes be applied to the tunnel projects, actions under Commitment 4 specify several additional requirements be put in place to address direct impacts on MNES. These additional requirements ensure risks to MNES values are specifically considered and addressed as part of or alongside the SSI and BAM assessment processes. Requirements relevant to the tunnels include:

- Undertake surveys to confirm biodiversity values and MNES during the planning phase of each transport project
- Include the biodiversity benefits of avoiding TECs, species and habitat as well as the costs of offsets into the evaluation of route options (for example multi-criteria analysis)
- Avoid and minimise impacts to biodiversity values, including MNES, in accordance with the BAM (or equivalent) and with specific consideration to the protected matters identified in Commitments 4.2 and 4.3 during the environmental impact assessment phase of each transport project
- Offset impacts to biodiversity values, including MNES, in accordance with the Biodiversity Assessment Method (or equivalent) and EPBC Act Environmental Offsets Policy, 2012 for any EPBC Act matters not covered by the BAM

Note that offsets needed for any direct impacts from the tunnels are not included in the conservation program under the Plan and will be additional to the offsets required to be secured under the Plan.

Commitment 4 also provides accountability and transparency in relation to the avoidance achieved, the nature and extent of any direct impacts, and the offsets required to address these impacts by requiring Transport for NSW to report to the Department and the executive implementation committee on these matters. Transport for NSW must report on:

- Avoidance achieved within the major transport corridors
- Any additional impacts outside the corridors for Commonwealth-listed TECs or species
- Any offsets to be secured under the SSI approval process and EPBC Act Environmental Offsets Policy, 2012

The Department will use this information to track impacts and adjust Transport for NSW's offset liabilities through the Plan's reconciliation accounting process (see Part 2). The direct impacts of the tunnel projects on biodiversity values, including MNES, will be published through the Plan's annual updates and five yearly reviews.

It is important to note that the impacts of the tunnel projects on MNES values are already assessed in this Assessment Report. Application of the BAM will apply to MNES values that are also Commonwealth listed.

Conclusion

The risk of notable direct impacts from the tunnels on MNES values is considered to be minimal. The total extent of potential direct impacts on MNES is likely to be small due to the limited land surface impacts and most of the tunnel footprints do not contain important MNES values potentially subject to notable impacts, further reducing the risk of impacts. Furthermore, the Plan includes a commitment to avoid and minimise impacts to MNES values where disturbance to the land surface is necessary, including specifically for the MNES values identified at potential risk of notable impacts. Where impacts to MNES values are unavoidable, the Plan requires those impacts to be offset in accordance with the BAM and EPBC Act Environmental Offsets Policy, 2012 to ensure they are acceptable.

36.6.3 POTENTIAL INDIRECT IMPACTS TO MNES

NATURE AND EXTENT OF INDIRECT IMPACTS

Activities associated with tunnels are described in Section 36.2.2. In summary, indirect impacts due to the tunnels may occur due:

- Construction activities
- Ancillary infrastructure, including ventilation systems
- Other infrastructure, such as entry and exit ramps and connection and tie in with existing roads and infrastructure
- Drainage work, pavement and finishing work

The main types of indirect impacts associated with these activities with the potential to indirectly impact MNES within or adjacent to the tunnel footprints are shown in Table 36-8.

The tunnels will generally reduce the risk of many indirect impacts associated with the rest of the major transport corridors on MNES values, as tunnelling substantially reduces the disturbance to the land surface required to construct the corridors. However, tunnelling will create larger risks associated with:

- Hydrological changes to groundwater
- Ground settlement potentially causing impacts to the land surface, including waterways
- Management of large quantities of spoil

Table 36-8: Key activities associated with tunnels and associated potential indirect impacts

Type of indirect impact/threat	Description
Hydrological disturbance	Changes to surface water and groundwater flows and water quality. Potential for groundwater level drawdown into the tunnel void and water quality impacts from the disposal of poor-quality groundwater and surface water drainage from the tunnel during operation
Soil erosion and sedimentation	Potential for soil erosion and sedimentation to lead to disturbance to vegetation and poor-quality stormwater run-off, particularly associated with the management of spoil
Disturbance of contaminated soils	Potential for disturbance to contaminated sites, causing water quality impacts
Spread of weeds	Spread of invasive species due to edge effects, surface water run-off, or changed fire regimes
Spread of infection/disease	Spread of pathogens from contaminated clothing and equipment or surface water runoff
Fauna disturbance due to noise, dust, or light	Noise, dust, or light created by equipment during construction or generated through the tunnel ventilation system during operation
Fauna mortality and barriers to fauna movement	Potential for mortality of threatened fauna species by vehicle strike and reduced movement and connectivity between habitat areas from barriers
Inadvertent impacts on adjacent habitat or vegetation	Damage to adjacent habitat during construction activities
Ground settling or subsidence	Potential for the ground in the vicinity of the tunnels to settle or subside due to the tunnel void or groundwater removal, which may cause disturbance to the land surface

ASSESSMENT OF POTENTIAL INDIRECT IMPACTS

Table 36-9 identifies the MNES that occur in the vicinity of the tunnel footprints that are most likely to be potentially indirectly impacted by the tunnels and assesses the potential for indirect impacts on these matters.

The MNES were identified and assessed based on:

- The presence/abundance of species records and potential habitat and TECs in the vicinity of the tunnels, including the information in Table 36-7 above about the occurrence of each species within the tunnel footprints
- Relevant threats to the species and TECs identified in Conservation Advices and Recovery Plans
- Proximity of the species and TECs to the tunnel footprints in the context of the indirect impact type (e.g. ground settling or disturbance is more likely to occur to biodiversity values within the tunnel footprint, weed invasion is a risk for values in proximity to construction sites that will generally be within the tunnel footprint)

Table 36-9: Key biodiversity values potentially indirectly impacted by tunnels and assessment of potential indirect impacts

Biodiversity value	Key locations of TECs or species records	Relevant tunnel	Key relevant indirect impacts/threats	Conclusion
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Mater Dei BioBank site Sydney Metro offset site	OSO	• Hydrological/soil disturbance • Spread of weeds • Soil erosion and sedimentation • Spread of infection/disease • Ground settling or subsidence	Several patches of these TECs, including several large (>20 ha) intact patches, have the potential to be indirectly impacted, particularly due to hydrological/soil disturbance and ground settling or subsidence. Commitment 6 specifically addresses key threats from the construction and operation of the tunnels on these TECs and is expected to adequately address potential indirect impacts
	Sydney Metro offset site Camden Golf Course, Narellan Mount Annan Botanic Gardens	MRFE		
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria	Mater Dei BioBank site Camden Airport Registered Property Agreement	OSO	• Hydrological/soil disturbance • Spread of weeds • Soil erosion and sedimentation • Spread of infection/disease • Ground settling or subsidence	
	Sydney Metro offset site Mount Annan Botanic Gardens Western Sydney University	MRFE		
Eucalyptus benthamii	Mater Dei BioBank site Camden Airport Registered Property Agreement Along the Nepean River in the vicinity of the OSO	OSO	• Hydrological/soil disturbance • Spread of weeds • Spread of infection/disease • Ground settling or subsidence	A large important population of the species occurs within the OSO tunnel footprint and has the potential to be indirectly impacted, particularly due to hydrological/soil disturbance and ground settling or subsidence. Commitment 6 specifically addresses key threats from the construction and operation of the tunnels on this species and is expected to adequately address potential indirect impacts
Pimelea spicata	Camden Golf Course, Narellan Mount Annan Botanic Gardens	MRFE	• Hydrological/soil disturbance • Spread of weeds	A large important population of the species occurs at Camden Golf Club immediately adjacent to the MRFE tunnel footprint and has the potential to be indirectly impacted. Commitment 6 specifically addresses key threats from the construction and operation of the tunnels on this species and is expected to adequately address potential indirect impacts

Biodiversity value	Key locations of TECs or species records	Relevant tunnel	Key relevant indirect impacts/threats	Conclusion
Pomaderris brunnea	Camden Airport Registered Property Agreement Along the Nepean River in the vicinity of the OSO	OSO	• Spread of weeds • Soil erosion and sedimentation • Ground settling or subsidence	A large important population of the species occurs within the Camden Airport Registered Property Agreement and within the riparian corridor of the Nepean River and has the potential to be indirectly impacted particularly due to ground settling or subsidence. Commitment 6 specifically addresses key threats from the construction and operation of the tunnels on this species and is expected to adequately address potential indirect impacts
Grey-headed Flying Fox	Mater Dei BioBank site	OSO	• Fauna disturbance due to noise	There are no known camps in the vicinity of the tunnels and potential indirect impacts relate to disturbance to individuals utilising foraging habitat only. The scale of potential indirect impacts to foraging habitat is small. The species is highly mobile, feeds on fruit and nectar from a variety of vegetation communities and has access to large areas of intact vegetation surrounding the Strategic Assessment Area
	Mount Annan Botanic Gardens	MRFE		
Large-eared Pied Bat	Mater Dei BioBank site	OSO	• Fauna disturbance due to noise	The area is unlikely to support breeding habitat and potential indirect impacts relate to disturbance to individuals utilising foraging habitat only. Only one recent record of the species occurs in the area (at the Mater Dei BioBank site) and the scale of potential indirect impacts to foraging habitat is small
Swift Parrot	Mater Dei BioBank site Camden Airport Registered Property Agreement	OSO	• Fauna disturbance due to noise	Potential indirect impacts relate to disturbance to individuals utilising foraging habitat only. The species is highly mobile, and the scale of impacts to potential foraging habitat is very small

Biodiversity value	Key locations of TECs or species records	Relevant tunnel	Key relevant indirect impacts/threats	Conclusion
Koala	Mount Annan Botanic Gardens	MRFE	• Hydrological/soil disturbance affecting feed trees • Fauna disturbance due to noise	While Koala has been recorded in the Botanic Gardens, the species is unlikely to be resident in the area. Habitat within the gardens is marginal, comprising supporting habitat only (see Chapter 30) and significant existing threats to Koalas are likely to exist in the area, including threats posed by roads, domestic dogs, barriers to movement (such as fences) and landscape hazards (such as swimming pools)

Commitments to address indirect impacts

The Plan includes a commitment to mitigate indirect impacts on TECs, species and their habitat within major transport corridors, including the OSO and MRFE tunnel sections (Commitment 6), in accordance with the:

- Major transport corridors class of action description, including the SSI (or equivalent) approval
- Major transport corridors class of action description and the BAM under the BC Act (or equivalent) for the non-certified major transport corridors (strategically assessed) (this includes the MRFE and OSO tunnel sections)
- Specific mitigation measures to address impacts on biodiversity values prescribed in Appendix E of the Plan

As described in Part 2, the major transport corridors will be subject to future environmental assessment and approval processes under the EP&A Act and/or the BC Act that will apply to each transport project prior to it proceeding.

The SSI assessment process and how it manages indirect impacts is described in Chapter 15, Section 15.6.3.

The BAM assessment process provides a robust method and set of requirements for identifying mitigation measures to address indirect impacts and may also require any residual indirect impacts that cannot be managed through mitigation measures to be offset. The BAM process will apply to any impacted MNES values that are also listed under the BC Act.

In addition to requiring the SSI and BAM assessment processes be applied to the tunnel projects, actions under Commitment 6 specify several additional requirements be put in place to address indirect impacts on MNES. These additional requirements ensure risks to MNES values are specifically considered and addressed as part of or alongside the SSI and BAM assessment processes. Requirements relevant to the tunnels include:

- Assess impacts on biodiversity values and other environmental values based on detailed design
- Implement specific mitigation measures prescribed in Appendix E of the Plan
- Identify and implement additional mitigation measures based on the outcomes of assessment of detailed designs in accordance with the requirements of the SSI approval process (or equivalent), as well as published, best practice guidelines, including but not limited to, the RMS Biodiversity Guidelines
- Apply further mitigation according to the BAM under the BC Act (or equivalent)

Importantly, the mitigation measures prescribed in Appendix E include specifically managing key threats to the three species identified in Table 36-9 as being at potential risk of notable indirect impacts from the tunnels – *Eucalyptus benthamii*, *Pimelea spicata* and *Pomaderris brunnea*. The key threats to be managed are:

- Hydrological disturbance
- Spread of weeds
- Spread of infection/disease
- Soil erosion and sedimentation
- Ground settling or subsidence

Ground settling or subsidence is identified as a risk to several TECs and species in Table 36-9. The risk of subsidence, including the risk of hydrological impacts due to groundwater drawdown, will be quantified and assessed through the SSI assessment process and mitigation measures will be identified and implemented to manage this risk through both this and the BAM assessment processes. If any residual risks to biodiversity values that cannot be managed through mitigation measures are identified, the BAM process may require these impacts to be offset. This process is considered adequate to manage the potential risks of ground settling or subsidence on MNES values.

Commitment 6 also includes several actions that provide additional assurance in relation to the implementation of mitigation measures to address indirect impacts of the tunnels. These include:

- Establish baseline monitoring data and undertake ongoing monitoring high environmental value areas and review adjust mitigation measures (where practical) in response to monitoring outcomes, in accordance with the requirements of the SSI assessment process (or equivalent)
- Report to the Department and executive implementation committee on the mitigation measures proposed to manage impacts of each major transport corridor project, including proposed techniques, timing, frequency and responsibility for implementing each measure

These actions provide additional assurance that the SSI and BAM assessment processes will lead to the implementation of mitigation measures to address indirect impacts of the tunnels in accordance with Commitment 6.

Conclusion

The commitment to mitigate indirect impacts on TECs, species and their habitat within the OSO and MRFE tunnel sections through the SSI and BAM assessment processes is considered adequate to manage the risks of indirect impacts on MNES values. These assessment processes provide robust methods for identifying and implementing mitigation measures to address indirect impacts. Several additional requirements will also be put in place to ensure risks to MNES values are specifically addressed as part of or alongside the SSI and BAM assessment processes. This includes mitigation specifically for the MNES values identified as particularly at risk of impacts. Additional assurance in relation to the effective identification and implementation of mitigation measures is provided through a requirement to monitor high-environmental value areas and adjust mitigation measures in response to monitoring outcomes.

36.7 OVERALL OUTCOME UNDER THE PLAN

The detailed assessments for Commonwealth listed species and TECs and other protected matters have shown that the direct, indirect, and cumulative impacts of the transport development under the Plan are acceptable and that the commitments under the Plan will adequately protect and conserve these matters in the context of these impacts.

37 Summary of urban program impacts

37.1 INTRODUCTION

This Chapter provides:

- A summary of the urban and industrial development, infrastructure/essential infrastructure, and intensive plant agriculture under the Plan
- A summary of the impacts of the urban and industrial development, infrastructure/essential infrastructure, and intensive plant agriculture within urban capable lands on MNES under the EPBC Act including:
  - Avoidance outcomes and commitments
  - Direct impacts and commitments to address impacts
  - Indirect impacts and commitments to address impacts
- An assessment of the potential additional impacts of essential infrastructure within the nominated areas
- A conclusion about the overall outcome in relation to urban and industrial development, infrastructure/essential infrastructure, and intensive plant agriculture under the Plan

The summary draws on the detailed analysis of the impacts of the Plan and the adequacy of the commitments under the Plan to address these impacts on each MNES presented earlier in this Assessment Report.

These detailed impact assessments have shown that the direct, indirect and cumulative impacts of development within urban capable land (and major transport corridors) on MNES are acceptable and that the commitments under the Plan will adequately protect and conserve these matters in the context of these impacts.

Part 7 provides an evaluation of the overall adequacy and acceptability of the Plan in the context of the impacts of the development under the Plan and in accordance with the regulatory requirements of the BC Act and EPBC Act.

Urban and industrial development, infrastructure/essential infrastructure, and intensive plant agriculture under the Plan is described in Chapter 7.

The locations of the nominated areas are shown in Figure 37-1.

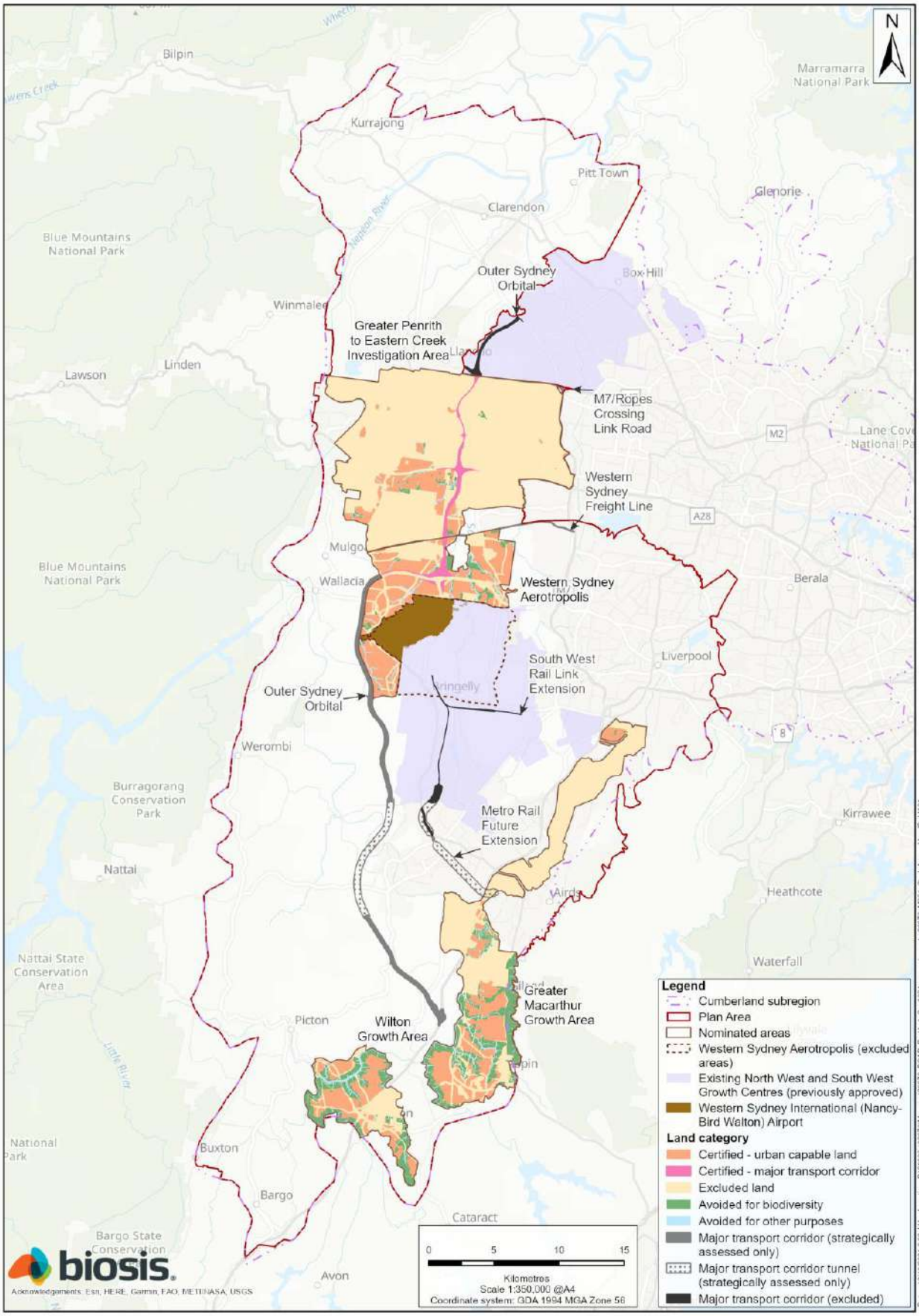

Figure 37-1: Locations of nominated areas within the Strategic Assessment Area

37.2 SUMMARY OF THE URBAN AND OTHER DEVELOPMENT

37.2.1 URBAN AND INDUSTRIAL DEVELOPMENT

Urban and industrial development will be confined to the urban capable lands within the nominated areas and includes any development permitted through residential, business, or industrial zones under relevant Local Environmental Plans, consistent with the structure plan and precinct plans for each nominated area.

Structure plans and precinct plans will be prepared for each nominated area by the relevant planning authority under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and will map the boundaries of the urban capable land and the intended land use zones. Relevant planning authorities will rezone the land over time in stages.

37.2.2 INTENSIVE PLANT AGRICULTURE IN THE AGRIBUSINESS PRECINCT

The Western Sydney airport presents an opportunity to invest in intensive plant agriculture and agribusiness industries. The agribusiness precinct within WSA occurs on the northern and western edges of the airport and supports the long-term retention and growth of intensive plant agriculture and agribusiness in the Western Parkland City.

Intensive plant agriculture will be confined to the agribusiness precinct within WSA and may include:

- Intensive plant agriculture, including protective structures used for production of fruit, vegetables, or flowers
- Agribusiness – businesses associated with the production, processing, marketing, and distribution of agricultural products, such as biotechnology research and development, food processing and export enabling infrastructure
- Advanced food manufacturing and logistics
- Wholesale markets, such as retail, distribution centres, cold stores, ripening rooms, and treatment facilities

37.2.3 INFRASTRUCTURE

Infrastructure development will generally be limited to urban capable land within the nominated areas and includes:

- Electricity transmission or distribution networks
- Gas pipelines
- Road or road infrastructure facilities, including public transport facilities (this is limited to local roads)
- Water reticulation systems, water storage facilities, water treatment facilities, or water supply systems
- Telecommunications facilities or telecommunication networks
- Supporting infrastructure for parks and public reserves (environmental facility, information and education facility, kiosk, recreation area, recreation facilities (outdoor), water recreation structure, road)

ESSENTIAL INFRASTRUCTURE

Certain essential infrastructure may be carried out by or on behalf of a public authority on land outside the urban capable land (not including land excluded from the Plan) within the nominated areas (i.e. on land avoided for biodiversity purposes or other reasons) provided specific requirements under the Plan are followed.

These requirements limit the scope of essential infrastructure development within these areas and will ensure that any infrastructure development in these areas avoids and mitigates and offsets any impacts to biodiversity values.

The potential impacts of essential infrastructure are assessed at Section 37.6.

37.3 AVOIDANCE OF IMPACTS

37.3.1 SUMMARY OF AVOIDANCE OUTCOMES

Consistent with Section 8.1.1.2 of the BAM, the process to identify the urban capable land boundaries within the nominated areas was an iterative one that began early in the assessment process before the final data on biodiversity values was completed. The urban capable land boundaries were identified in three phases:

- Strategic planning to locate the nominated areas
- Initial development of footprints through Land Use and Infrastructure Implementation Plans (LUIIP)

- Iterative refinement of the footprints through development of the Plan and assessment of impacts

Details of the process to design the urban capable land within the nominated areas are provided in Chapter 14.

Urban and industrial development, infrastructure, and intensive plant agriculture in urban capable land within nominated areas has avoided the majority of native vegetation and key areas of high biodiversity values, including Commonwealth-listed TECs important populations and habitat connectivity.

Within the nominated areas, total avoidance (not including excluded lands) is summarised in Table 37-1.

Table 37-1: Avoidance outcomes for urban and industrial development, infrastructure, and intensive plant agriculture within nominated areas

Biodiversity values	Summary of avoidance outcome in the nominated areas*
Native vegetation	67.2% avoided
High (intact) condition native vegetation	95.2% avoided
Commonwealth-listed TECs (critically endangered/endangered)	87.5% avoided
Commonwealth important populations	12 of the 14 species avoided (either wholly or partially)
Habitat connectivity (BIO Map areas)	88.3% of BIO Map core areas
	86.0% of BIO Map corridors

*Note that these figures include the amount of land 'avoided' for other purposes (e.g. riparian corridors and steep land) and not just biodiversity purposes. The figures do not include excluded land

37.3.2 COMMITMENTS FOR AVOIDANCE

The Plan includes a commitment (Commitment 2) to avoid and minimise impacts from urban and industrial development, and infrastructure, to at least 4,505 hectares of land within the nominated areas. This includes

- Avoiding 3,670 hectares of native vegetation comprising:
  - 2,735 hectares of native vegetation because of its biodiversity value
  - 935 hectares of riparian corridors and steep land
- Avoiding specific amounts of habitat for Commonwealth and NSW listed TECs
- Limiting cumulative direct impacts from essential infrastructure within non-certified land to the Commonwealth listed Shale Sandstone Transition Forest TEC and prioritising the avoidance of impacts from this infrastructure to specific known populations of flora species and important Koala corridors

37.4 DIRECT IMPACTS

37.4.1 SUMMARY OF IMPACTS

The direct impacts that may occur due to the nominated areas are associated with construction and are:

- Habitat loss
- Habitat fragmentation and loss of habitat connectivity

The direct impacts of the nominated areas on MNES are assessed in Chapters 29 to 35.

A summary of the direct impacts from urban development on Commonwealth-listed species and TECs is provided in:

- Table 37-2 – urban impacts to threatened fauna
- Table 37-3 – urban impacts to threatened flora
- Table 37-4 – urban impacts to TECs

These tables identify impacts in relation to each nominated area, as well as the total impact of the nominated areas and the contribution of the urban program to the total impacts of the development under the Plan.

The urban development will not have notable direct impacts on other EPBC Act protected matters, including:

- Migratory species (see Chapter 32)
- Ramsar wetlands (see Chapter 33)
- World and National Heritage (see Chapter 34)
- Commonwealth land (see Chapter 35)

THREATENED FAUNA

The following outlines the magnitude of impact to each threatened fauna species solely with regards to the urban capable development program. Chapter 30 provides a detailed assessment of each fauna species as a result of all development (urban capable in addition to transport development) under the Plan and produces a risk ranking for each fauna species with regards to their magnitude of direct impacts under the Plan. It is noted that the risk ranking relates to both urban capable and transport development, rather than just urban capable development, and so it is possible for a species to have low urban capable development impacts yet a high risk rating as a result of impacts due to transport development (and vice versa).

Urban development within the nominated areas will directly impact potential habitat for 11 of the 20 fauna species. These include: Regent Honeyeater (low risk), Australasian Bittern (low risk), Swift Parrot (medium risk), Australian Painted Snipe (very low risk), Large-eared Pied Bat (low risk), Spot-tailed Quoll (low risk), Greater Glider (very low risk), Koala (high risk), Grey-headed Flying Fox (low risk), Giant Burrowing Frog (very low risk) and Green and Golden Bell Frog (very low risk).

The most notable direct impacts occur to:

- Regent Honeyeater (low risk) and Swift Parrot (medium risk) within GMAC and Wilton
- Grey-headed Flying-fox (low risk) within WSA
- Large-eared Pied Bat (low risk) in Wilton and GMAC

The largest impacts to potential habitat will occur to:

- Species with broad associations with woodland habitats primarily for foraging, such as the Swift Parrot (medium risk) (827.2 ha of impact) and the Regent Honeyeater (low risk) (827.2 ha of impact)
- Wide ranging species such as the Spot-tailed Quoll (low risk) (401.5 ha of impact) and Grey-headed Flying-fox (low risk) (404 ha of impact)

The species most impacted in terms of the percentage of total habitat in the Strategic Assessment Area is the Koala (high risk), which will have 1.6% of its potential habitat impacted.

THREATENED FLORA

The following outlines the magnitude of impact to each threatened flora species solely with regards to development of the urban capable development program. Similar to fauna, Chapter 29 provides a detailed assessment of each species as a result of all development (transport in addition to urban capable development) under the Plan and produces a risk ranking for each flora species with regards to their magnitude of direct impacts under the Plan. It is noted that the risk ranking relates to both urban capable and transport development, rather than just urban capable development, and so it is possible for a species to have low urban capable impacts yet a high risk rating as a result of impacts due to transport development (and vice versa).

The nominated areas will directly impact potential habitat for 14 of the 23 flora species.

The most notable direct impacts occur to:

- *Pimelea spicata* (high risk) within Wilton and WSA
- *Acacia pubescens* (very low risk) within Wilton, GMAC, WSA and GPEC

The largest impacts to potential habitat will occur to:

- *Acacia pubescens* (very low risk) (1,096.1 ha)
- *Pimelea spicata* (high risk) (735.8 ha)
- *Acacia bynoeana* (very low risk) (415.5 ha)

The species most impacted in terms of the percentage of total habitat in the Strategic Assessment Area is *Acacia pubescens* (very low risk), which will have 3.0% of its potential habitat impacted.

The nominated areas will directly impact known important populations of some flora species, including: *Pultenaea parviflora* (high risk) (2 populations).

THREATENED ECOLOGICAL COMMUNITIES

The following outlines the magnitude of impact to each TEC with solely with regards to development of the urban capable land program. Chapter 31 provides a detailed assessment of each species as a result of all development (transport in addition to urban capable development) under the Plan. The following outlines the area of each TEC impacted by urban capable development under the Plan, with the total impact of all development under the Plan (transport in addition to urban development) provided in brackets to provide additional context.

Development within urban capable land will directly impact five of the TECs. These include:

- Shale Sandstone Transition Forest of the Sydney Basin Bioregion 180.7 ha impacted by urban capable land (180.7 ha impacted in total by the Plan)
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest: 127.6 ha impacted by urban capable land (180.3 ha impacted in total by the Plan)
- River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria: 35.8 ha impacted by urban capable land (159.2 ha impacted in total by the Plan)
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion: 12.3 ha impacted by urban capable land (30.9 ha impacted in total by the Plan)
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community: 2.2 ha impacted by urban capable land (8.0 ha impacted in total by the Plan)

The most notable direct impacts occur to:

- Shale Sandstone Transition Forest of the Sydney Basin Bioregion within Wilton and GMAC
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest within GMAC, WSA and GPEC

The TEC most impacted in terms of the percentage of total TEC in the Strategic Assessment Area is Shale Sandstone Transition Forest of the Sydney Basin Bioregion (2.2 per cent).

Table 37-2: Urban impacts to potential habitat for Commonwealth-listed threatened fauna

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS FROM URBAN DEVELOPMENT IN NOMINATED AREAS				TOTAL URBAN IMPACTS			
				Wilton (ha)	GMAC (ha)	WSA (ha)	GPEC (ha)	Total nominated area impacts (ha)	Total nominated area impacts to important populations	Total nominated area impacts as % of habitat in SAA	Nominated area % of total Plan impacts
BIRDS											
Anthochaera phrygia	Regent Honeyeater	CE	59,369.2	149.3	247.4	302.7	127.8	**827.2**	**0**	**1.4%**	**65.1%**
Botaurus poiciloptilus	Australasian Bittern	E	2,534.5	0.0	6.5	9.4	5.9	**21.9**	**0**	**0.9%**	**22.4%**
Calidris canutus	Red Knot	E, Migratory	182.3	0.0	0.0	0.0	0.0	**0.0**	**0**	**0.0%**	**0.0%**
Calidris ferruginea	Curlew Sandpiper	CE, Migratory	182.3	0.0	0.0	0.0	0.0	**0.0**	**0**	**0.0%**	**0.0%**
Charadrius leschenaultii	Greater Sand-plover	V, Migratory	182.3	0.0	0.0	0.0	0.0	**0.0**	**0**	**0.0%**	**0.0%**
Lathamus discolor	Swift Parrot	CE	59,369.2	149.3	247.4	302.7	127.8	**827.2**	1	**1.4%**	**65.1%**
Limosa lapponica	Bar-tailed Godwit	V, Migratory	182.3	0.0	0.0	0.0	0.0	**0.0**	**0**	**0.0%**	**0.0%**
Numenius madagascariensis	Eastern Curlew	CE, Migratory	182.3	0.0	0.0	0.0	0.0	**0.0**	**0**	**0.0%**	**0.0%**
Rostratula australis	Australian Painted Snipe	E	2,230.7	1.3	9.1	20.0	3.7	**34.1**	**0**	**1.5%**	**67.5%**

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS FROM URBAN DEVELOPMENT IN NOMINATED AREAS				TOTAL URBAN IMPACTS			
				Wilton (ha)	GMAC (ha)	WSA (ha)	GPEC (ha)	Total nominated area impacts (ha)	Total nominated area impacts to important populations	Total nominated area impacts as % of habitat in SAA	Nominated area % of total Plan impacts
MAMMALS											
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V	25,451.4	106.7	172.8	0.0	0.9	**280.5**	1	**1.1%**	**98.4%**
Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (south eastern mainland population)	E	32,445.4	101.6	142.7	83.3	73.9	**401.5**	0	**1.2%**	**62.7%**
Petauroides volans	Greater Glider	V	25,609.8	12.1	48.0	4.6	0.1	**64.8**	0	**0.3%**	**51.0%**
Phascolarctos cinereus	Koala (combined populations of Qld, NSW and the ACT)	V	15,091.2	106.9	135.2	0.0	0.0	242.1	0	**1.6%**	**100.0%**
Pteropus poliocephalus	Grey-headed Flying-fox	V	26,868.8	31.0	110.5	201.4	61.0	**404.0**	1	**1.5%**	**53.8%**
REPTILES											
Hoplocephalus bungaroides	Broad-headed Snake	V	6,695.2	0.0	0.0	0.0	0.0	**0.0**	0	**0.0%**	**0.0%**

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS FROM URBAN DEVELOPMENT IN NOMINATED AREAS				TOTAL URBAN IMPACTS			
				Wilton (ha)	GMAC (ha)	WSA (ha)	GPEC (ha)	Total nominated area impacts (ha)	Total nominated area impacts to important populations	Total nominated area impacts as % of habitat in SAA	Nominated area % of total Plan impacts
AMPHIBIANS											
Heleioporus australiacus	Giant Burrowing Frog	V	4,064.2	0.3	0.3	0.0	0.0	**0.6**	0	**0.0%**	**100.0%**
Litoria aurea	Green and Golden Bell Frog	V	5,500.3	0.0	0.0	0.0	11.0	**11.0**	2	**0.2%**	**78.7%**
INVERTEBRATES											
Pommerhelix duralensis	Dural Land Snail	E	25,498.5	0.0	0.0	0.0	0.0	**0.0**	0	**0.0%**	**0.0%**
FISH											
Macquaria australasica	Macquarie Perch	E	21	0.0	0.0	0.0	0.0	**0.0**	0	**0.0%**	0.0%

Note: The White-throated Needletail (*Hirundapus caudacutus*) is not included in this table, as it was not possible to produce a meaningful habitat map for this species as it is predominantly an aerial species. Refer to Chapter 30 for further information.

Table 37-3: Urban impacts to potential habitat for Commonwealth-listed threatened flora

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS FROM URBAN DEVELOPMENT IN NOMINATED AREAS				TOTAL URBAN IMPACTS			
				Wilton (ha)	GMAC (ha)	WSA (ha)	GPEC (ha)	Total nominated area impacts (ha)	Total nominated area impacts to important populations	Total nominated area impacts as % of habitat in SAA	Nominated area % of total Plan impacts
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	V	31,541.6	240.3	158.9	12.3	3.9	**415.5**		**1.3%**	**94.9%**
Acacia pubescens	Downy Wattle, Hairy Stemmed Wattle	V	36,224.2	428.2	265.1	297.1	105.7	**1,096.1**		**3.0%**	**79.6%**
Allocasuarina glareicola		E	4,431.9	0.0	0.0	0.0	12.9	**12.9**		**0.3%**	**74.1%**
Commersonia prostrata	Dwarf Kerrawang	E	61.9					**0.0**		**0.0%**	**0.0%**
Cynanchum elegans	White-flowered Wax Plant	E	3,322.2					**0.0**		**0.0%**	**0.0%**
Deyeuxia appressa		E	19.3					**0.0**		**0.0%**	**0.0%**
Eucalyptus benthamii	Camden White Gum, Nepean River Gum	V	4,797.9					**0.0**		**0.0%**	**0.0%**
Genoplesium baueri	Yellow Gnat-orchid	E	768.3					**0.0**		**0.0%**	**0.0%**
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	7,468.0	2.5	2.3	7.1	0.1	**12.0**	**1**	**0.2%**	**75.6%**
Hibbertia puberula subsp. *glabrescens*		CE	43.7					**0.0**		**0.0%**	**0.0%**

Scientific name	Common name	Cth status	Total potential habitat in SAA (ha)	IMPACTS FROM URBAN DEVELOPMENT IN NOMINATED AREAS				TOTAL URBAN IMPACTS			
				Wilton (ha)	GMAC (ha)	WSA (ha)	GPEC (ha)	Total nominated area impacts (ha)	Total nominated area impacts to important populations	Total nominated area impacts as % of habitat in SAA	Nominated area % of total Plan impacts
Leucopogon exolasius	Woronora Beard-heath	V	267.2	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Melaleuca deanei	Deane's Melaleuca	V	14,395.2	45.4	60.8	0.0	0.0	**106.2**		**0.7%**	**100.0%**
Micromyrtus minutiflora		V	36,704.5	0.0	0.0	8.3	10.6	**18.9**		**0.1%**	**11.1%**
Persicaria elatior	Knotweed	V	1,310.7	0.0	0.0	2.3	1.1	**3.4**		**0.3%**	**6.8%**
Persoonia bargoensis	Bargo Geebung	V	12,293.0	37.1	46.4	0.0	0.0	**83.5**		**0.7%**	**100.0%**
Persoonia glaucescens	Mittagong Geebung	V	2,378.2	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Persoonia hirsuta	Hairy Geebung, Hairy Persoonia	E	11,416.8	0.0	0.0	0.0	0.0	**0.0**		**0.0%**	**0.0%**
Persoonia nutans	Nodding Geebung	E	15,043.3	0.0	0.0	31.1	24.6	**55.7**		**0.4%**	**39.1%**
Pimelea curviflora var. *curviflora*		V	13,011.3	0.0	0.0	0.0	15.9	**15.9**		**0.1%**	**28.8%**
Pimelea spicata	Spiked Rice-flower	E	34,815.5	387.7	66.0	219.6	62.6	**735.8**	**1**	**2.1%**	**75.5%**
Pomaderris brunnea	Rufous Pomaderris	V	26,076.2	17.0	21.1	0.0	0.0	**38.1**		**0.1%**	**18.4%**
Pterostylis saxicola	Sydney Plains Greenhood	E	11,727.8	11.2	35.0	0.0	0.9	**47.1**		**0.4%**	**100.0%**
Pultenaea parviflora		V	20,270.9	0.0	0.0	21.2	13.0	**34.2**	**2**	**0.2%**	**15.6%**

Table 37-4: Urban impacts to Commonwealth-listed threatened ecological communities

TEC Name	Cth status	Total TEC in SAA (ha)	IMPACTS FROM URBAN DEVELOPMENT IN NOMINATED AREAS				TOTAL URBAN IMPACTS		
			Wilton (ha)	GMAC (ha)	WSA (ha)	GPEC (ha)	Total nominated area impacts (ha)	Total nominated area impacts as % of habitat in SAA	Nominated area % of total Plan impacts
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	E	2,769.3	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	E	269.3	0.0	0.0	1.3	0.9	**2.2**	**0.8%**	**27.3%**
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CE	794.4	0.0	0.0	7.8	4.5	**12.3**	**1.5%**	**39.8%**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	9,954.3	9.6	21.1	72.8	24.1	**127.6**	**1.3%**	**70.8%**
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	CE	9.4	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**
River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria	CE	6,667.0	0.0	7.4	21.2	7.2	**35.8**	**0.5%**	**22.5%**
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	CE	8,301.5	74.3	106.4	0.0	0.0	**180.7**	**2.2%**	**100.0%**
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	CE	44.4	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	CE	968.1	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**

37.4.2 COMMITMENTS TO ADDRESS IMPACTS

The Plan includes commitments to address the direct impacts of the nominated areas on Commonwealth listed species and TECs. The key commitments apply to both the urban and transport program and include to:

- Secure a minimum of 5,325 hectares of native vegetation in the Cumberland subregion (Commitment 8) to conserve biodiversity values in perpetuity, including specific amounts of habitat for Commonwealth-listed species and TECs
- Undertake ecological restoration of up to 25 per cent of the offset target for native vegetation in areas secured for conservation within the Cumberland subregion (Commitment 13)
- Secure priority Koala corridors within the Cumberland subregion, to support habitat connectivity (Commitment 12)

There are also a range of specific commitments for the species and TECs at the highest risk of adverse direct impacts.

37.5 INDIRECT IMPACTS

37.5.1 SUMMARY OF IMPACTS

Potential indirect impacts are assessed in detail for each Commonwealth-listed matter in Chapters 29, 30 and 31, and for other protected matters in Chapters 32, 33, 34 and 35. Chapter 15 summarises the commitments and mitigation measures and processes to implement them for the development in the urban capable lands.

Species and TECs and other protected matters with specific mitigation measures related to the urban and other development in the urban capable land, and that are therefore considered most likely to be impacted by this development, are:

- Fauna:
  - Koala
  - Macquarie Perch
  - Green and Golden Bell Frog
  - Grey-headed Flying Fox
  - Regent Honeyeater
  - Swift Parrot
  - Spotted-tailed Quoll
  - Greater Glider
- Flora:
  - *Persoonia nutans*
  - *Pimelea spicata*
  - *Pultenaea parviflora*
  - *Grevillea parviflora* subsp. *parviflora*
  - *Persoonia bargoensis*
  - *Genoplesium baueri*
  - *Melaleuca deanei*
  - *Pterostylis saxicola*
- TECs:
  - Cooks River Castlereagh Ironbark Forest
  - Cumberland Plain Woodland
  - River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria
  - Shale Sandstone Transition Forest
  - Coastal Swamp Oak Forest

Development within the nominated areas will not have notable indirect impacts on other EPBC Act protected matters, including:

- Migratory species (see Chapter 32)
- Ramsar wetlands (see Chapter 33)
- World and National Heritage (see Chapter 34)

37.5.2 COMMITMENTS TO ADDRESS IMPACTS

The Plan includes a commitment to mitigate indirect and prescribed impacts on TECs and species from development within the nominated areas (Commitment 5), including implementing development controls in the nominated areas to protect species, as prescribed in Appendix E of the Plan.

Two broad types of development controls will be implemented:

- General environmental controls that will benefit the environment generally, including biodiversity values
- Specific controls that apply to specific species and TECs in specific locations or broader nominated areas. These controls have been identified through this Assessment Report and are needed to address residual risks to species or TECs that remain after implementation of the general environmental controls

The commitment to manage indirect impacts of urban and industrial development and intensive plant agriculture within the nominated areas will be delivered primarily through the NSW planning system, and specifically, the nominated areas planning delivery framework. The overarching planning delivery framework is described in Chapter 9.

The key mechanism to implement the general environmental controls and the specific controls in the nominated areas is Development Control Plans (DCPs). DCPs will be prepared for each nominated area and set out the controls that need to be addressed by neighbourhood plans and development applications to mitigate indirect impacts.

37.6 ASSESSMENT OF POTENTIAL ADDITIONAL IMPACTS OF ESSENTIAL INFRASTRUCTURE

37.6.1 INTRODUCTION

The Plan is seeking approval under the EPBC Act (but not the BC Act) for certain essential infrastructure development to occur within non-certified land (but not excluded land) in the nominated areas.

Planning for essential infrastructure to support the nominated areas, such as water and electricity utilities, is in various stages of development, and this infrastructure may need to be located outside urban capable land.

Essential infrastructure will be subject to a future process of avoidance and minimisation as part of the strategic planning and detailed design phase of each project. Each project will be managed through the NSW planning and approvals framework under the EP&A Act as current at the time of the project.

It is important to note that approval is not being sought under the Plan for essential infrastructure within avoided land under the BC Act. Separate approval under the BC Act will need to be sought at the time the project is proposed (if the Act is triggered), which includes requirements to avoid, minimise, mitigate and offset impacts.

Essential infrastructure must be carried out in accordance with:

- Cumberland Plain Conservation Plan Guidelines for Infrastructure Development in Appendix A of the Plan (Appendix A guidelines)
- Relevant commitments in the Plan

This section assesses the potential additional impacts to protected matters under the EPBC Act due to essential infrastructure projects that may be proposed within non-certified land. The section:

- Provides definitions of the different land types in the nominated areas
- Sets out the scope of essential infrastructure development
- Describes the assessment and implementation processes and commitments for essential infrastructure

- Analyses the potential direct and indirect impacts to EPBC Act threatened species and TECs
- Analyses the potential impacts to other matters protected by the EPBC Act
- Provides a conclusion about the likely outcomes for protected matters related to essential infrastructure

37.6.2 DEFINITIONS OF LAND TYPES IN THE NOMINATED AREAS

There are different land types in the nominated areas. These are relevant to the scope of essential infrastructure.

CERTIFIED LANDS

Certified lands within the nominated areas are referred to as 'certified-urban capable land'. These areas are proposed to be approved under both the EPBC Act and BC Act and include the development footprints for urban development.

Essential infrastructure that occurs within the urban capable land is assessed under the EPBC Act in Chapters 27 to 35.

NON-CERTIFIED LANDS

Not all the nominated areas are proposed for urban development. These areas are non-certified land and comprise land that has been avoided and land that is excluded from the assessment.

Avoided land

The definition of what constitutes avoidance has been adopted from the BAM process. Avoided land is land that has been avoided from development in the nominated areas through the conservation planning process undertaken as part of developing the Plan. This includes land:

- Avoided for biodiversity. This is land that has high biodiversity values to be protected and that has been avoided from development within urban capable land
- Avoided for other purposes. This is land that cannot be feasibly developed due to topography (area of steep slope within avoided lands) or is land that is mapped as a riparian corridor associated with a Strahler order 3 stream or above (or Strahler order 2 streams with mapped vegetation, adjacent to avoided lands or that contribute to landscape connectivity)

The section considers the potential impacts of essential infrastructure on avoided land in the nominated areas.

Excluded land

Some land within the nominated areas was not considered for inclusion in the area proposed for development under the Plan and has therefore been identified as 'excluded' land. This land include:

- Existing protected land, including reserves and established offset sites
- Council owned land which is zoned for environmental conservation, environmental management, or recreation
- Commonwealth land, such as Defence Establishment Orchard Hills
- Lands within the nominated areas already assessed as part of another development approval (Bingara Gorge), or lands progressing through an alternate assessment (Mount Gilead, Menangle Park, Sydney Metro Stage 1)
- Lands already developed (existing urban areas, urban land zones and roads)

37.6.3 SCOPE OF ESSENTIAL INFRASTRUCTURE

The spatial scope, types of actions and activities, and criteria that must be met for essential infrastructure projects that are assessed in this section are described below. These are largely taken from the Appendix A guidelines.

SPATIAL SCOPE

The spatial scope of essential infrastructure that is assessed in this section applies to projects that occur on avoided land within the nominated areas and does not address the potential impacts of essential infrastructure that occur:

- On excluded lands within the nominated areas
- Outside of the nominated areas

It is important to note that the potential impacts of essential infrastructure projects on EPBC Act protected matters within the urban capable land of each nominated areas are assessed in Chapters 27 to 35.

It is also important to note that the Appendix A guidelines make reference to essential infrastructure projects that occur "wholly or mostly within the nominated areas". Given the uncertainty about the scale, nature, and extent of potential impacts outside the nominated areas, the spatial scope of the assessment within this Assessment Report is restricted to essential infrastructure that occurs within the nominated areas (on avoided land). Potential impacts of activities that might occur outside the nominated areas have not been assessed.

TYPES OF ACTIONS AND ACTIVITIES

Actions

The Appendix A guidelines define essential infrastructure as including the following types of actions:

- Electricity generating works or solar energy systems
- Electricity transmission or distribution
- Pipelines and pipeline corridors
- Roads and traffic
- Sewerage systems
- Stormwater management systems
- Telecommunications and other communication facilities
- Waste or resource management facilities
- Water supply systems
- Koala exclusion fencing as described in the SEPP (Strategic Conservation Planning)
- Fauna crossings as described in the SEPP (Strategic Conservation Planning)

Activities

Development of the essential infrastructure projects includes all activities associated with the design, construction and operation of the actions listed above. Specific activities that may be carried out under the Plan for these projects include, but are not limited to:

- Vegetation clearing
- Earthworks
- Utility works
- Landscaping
- Erosion and sediment control
- Laydown areas
- Road construction
- Construction of supporting infrastructure such as stations, car parks and pedestrian access
- Electricity infrastructure
- Site offices and access roads
- Pipelines
- Construction of buildings that form part of the permitted actions
- Dust and noise suppression
- Stormwater management (including detention basins, ponds and dams)
- Maintenance and upgrade activities

CRITERIA

The Appendix A guidelines constrain the types of actions that may be undertaken through a set of criteria that must be met. Any essential infrastructure project must also meet the following criteria:

- Essential infrastructure designed to service and support urban and industrial development within nominated areas of the Western Parkland City
- Wholly or mostly within the nominated areas

and which is also

- Local development, under Part 4 (Division 4.3) of the EP&A Act, or
- Part 5 activities (Division 5.1) under the EP&A Act (except for road activities).

It does not include:

- State significant development
- State significant infrastructure
- Classified Roads
- Division 5.1 Road Activities (EP&A Act)

In practice, these criteria restrict the scope of essential infrastructure development to smaller scale projects that are carried out by public authorities to facilitate growth in the nominated areas where the activities cannot be accommodated within the urban capable land.

37.6.4 ASSESSMENT AND IMPLEMENTATION PROCESSES FOR ESSENTIAL INFRASTRUCTURE

APPENDIX A GUIDELINES

Assessment requirements

The Appendix A guidelines set out what is required to protect biodiversity in terms of planning, assessment and implementation as each essential infrastructure project is brought forward. The guidelines are designed to ensure that essential infrastructure avoids, minimises, mitigates and offsets impacts on relevant EPBC Act matters consistent with the conservation outcomes of the Plan.

Each essential infrastructure project will be managed through the NSW planning and approvals framework as current at the time of the project. This process will be critical to adequately avoiding, minimising, mitigating and offsetting any impacts to MNES as a result of essential infrastructure projects on avoided land.

The Appendix A guidelines state that:

- *Environmental impacts of the activities are considered under the Environmental Planning and Assessment Act, and an 'avoid, minimise and mitigate' process is applied*
- *MNES are considered through the 'avoid, minimise and mitigate' process and any relevant MNES-specific requirements of the Plan are applied (Plan Commitments 2.1, 2.2 and 5)*
- *The biodiversity impacts of the activities will be assessed under the Biodiversity Conservation Act, if triggered, and an 'avoid, mitigate, offset' process will be applied*
- *The proponent has notified the department of the Development*

While these legislative requirements and processes may alter over time, the Appendix A guidelines specify that essential infrastructure will be planned, assessed, and delivered to an equivalent standard in line with the current legislation.

Implementation

The Department is introducing the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development (infrastructure development guideline) to support the implementation of the Appendix A guidelines and the commitments for essential infrastructure in the Plan.

The infrastructure development guideline will be made under Clause 228 of the EP&A Regulation 2000 and ensures essential infrastructure development within avoided land avoids and minimises impacts to biodiversity values and mitigates indirect impacts in accordance with the requirements of the Plan.

The guideline includes development controls, including controls relating to avoiding and minimising impacts to biodiversity values and specific TECs and species, including Koala habitat and corridors.

Box 1 outlines the avoid, minimise, mitigate, and offset requirements for essential infrastructure (taken from the Appendix A guidelines and reflected in the infrastructure development guideline).

The infrastructure development guideline is supported by the SEPP (Strategic Conservation Planning). The SEPP requires local development under Part 4 of the EP&A Act to take the infrastructure development guideline into consideration. The SEPP and the EP&A Regulation 2000 also specify notification requirements (see below).

BOX 1: AVOID, MINIMISE, MITIGATE AND OFFSET REQUIREMENTS FOR ESSENTIAL INFRASTRUCTURE (TAKEN FROM THE APPENDIX A GUIDELINES AND REFLECTED IN THE INFRASTRUCTURE DEVELOPMENT GUIDELINE)

To be consistent with the Plan's strategic assessment approval, essential infrastructure must be consistent with all the objectives and biodiversity matters as follows:

Objectives:

1. Locate essential infrastructure in the certified–urban capable land in the nominated areas, where possible

2. Design and site essential infrastructure to avoid or minimise environmental impacts

3. Avoid or minimise direct impacts on EPBC Act-listed threatened ecological communities, known populations of threatened flora species and koala habitat protected under the Plan

4. Minimise or mitigate indirect and prescribed impacts on threatened ecological communities, species, and their habitats to best practice standards

5. Minimise or mitigate indirect and prescribed impacts on the Southern Sydney Koala population to best practice standards.

Biodiversity matters:

1. Design and site essential infrastructure to avoid adverse impacts on biodiversity. Where adverse impacts cannot feasibly or practicably be avoided, minimise impacts by refining design elements.

2. Avoid or minimise impacts on the following EPBC Act-listed threatened ecological communities:

- Shale Sandstone Transition Forest

- Cumberland Plain Woodlands and Shale-Gravel Transition Forest

- River-Flat Eucalypt Forest

- Coastal Swamp Oak (Casuarina glauca) Forest

- Cooks River Castlereagh Ironbark Forest

3. Avoid or minimise direct impacts to populations of threatened flora species, prioritising avoiding impacts to known populations of:

- Grevillea parviflora subsp. parviflora (Small-flower Grevillea)

- Persoonia bargoensis (Bargo Geebung)

- Persoonia nutans (Nodding Geebung)

- Genoplesium baueri (Yellow Gnat-orchid)

- Pimelea spicata (Spiked Rice-flower)

- Pultenaea parviflora

4. Avoid or minimise direct impacts to koala habitat protected under the Plan

5. Design infrastructure to maintain the integrity and connectivity of Koala corridors and habitat protected under the Plan, within the Wilton and Greater Macarthur Growth Areas

6. Implement specific mitigation measures to address indirect and prescribed impacts on the Southern Sydney koala population. This includes:

- installing koala exclusion fencing during construction, and

- maintaining the integrity of any existing koala exclusion fencing

7. Develop and implement mitigation measures to address indirect and prescribed impacts on threatened ecological communities, threatened species and their habitats during construction and operation of infrastructure. Refer to Appendix E of the Plan for appropriate mitigation measures

8. Fulfil biodiversity offset requirements under the BC Act and/or any other relevant legislation.

Notification requirements

Proponents of essential infrastructure on avoided land must follow the notification requirements in the SEPP (Strategic Conservation Planning) and EP&A Regulation 2000. As described in the Appendix A guidelines, proponents must notify the Department of the intention to carry out works on avoided land in writing. The notification must include:

- A plan of proposed works
- An ecology report, that includes quantified impacts on threatened ecological communities, species, and their habitats, and impacts on matters of national environmental significance
- How the guidelines have been addressed
- Ongoing mitigation measures.

A proponent must notify the Department of any modification to the essential infrastructure if there is an increase or decrease in biodiversity impacts associated with the modification post notification.

The infrastructure development guidelines include a consistency statement template to be used when notifying the Department of essential infrastructure activities on avoided land.

Impact thresholds for MNES

The Appendix A guidelines include thresholds for impacts from essential infrastructure to Commonwealth-listed TECs in the avoided land and specifies that the EPBC Act approval under the Plan (if granted) would only apply up to those thresholds.

Impacts beyond these thresholds are not assessed in this Assessment Report, and proponents in that circumstance may need to seek separate approval under the EPBC Act for essential infrastructure proposals.

The Appendix A guidelines specify that the Department is responsible for monitoring impacts to these TECs associated with essential infrastructure and notifying proponents of essential infrastructure when thresholds have been reached.

The thresholds are identified in Table 37-5.

Table 37-5: Impact thresholds for Commonwealth-listed TECs in avoided land

TEC name	GMAC	GPEC	WSA	Wilton
Coastal Swamp Oak (Casuarina glauca) Forest	Not present	0.10 ha	0.50 ha	Not present

TEC name	GMAC	GPEC	WSA	Wilton
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Not present	0.00 ha	0.50 ha	Not present
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	0.70 ha	1 ha	0.60 ha	Not present
River-flat Eucalypt Forest	0.30 ha	0.80 ha	1.80 ha	Not present
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	23.80 ha	Not present	Not present	16.50 ha
Western Sydney Dry Rainforest and Moist Woodland on Shale	0.30 ha	Not present	Not present	Not present

Compliance

The Appendix A guidelines set out roles and responsibilities and processes for compliance in relation to essential infrastructure in avoided land. These are set out in Table 37-8 (taken from the Appendix A guidelines).

Table 37-6: Compliance responsibilities and processes (taken from the Appendix A guidelines)

Role	*Compliance and reporting responsibilities*
Proponent	*Proponent to notify the Department where an essential infrastructure project, applicable to these requirements, will impact on MNES, or other relevant EPBC Act matters in…avoided land. The notification should demonstrate how compliance with these requirements has been achieved*
The Department	*The Department will:* • *Notify proponents of their obligations under the EPBC Act, including information on how proponents should be meeting these requirements* • *Monitor the impacts of development on avoided land, including tracking impacts to EPBC-listed TEC with a cumulative impact threshold approved through the Plan….* • *Monitor compliance with the avoidance, mitigation and offset commitments under the Plan, relevant to these requirements (refer to Commitments 2.1, 2.2, 5 and 7)* • *Notify proponents when impacts thresholds for EPBC Act-listed TECs have been reached and consider further actions within the planning system* • *Provide annual updates to* [DAWE] • *Undertake monitoring and audit of infrastructure construction and operation as required, to ensure adequate mitigation measures are being applied*

COMMITMENTS

The Plan also includes commitments for essential infrastructure that support the Appendix A guidelines. These are:

- Commitment 1: Development will be undertaken in accordance with the Plan and any conditions of approval. Actions under this commitment relevant to essential infrastructure include:
    - Integrate the Plan into the planning delivery framework for the nominated areas through mechanisms including the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
    - Require proponents of essential infrastructure to notify the Department of any development or activity in avoided land, including how the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development have been addressed
    - Implement the *Cumberland Plain Conservation Plan Guidelines for Infrastructure Development*
- Commitment 2.1: Limit cumulative direct impacts over the life of the Plan from essential infrastructure to Commonwealth-listed TECs in avoided land (these impact thresholds are shown in Table 37-5)

- Commitment 2.2: Prioritise the avoidance of impacts from essential infrastructure in avoided land to:
  - Known populations of the following threatened flora species:
    - *Grevillea parviflora* subsp. *parviflora*
    - *Persoonia bargoensis*
    - *Persoonia nutans*
    - *Genoplesium baueri*
    - *Pimelea spicata*
    - *Pultenaea parviflora*
  - Important habitat for Koala within the Wilton and GMAC to maintain the function of Koala movement corridors

37.6.5 POTENTIAL IMPACTS TO THREATENED SPECIES AND TECS

POTENTIAL DIRECT IMPACTS

The potential direct impacts to threatened species and TECs due to essential infrastructure projects include habitat loss and fragmentation. Given that it is not possible at this stage to know the location, scale and nature of specific projects, the following approach was used to understand the potential direct impacts to threatened species and TECs. For each nominated area:

- The presence of known populations of threatened species (i.e. where records exist) and mapped TECs on avoided lands was determined. This was based on the baseline data that was prepared for each species and TEC (see Chapters 29 to 31 for details)
- The potential for direct impacts to these species and TECs due to essential infrastructure was assessed. This included consideration of:
  - The location, extent and sensitivity of MNES values and judgement about the likelihood that impacts could occur. For example, flora populations occurring within corridors away from the urban capable land may be less likely to be directly impacted than flora populations on flat land near the edge of urban capable land
  - How the requirements of the Appendix A guidelines may apply to each relevant MNES
- The likely outcome for each MNES following the application of the Appendix A guidelines and the NSW planning and approvals framework was determined

The following tables set out the analysis for each nominated area:

- Table 37-7 - Wilton
- Table 37-8- GMAC

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland P Conservation Plan Guidelines for Infrastructure Development
TECs			
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	Small areas of the TEC occur within avoided lands in GMAC (36 ha). Of the 36 ha, 15.1 ha is in good (intact) condition and 20.9 ha is in moderate (thinned) condition. Impacts to the TEC are possible from essential infrastructure as the majority of it occurs: • Between areas of urban capable lands • On flatter lands that have been avoided for biodiversity purposes See Map 31-5 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to t the Appendix A guidelines and commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values • Limit the maximum cumulati impact to 0.7 ha in avoided la GMAC

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland P Conservation Plan Guidelines for Infrastructure Development
			• Require any residual impacts offset under BC Act/BAM requirements
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	CE	Significant areas of the TEC occur within avoided lands in GMAC (1,190.9 ha). Of the 1,190.9ha, 985.3 ha is in good (intact) condition, 197.4 ha is in moderate (thinned), and 8.3 ha is in poor (scattered) condition. Given the extent of the TEC on avoided lands, it is probable that impacts from essential infrastructure will occur to the TEC. The likelihood of impact is reduced for those areas of the TEC that occur in riparian or steep areas (178.5 ha). See Map 31-6 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to t the Appendix A guidelines and commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values • Limit the maximum cumulati impact to 23.8 ha in avoided l GMAC • Require any residual impacts offset under BC Act/BAM requirements
Western Sydney Dry Rainforest and Moist Woodland on Shale	CE	Small areas of the TEC occur within avoided lands in GMAC (15.2 ha). Of the 15.2 ha, 2.1 ha is in good (intact) condition and 13.1 ha is in moderate (thinned) condition. Impacts to the TEC are possible as it occurs on avoided lands in the centre of GMAC between urban capable land. The likelihood of impact is reduced where the TEC occurs in riparian corridors or on steep areas (4.7 ha). See Map 31-8 or mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to t the Appendix A guidelines and commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values • Limit the maximum cumulati impact to 0.3 ha in avoided la GMAC • Require any residual impacts offset under BC Act/BAM requirements
River-flat Eucalypt Forest on Coastal Floodplains	CE	Small areas of the potential TEC occur within avoided lands in GMAC (15.6 ha). Of the 14.4 ha, 12.1 ha is in good (intact) condition and 3.5 ha is in moderate (thinned) condition. Impacts to the potential TEC are possible as it occurs on avoided land in the centre of GMAC between urban capable land. The likelihood of impact is reduced where the potential TEC occurs in riparian corridors or on steep areas (7.5 ha). See Map 31-2 for mapping of the EC across the Strategic Assessment Area.	To constrain potential impacts to t the Appendix A guidelines and commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values • Limit the maximum cumulati impact to 0.3 ha in avoided la GMAC • Require any residual impacts offset under BC Act/BAM requirements
THREATENED FLORA			
Genoplesium baueri (Yellow Gnat-orchid)	E	One known population of the species occurs within avoided land in GMAC.	To constrain potential impacts to t species, the Appendix A guideline commitments, including the infrastructure development guidel

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland P Conservation Plan Guidelines for Infrastructure Development
		Population 21 is important and contains 1 record comprising 1 individual. The whole population occurs within avoided lands. Impacts to this population from essential infrastructure in this area could be possible although unlikely because the population occurs on the far eastern edge of GMAC approximately 450 m away from the nearest urban capable land. See Map 29-8 for mapped potential habitat and populations across the Strategic Assessment Area.	• Require efforts to avoid and minimise impacts to biodivers values, including this species specifically • Require any residual impacts offset under BC Act/BAM requirements
Grevillea parviflora subsp. *parviflora* (Small-flower Grevillea)	V	One known population of the species occurs within avoided land in GMAC. Population 519 is not important and contains 6 records comprising 6 individuals. Of these records, 1 (1 individual) occurs within avoided lands in GMAC. The area where the record occurs may be protected as part of the George's River Koala reserve and therefore direct impacts to the species are unlikely to occur. See Map 29-9 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to t species, the Appendix A guideline commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values, including this species specifically • Require any residual impacts offset under BC Act/BAM requirements
Pimelea spicata (Spiked Rice-flower)	E	One known population of the species occurs partially within avoided land in GMAC and partially outside the nominated areas. Population 533 is important and contains 2 records comprising. The area where the record occurs may be protected as part of the George's River Koala reserve and therefore direct impacts to the species are unlikely to occur. See Map 29-20 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to t the Appendix A guidelines and commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values, including this species specifically • Require any residual impacts offset under BC Act/BAM requirements
Pomaderris brunnea (Rufous Pomaderris)	V	Seven known populations of the species occur within avoided land in GMAC. Population 470 is not mapped as important and contains 1 record comprising 1 individual. Impacts to the population are possible as population occurs on avoided land in between and approximately 20 m from urban capable lands. Population 471 is not mapped as important and contains 3 records comprising 3 individuals. Impacts are possible as the entire population occurs on avoided land in the south west of GMAC. Impacts are more likely where one record occurs 20 m from the development footprint. The likelihood of impacts to the other two records are reduced as they occur in steeper areas closer to the boundary of GMAC. Three populations occur to the east of Appin Road in the area proposed to be included in the George's River Koala Reserve and therefore direct impacts to the species are unlikely to occur. They are: • Population 513 - not important, 15 records	To constrain potential impacts to t the Appendix A guidelines and commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values, including this species specifically • Require any residual impacts offset under BC Act/BAM requirements

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland P Conservation Plan Guidelines for Infrastructure Development
		• Population 515 - not important, 4 records Population 586 is important and contains 7 records comprising 7 individuals. Of these records, 3 records (3 individuals) occur on avoided land in the centre of GMAC. Impacts to this population are possible as some records occur <100 m from urban capable land. Population 587 is important and contains 2 records comprising 2 individuals. The entire population occurs within avoided lands in the south-west of GMAC. Impacts to the population are possible as it occurs on the edge of urban capable land. See Map 29-21 for mapped potential habitat and populations across the Strategic Assessment Area.	
THREATENED FAUNA			
Dasyurus maculatus (Spot-tailed Quoll)	E	The species has been recorded on avoided land to the east of Appin Road in GMAC, and areas of potential habitat (1,638 ha) for the Quoll are present. Potential habitat is closely associated with the occurrence of Shale Sandstone Transition Forest in the Sydney Basin Bioregion and essential infrastructure projects have the potential to impact these areas. See Map 30-25 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to t species, the Appendix A guideline commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values • Require any residual impacts offset under BC Act/BAM requirements In addition: • Given the extensive nature of Sandstone Transition Forest o avoided land, the impact limit TEC (23.8 ha within GMAC) w reduce any potential direct im to potential habitat for the spe • The requirement to consider t connectivity of important Koa corridors within avoided land GMAC will help maintain any connectivity for the Spot-taile
Lathamus discolor (Swift Parrot)	CE	The species has been recorded on avoided lands in GMAC, and areas of potential foraging habitat (1,706.6 ha) for the Swift Parrot are present. Direct impacts to potential foraging habitat are possible, especially where it occurs near to urban capable lands. See Map 30-26 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to t species, the Appendix A guideline commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values • Require any residual impacts offset under BC Act/BAM requirements Given the extensive nature of Shal Sandstone Transition Forest on avo land, the impact limit for the TEC within GMAC) will help reduce ar

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland P Conservation Plan Guidelines for Infrastructure Development
			potential direct impacts to foragin habitat for the species.
Phascolarctos cinereus (Koala)	V; FPAL	Important Koala habitat occurs extensively on avoided lands in GMAC. The habitat is closely associated with the occurrence of Shale Sandstone Transition Forest in the Sydney Basin Bioregion and essential infrastructure projects have the potential to impact areas of Koala habitat. See Map 30-14 and Map 30-17 for mapped habitat and species records across the Strategic Assessment Area.	To constrain potential impacts to t species, the Appendix A guideline commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values, including important K habitat specifically • Consider the connectivity of K corridors in avoided land in W • Require any residual impacts offset under BC Act/BAM requirements Given the close association betwee important Koala habitat and Shale Sandstone Transition Forest in the Basin Bioregion the impact limit fo TEC (23.8 ha within GMAC) will h reduce any potential direct impact Koala habitat. Appendix E of the Plan also includ requirements for Koala exclusion f to be maintained in the event that essential infrastructure is construc within Koala corridors. These inclu measures to ensure the integrity of exclusion fencing which intercepts planned linear infrastructure, and ensure exclusion fencing and conn structures are in place to protect co integrity and prevent Koalas from entering any roads constructed as essential infrastructure.
Pteropus poliocephalus (Grey-headed Flying-fox)	V	The species has been recorded on avoided lands in GMAC, and areas of foraging habitat (695.8 ha) for the Grey-headed Flying-fox are present. There are no known camps or important roosting sites for the species in these areas. Direct impacts to foraging habitat are possible, especially where it occurs near to urban capable lands. See Map 30-8 and Map 30-9 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to t species, the Appendix A guideline commitments, including the infrastructure development guidel • Require efforts to avoid and minimise impacts to biodivers values • Require any residual impacts offset under BC Act/BAM requirements Given the extensive nature of Shal Sandstone Transition Forest on avo land, the impact limit for the TEC within Wilton) will help reduce an impacts to foraging habitat for the

- Table 37-9 - WSA
- Table 37-10 - GPEC

It is noted that exclusion fencing and fauna crossing constructed for the protection of Koalas will partially be delivered as essential infrastructure on avoided land. It is not considered that exclusion fencing constitutes additional or novel risks of fragmentation compared to other linear infrastructure which may be constructed as essential infrastructure (such as roads and fences). The general assessment of potential impacts of essential infrastructure is therefore considered to adequately capture and address any risks which may be posed by Koala exclusion fences.

Table 37-7: Potential direct impacts to biodiversity values in Wilton

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
TECS				
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	CE	Significant areas of the TEC occur within avoided lands in Wilton (825.7 ha). Of the 825.7 ha, 457.1 ha is in good (intact) condition, 361.9 ha is in moderate (thinned) condition, and 6.8 ha is in poor (scattered) condition. Given the extent of the TEC on avoided land, it is probable that impacts from essential infrastructure will occur to the TEC. The likelihood of impact is reduced for those areas of the TEC that occur in riparian or steep areas (69.9 ha). See Map 31-6 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 16.5 ha in avoided land in Wilton • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 16.5 ha of the TEC may be impacted by essential infrastructure within Wilton over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.
THREATENED FLORA				
Grevillea parviflora subsp. *parviflora* (Small-flower Grevillea)	V	Two known populations of the species occur within avoided land in Wilton. Population 104 is important and contains 13 records comprising 339 individuals. Of these 13 records, 8 (331 individuals) occur within avoided lands in the north of Wilton approximately 230 m from urban capable land. Impacts to this population from essential infrastructure in this area could be possible. Population 518 is important and contains 1 record comprising 1 individual. Impacts to this population are unlikely because the population occurs on the western edge of Wilton, approximately 600 m from the nearest urban capable land, and close to steep areas and sandstone cliffs. See Map 29-9 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.2 specifies that avoidance of known populations of this species will be prioritised. Given the limited distribution of the species within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Persoonia bargoensis (Bargo Geebung)	V	One known population of the species occurs within avoided lands in Wilton. Population 114 is important and contains 271 records. Of these records, 3 occur within avoided lands in the north west and east of Wilton. Impacts to this population from essential infrastructure in this area could be possible. See Map 29-15 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.2 specifies that avoidance of known populations of this species will be prioritised. Given the limited distribution of the species within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.
THREATENED FAUNA				
Lathamus discolor (Swift Parrot)	CE	The species has been recorded on avoided lands in Wilton, and areas of potential foraging habitat (1,215.6 ha) for the Swift Parrot are present. Direct impacts to potential foraging habitat are possible, especially where it occurs near to urban capable lands. See Map 30-26 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Require any residual impacts to be offset under BC Act/BAM requirements Given the extensive nature of Shale Sandstone Transition Forest on avoided land, the impact limit for the TEC (825.7 ha within Wilton) will help reduce any potential direct impacts to foraging habitat for the species.	It is possible that foraging habitat for the species will be impacted by essential infrastructure projects. However, the Appendix A guidelines will constrain the scale of potential impacts. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Phascolarctos cinereus (Koala)	V; FPAL	Important Koala habitat occurs extensively on avoided lands in Wilton. The habitat is closely associated with the occurrence of Shale Sandstone Transition Forest in the Sydney Basin Bioregion and essential infrastructure projects have the potential to impact areas of Koala habitat. See Map 30-14 and Map 30-17 for mapped habitat and species records across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including important Koala habitat specifically • Consider the connectivity of Koala corridors in avoided land in Wilton • Require any residual impacts to be offset under BC Act/BAM requirements Given the close association between important Koala habitat and Shale Sandstone Transition Forest the impact limit for the TEC (16.5 ha in Wilton) will help reduce any direct impacts to Koala habitat Appendix E of the Plan also includes requirements for Koala exclusion fencing to be maintained in the event that essential infrastructure is constructed within Koala corridors. These include measures to ensure the integrity of exclusion fencing which intercepts infrastructure, and to ensure exclusion fencing and connectivity structures are in place to protect corridor integrity and prevent Koalas from entering roads that are essential infrastructure	It is possible that Koala habitat will be impacted by essential infrastructure. However, the Appendix A guidelines, Commitment 2.2 and Appendix E of the Plan together will: • Constrain the scale of potential impacts • Protect Koala habitat within the Wilton and Greater Macarthur Growth Areas to maintain the function of Koala movement corridors • Maintain the integrity of Koala exclusion fencing and ensure habitat corridor functionality Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Pteropus poliocephalus (Grey-headed Flying-fox)	V	The species has been recorded on avoided land in Wilton, and areas of foraging habitat (54.4 ha) for the Grey-headed Flying-fox are present. There are no known camps or important roosting sites for the species in these areas. Direct impacts to foraging habitat are possible, especially where it occurs near to urban capable land. See Map 30-8 and Map 30-9 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Require any residual impacts to be offset under BC Act/BAM requirements Given the extensive nature of Shale Sandstone Transition Forest on avoided land, the impact limit for the TEC (16.5 ha within Wilton) will help reduce any direct impacts to foraging habitat for the species	It is possible that foraging habitat for the species will be impacted by essential infrastructure projects. However, the Appendix A guidelines will constrain the scale of potential impacts. Where impacts occur they will be offset in accordance with the requirements of the BAM.

Table 37-8: Potential direct impacts to biodiversity values in GMAC

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
TECs				
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	Small areas of the TEC occur within avoided lands in GMAC (36 ha). Of the 36 ha, 15.1 ha is in good (intact) condition and 20.9 ha is in moderate (thinned) condition. Impacts to the TEC are possible from essential infrastructure as the majority of it occurs: • Between areas of urban capable lands • On flatter lands that have been avoided for biodiversity purposes See Map 31-5 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.7 ha in avoided land in GMAC • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.7 ha of the TEC may be impacted by essential infrastructure within GMAC over the life of the Plan. Given the limited distribution of the TEC within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	CE	Significant areas of the TEC occur within avoided lands in GMAC (1,190.9 ha). Of the 1,190.9ha, 985.3 ha is in good (intact) condition, 197.4 ha is in moderate (thinned), and 8.3 ha is in poor (scattered) condition. Given the extent of the TEC on avoided lands, it is probable that impacts from essential infrastructure will occur to the TEC. The likelihood of impact is reduced for those areas of the TEC that occur in riparian or steep areas (178.5 ha). See Map 31-6 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 23.8 ha in avoided land in GMAC • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 23.8 ha of the TEC may be impacted by essential infrastructure within GMAC over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Western Sydney Dry Rainforest and Moist Woodland on Shale	CE	Small areas of the TEC occur within avoided lands in GMAC (15.2 ha). Of the 15.2 ha, 2.1 ha is in good (intact) condition and 13.1 ha is in moderate (thinned) condition. Impacts to the TEC are possible as it occurs on avoided lands in the centre of GMAC between urban capable land. The likelihood of impact is reduced where the TEC occurs in riparian corridors or on steep areas (4.7 ha). See Map 31-8 or mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.3 ha in avoided land in GMAC • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.3 ha of the TEC may be impacted by essential infrastructure within GMAC over the life of the Plan. Given the limited distribution of the TEC within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.
River-flat Eucalypt Forest on Coastal Floodplains	CE	Small areas of the potential TEC occur within avoided lands in GMAC (15.6 ha). Of the 14.4 ha, 12.1 ha is in good (intact) condition and 3.5 ha is in moderate (thinned) condition. Impacts to the potential TEC are possible as it occurs on avoided land in the centre of GMAC between urban capable land. The likelihood of impact is reduced where the potential TEC occurs in riparian corridors or on steep areas (7.5 ha). See Map 31-2 for mapping of the EC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.3 ha in avoided land in GMAC • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.3 ha of the TEC may be impacted by essential infrastructure within GMAC over the life of the Plan. Given the limited distribution of the TEC within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.
THREATENED FLORA				

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Genoplesium baueri (Yellow Gnat-orchid)	E	One known population of the species occurs within avoided land in GMAC. Population 21 is important and contains 1 record comprising 1 individual. The whole population occurs within avoided lands. Impacts to this population from essential infrastructure in this area could be possible although unlikely because the population occurs on the far eastern edge of GMAC approximately 450 m away from the nearest urban capable land. See Map 29-8 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.2 specifies that avoidance of known populations of this species will be prioritised. Given the limited distribution of the species within avoided lands it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.
Grevillea parviflora subsp. *parviflora* (Small-flower Grevillea)	V	One known population of the species occurs within avoided land in GMAC. Population 519 is not important and contains 6 records comprising 6 individuals. Of these records, 1 (1 individual) occurs within avoided lands in GMAC. The area where the record occurs may be protected as part of the George's River Koala reserve and therefore direct impacts to the species are unlikely to occur. See Map 29-9 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	The area where the population occurs may be protected as part of the proposed Koala reserve and therefore direct impacts to the species are unlikely to occur.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Pimelea spicata (Spiked Rice-flower)	E	One known population of the species occurs partially within avoided land in GMAC and partially outside the nominated areas. Population 533 is important and contains 2 records comprising. The area where the record occurs may be protected as part of the George's River Koala reserve and therefore direct impacts to the species are unlikely to occur. See Map 29-20 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	The area where the record occurs may be protected as part of the proposed Koala reserve and therefore direct impacts to the species are unlikely to occur.
Pomaderris brunnea (Rufous Pomaderris)	V	Seven known populations of the species occur within avoided land in GMAC. Population 470 is not mapped as important and contains 1 record comprising 1 individual. Impacts to the population are possible as population occurs on avoided land in between and approximately 20 m from urban capable lands. Population 471 is not mapped as important and contains 3 records comprising 3 individuals. Impacts are possible as the entire population occurs on avoided land in the south west of GMAC. Impacts are more likely where one record occurs 20 m from the development footprint. The likelihood of impacts to the other two records are reduced as they occur in steeper areas closer to the boundary of GMAC. Three populations occur to the east of Appin Road in the area proposed to be included in the George's River Koala Reserve and therefore direct impacts to the species are unlikely to occur. They are: • Population 513 - not important, 15 records • Population 515 - not important, 4 records	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	Four populations of the species are at risk of direct impacts from essential infrastructure in GMAC. Commitment 2.2 specifies that avoidance of known populations of this species will be prioritised. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
		Population 586 is important and contains 7 records comprising 7 individuals. Of these records, 3 records (3 individuals) occur on avoided land in the centre of GMAC. Impacts to this population are possible as some records occur <100 m from urban capable land. Population 587 is important and contains 2 records comprising 2 individuals. The entire population occurs within avoided lands in the south-west of GMAC. Impacts to the population are possible as it occurs on the edge of urban capable land. See Map 29-21 for mapped potential habitat and populations across the Strategic Assessment Area.		
THREATENED FAUNA				
Dasyurus maculatus (Spot-tailed Quoll)	E	The species has been recorded on avoided land to the east of Appin Road in GMAC, and areas of potential habitat (1,638 ha) for the Quoll are present. Potential habitat is closely associated with the occurrence of Shale Sandstone Transition Forest in the Sydney Basin Bioregion and essential infrastructure projects have the potential to impact these areas. See Map 30-25 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Require any residual impacts to be offset under BC Act/BAM requirements In addition: • Given the extensive nature of Shale Sandstone Transition Forest on avoided land, the impact limit for the TEC (23.8 ha within GMAC) will help reduce any potential direct impacts to potential habitat for the species • The requirement to consider the connectivity of important Koala	It is possible that foraging habitat for the species will be impacted by essential infrastructure projects. However, the Appendix A guidelines will constrain the scale of potential impacts. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
			corridors within avoided land in GMAC will help maintain any connectivity for the Spot-tailed Quoll	
Lathamus discolor (Swift Parrot)	CE	The species has been recorded on avoided lands in GMAC, and areas of potential foraging habitat (1,706.6 ha) for the Swift Parrot are present. Direct impacts to potential foraging habitat are possible, especially where it occurs near to urban capable lands. See Map 30-26 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Require any residual impacts to be offset under BC Act/BAM requirements Given the extensive nature of Shale Sandstone Transition Forest on avoided land, the impact limit for the TEC (23.8 ha within GMAC) will help reduce any potential direct impacts to foraging habitat for the species.	It is possible that foraging habitat for the species will be impacted by essential infrastructure projects. However, the Appendix A guidelines will constrain the scale of potential impacts. Where impacts occur they will be offset in accordance with the requirements of the BAM.

Phascolarctos cinereus (Koala)	V; FPAL	Important Koala habitat occurs extensively on avoided lands in GMAC. The habitat is closely associated with the occurrence of Shale Sandstone Transition Forest in the Sydney Basin Bioregion and essential infrastructure projects have the potential to impact areas of Koala habitat. See Map 30-14 and Map 30-17 for mapped habitat and species records across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including important Koala habitat specifically • Consider the connectivity of Koala corridors in avoided land in Wilton • Require any residual impacts to be offset under BC Act/BAM requirements Given the close association between important Koala habitat and Shale Sandstone Transition Forest in the Sydney Basin Bioregion the impact limit for the TEC (23.8 ha within GMAC) will help reduce any potential direct impacts to Koala habitat. Appendix E of the Plan also includes requirements for Koala exclusion fencing to be maintained in the event that essential infrastructure is constructed within Koala corridors. These include measures to ensure the integrity of exclusion fencing which intercepts planned linear infrastructure, and to ensure exclusion fencing and connectivity structures are in place to protect corridor integrity and prevent Koalas from entering any roads constructed as essential infrastructure.	It is possible that Koala habitat will be impacted by essential infrastructure projects. However, the Guidelines, Commitment 2.2 and Appendix E of the Plan together will: • Constrain the scale of potential impacts • Protect Koala habitat within the Wilton and Greater Macarthur Growth Areas to maintain the function of Koala movement corridors • Maintain the integrity of Koala exclusion fencing and ensure habitat corridor functionality Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Pteropus poliocephalus (Grey-headed Flying-fox)	V	The species has been recorded on avoided lands in GMAC, and areas of foraging habitat (695.8 ha) for the Grey-headed Flying-fox are present. There are no known camps or important roosting sites for the species in these areas. Direct impacts to foraging habitat are possible, especially where it occurs near to urban capable lands. See Map 30-8 and Map 30-9 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Require any residual impacts to be offset under BC Act/BAM requirements Given the extensive nature of Shale Sandstone Transition Forest on avoided land, the impact limit for the TEC (23.8 ha within Wilton) will help reduce any direct impacts to foraging habitat for the species	It is possible that foraging habitat for the species will be impacted by essential infrastructure projects. However, the Appendix A guidelines will constrain the scale of potential impacts. Where impacts occur they will be offset in accordance with the requirements of the BAM.

Table 37-9: Potential direct impacts to biodiversity values in WSA

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
TECs				
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	E	Small areas (24.8 ha) of the TEC occur within the avoided lands of WSA. Of the 24.8 ha, 23.4 ha is in moderate (thinned) condition and 1.4 is in low (scattered) condition. Impacts to the TEC are possible where it occurs within land avoided for biodiversity purposes (2.6 ha). The likelihood of impact is reduced where the TEC occurs in riparian corridors (22.2 ha). See Map 31-3 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.5 ha in avoided land in WSA • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.5 ha of the TEC may be impacted by essential infrastructure within WSA over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion	CE	Small areas (24.5 ha) of the TEC occur within the avoided lands of WSA. Of the 24.5 ha, 18.9 ha is in good (intact) condition and 5.6 ha is in moderate (thinned) condition. Impacts to the TEC are possible where it occurs between urban capable lands. See Map 31-4 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.5 ha in avoided land in WSA • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.5 ha of the TEC may be impacted by essential infrastructure within WSA over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	Small areas (27.7 ha) of the TEC occur within the avoided land of WSA. The 27.7 ha is in moderate (thinned) condition. Impacts to the TEC are possible where it occurs between urban capable lands. The likelihood of impact is reduced where the TEC occurs in riparian corridors (16 ha). See Map 31-5 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.6 ha in avoided land in WSA • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.6 ha of the TEC may be impacted by essential infrastructure within WSA over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.
River-flat Eucalypt Forest on Coastal Floodplains	CE	Areas of the potential TEC occur within avoided lands in WSA (90.9 ha). Of the 90.9 ha, 11.7 ha is in good (intact) condition, 72.8 ha is in moderate (thinned) condition, and 6.4 ha is in poor (scattered) condition. Impacts to the potential TEC are possible where it occurs between urban capable lands. The likelihood of impacts are reduced where the TEC occurs in riparian corridors (60.5 ha). See Map 31-2 for mapping of the EC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 1.8 ha in avoided land in WSA • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 1.8 ha of the TEC may be impacted by essential infrastructure within WSA over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
THREATENED FLORA				
Persoonia nutans (Nodding Geebung)	E	One known population of the species occurs within avoided land in WSA. Population 60 is mapped as important and contains 11 records. Of these, 1 record (1 individual) occurs within avoided lands in the south east of WSA. Without commitments to protect it, impacts to this population could be possible as it occurs on the edge of urban capable land. See Map 29-18 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.2 specifies that avoidance of known populations of this species will be prioritised. Given the limited distribution of the species within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.
Pultenaea parviflora	V	One known population of the species occurs within avoided lands in WSA. Population 181 is not mapped as important and contains 78 records comprising 78 individuals. Of these, 4 records occur within avoided lands in the south east of WSA (in a similar location to *Persoonia nutans*). Without commitments to protect it, impacts to this population could be possible as it occurs on the edge of urban capable land. See Map 29-23 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.2 specifies that avoidance of known populations of this species will be prioritised. Given the limited distribution of the species within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.

Table 37-10: Potential direct impacts to biodiversity values in GPEC

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
TECs				
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	E	Very small areas (3.3 ha) of the TEC occur within the avoided land of GPEC. It is all in moderate (thinned) condition. Impacts to the TEC are possible although relatively unlikely as 3 ha occurs in riparian corridors. See Map 31-3 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.1 ha in avoided land in GPEC • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.1 ha of the TEC may be impacted by essential infrastructure within GPEC over the life of the Plan. Given the limited distribution of the TEC within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	Small areas (47.8 ha) of the TEC occur within the avoided land of GPEC. Of the 47.8 ha, 7.1 ha is in good (intact) condition, and 40.7 ha is in moderate (thinned) condition. The TEC is located in the south of GPEC and impacts from essential infrastructure are possible. See Map 31-5 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 1 ha in avoided land in GPEC • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 1 ha of the TEC may be impacted by essential infrastructure within GPEC over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
River-flat Eucalypt Forest on Coastal Floodplains	CE	Areas of the potential TEC occur within avoided lands in GPEC (38.5 ha) Of the 38.5 ha, 8.6 ha is in good (intact) condition, and 29.9 ha is in moderate (thinned) condition. Impacts to the potential TEC are possible where it occurs between urban capable lands. The likelihood of impacts are reduced where the TEC occurs in riparian corridors (22.3 ha). See Map 31-2 for mapping of the TEC across the Strategic Assessment Area.	To constrain potential impacts to the TEC, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Limit the maximum cumulative impact to 0.8 ha in avoided land in GPEC • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.1 specifies that a maximum of 0.8 ha of the TEC may be impacted by essential infrastructure within GPEC over the life of the Plan. Where impacts occur they will be offset in accordance with the requirements of the BAM.
THREATENED FLORA				
Pultenaea parviflora	V	One known population of the species occurs within avoided land in GPEC. Population 226 is not mapped as important and contains 2 records, with one record comprising 150 individuals. The whole population occurs within avoided lands in the south east of GPEC. Impacts to this population are possible as it occurs on the edge of urban capable land. See Map 29-23 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values, including this species specifically • Require any residual impacts to be offset under BC Act/BAM requirements	Commitment 2.2 specifies that avoidance of known populations of this species will be prioritised. Given the limited distribution of the species within avoided land it is considered likely that avoidance of direct impacts will be possible. Where impacts occur they will be offset in accordance with the requirements of the BAM.

EPBC matter	EPBC status	Occurrence and possible impacts	Application of the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development	Likely outcome
THREATENED FAUNA				
Lathamus discolor (Swift Parrot)	CE	The species has been recorded on avoided lands in GPEC, and areas of potential foraging habitat (145.4 ha) for the Swift Parrot are present. Direct impacts to potential foraging habitat are possible, especially where it occurs near to urban capable lands. See Map 30-26 for mapped potential habitat and populations across the Strategic Assessment Area.	To constrain potential impacts to the species, the Appendix A guidelines and commitments, including the infrastructure development guidelines: • Require efforts to avoid and minimise impacts to biodiversity values • Require any residual impacts to be offset under BC Act/BAM requirements	It is possible that foraging habitat for the species will be impacted by essential infrastructure projects. However, the Appendix A guidelines will constrain the scale of potential impacts. Where impacts occur they will be offset in accordance with the requirements of the BAM.
Litoria aurea (Green and Golden Bell Frog)	V	Records of the species are present on avoided land associated with Ropes Creek within GPEC. Recent surveys for the species at Ropes Creek in accordance with relevant guidelines did not record the species (see Supporting Document I) and therefore impacts on the species are considered very unlikely See Map 30-7 for mapped potential habitat and populations across the Strategic Assessment Area.	The Appendix A guidelines are unlikely to apply to this species as direct impacts to the species are not likely to occur as a result of essential infrastructure projects.	Direct impacts to the species are not likely to occur as a result of essential infrastructure projects.

POTENTIAL INDIRECT IMPACTS

Nature and extent of potential indirect impacts

It is not possible to determine at this stage the specific nature, extent and duration of the indirect impacts of essential infrastructure projects on biodiversity values. However, the main types of indirect impacts associated with essential infrastructure actions are shown in Table 37-11.

It is noted that exclusion fencing and fauna crossing constructed for the protection of Koalas will partially be delivered as essential infrastructure on avoided land. It is not considered that exclusion fencing constitutes additional or novel risks of indirect impacts compared to other linear infrastructure which may be constructed as essential infrastructure (such as roads and fences). The general assessment of potential impacts of essential infrastructure is therefore considered to adequately capture and address any risks which may be posed by Koala exclusion fences.

Table 37-11: Potential indirect impact types for essential infrastructure projects

Indirect impact type	Nature of indirect impact	Extent/general location of indirect impact and/or high risk areas	Duration of indirect impact
Hydrological disturbance	Changes to surface water and groundwater flows and quality	Waterways, wetlands, flood-prone areas within or downstream of essential infrastructure projects	Short term to long-term
Spread of infection/disease	Spread of pathogens from contaminated clothing and equipment or surface water runoff	Native vegetation retained within or adjacent to essential infrastructure projects	Likely long-term
Spread of weeds	Spread of invasive species due to edge effects, surface water run-off, or changed fire regimes	Native vegetation retained within or adjacent to essential infrastructure projects	Likely long-term
Predation / competition by pest / domestic fauna	Increased predation and competition of species by pest / domestic fauna	Habitat retained within or adjacent to essential infrastructure projects, including well-connected habitat corridors	Likely long-term
Altered fire regimes	Altered fire regimes as a result of increased burns for asset protection or reduced ability to burn due to risk to surrounding urban areas	Native vegetation retained within or immediately adjacent to essential infrastructure projects, particularly asset protection zones	Long-term
Fauna mortality, fauna displacement and barriers to fauna movement	Potential for mortality of threatened fauna species by vehicle strike and reduced movement and connectivity between habitat areas from barriers	Habitat intersected by essential infrastructure projects	Long-term
Fauna disturbance due to noise, dust or light	Noise, dust or light created by equipment during construction or by new structures during operation	Habitat retained within or immediately adjacent to essential infrastructure projects	Short-term to long-term
Inadvertent impacts on adjacent habitat or vegetation	Damage to adjacent habitat during construction activities or during ongoing management	Native vegetation immediately adjacent to essential infrastructure projects	Short-term to long-term

Commitments to address indirect impacts

In relation to indirect impacts, the Appendix A guidelines specify that each essential infrastructure project must:

- Consider the environmental impacts of the essential infrastructure project under the EP&A Act, and apply an 'avoid, minimise and mitigate' process

- Consider MNES through the 'avoid, minimise and mitigate' process and apply any relevant MNES-specific requirements of the Plan (Commitments 2.1, 2.2 and 5)
- Assess the biodiversity impacts of the essential infrastructure under the BC Act if triggered, and apply an 'avoid, mitigate, offset' process in accordance with this Act and the BAM

The Plan also includes two commitments relevant to mitigating indirect impacts from essential infrastructure:

- Commitment 5 – this relates to mitigating indirect impacts from infrastructure on TECs and species and their habitat, including meeting specific mitigation requirements in accordance with Appendix E of the Plan
- Commitment 7 – this relates to mitigating indirect impacts from infrastructure on the Southern Sydney Koala population to best practice standards and in line with advice from the Office of the NSW Chief Scientist & Engineer, and in accordance with Appendix E of the Plan

These commitments are supported by the Appendix A guidelines and infrastructure development guidelines. As shown in Box 1, the infrastructure development guideline includes:

- Objectives that apply to essential infrastructure to:
  - Minimise or mitigate indirect impacts on TECs, species, and their habitats to best practice standards
  - Minimise or mitigate indirect impacts on the Southern Sydney koala population to best practice standards and in line with the Chief Scientist Koala Report (2020) and Chief Scientist Koala Advice (2021).
- Biodiversity matters to be addressed:
  - Develop and implement mitigation measures to address indirect impacts TECs, species and their habitats during construction and operation of infrastructure projects in consideration of Appendix E of the Plan
  - Implement specific mitigation measures to address indirect impacts on the Southern Sydney koala population. This includes:
    - installing koala exclusion fencing as part of the development,
    - maintaining the integrity of any existing koala-exclusion fencing

The infrastructure development guidelines also specify that where existing or planned linear infrastructure such as gas and electricity transmission must cross the koala-exclusion fencing, '*appropriate access treatments such as gates or koala bridges are to be provided to ensure koalas remain excluded from development areas and can continue to successfully access habitat corridors. These are to be designed in accordance with best practice*'.

The infrastructure development guideline is made under the EP&A Regulation 2000 and must be taken into account when public authorities consider the likely impact of infrastructure on the environment under the EP&A Act through the future environmental assessment and approval processes for each essential infrastructure project.

These future process of environmental assessment and approval and the requirements under the Appendix A guidelines and commitments, supported by the infrastructure development guideline, are considered adequate to effectively manage the risks of indirect impacts of essential infrastructure projects on MNES.

It is also important to note that the BC Act and BAM process will be generally triggered. This process requires an assessment of the risks and consequences of indirect impacts on biodiversity values protected under the Act, and identification of mitigation measures to address these risks. Requirements to implement mitigation measures are typically incorporated into the approval, and the Act includes an enforcement and compliance framework for ensuring the mitigation measures are implemented in accordance with the approval.

37.6.6 POTENTIAL IMPACTS TO OTHER MATTERS

No other protected matters will be potentially impacted by essential infrastructure projects. This is because:

- There is no important habitat for listed migratory species within the nominated areas (see Chapter 32)
- Development within the nominated areas will not affect any Ramsar sites (see Chapter 33)
- Development within the nominated areas will not affect any World or National Heritage sites (see Chapter 34)
- Essential infrastructure projects will not be able to be carried on Commonwealth land (this is excluded land)

37.6.7 CONCLUSION

It is considered the Appendix A guidelines and commitments relevant to essential infrastructure will lead to acceptable outcomes for MNES as they:

- Provide for only a limited amount of development outside the urban capable land, which has been assessed in this Assessment Report. This development must be necessary to support the urban and industrial development under the Plan. This limited scope reduces the potential for impacts to MNES from the development
- Require implementation of assessment processes to be applied under existing legal frameworks – the EP&A Act – that require direct and indirect impacts to be avoided and minimised, mitigated and offset
- Will achieve avoidance and outcomes consistent with the Plan
- Will ensure mitigation measures are put in place to address all relevant indirect impacts
- Require unavoidable impacts to be offset in accordance with the BAM. As these impacts are not accounted for in terms of commitments under the Plan, these offsets would be additional to the offsets to that required under the Plan. The process to determine the offset amounts and deliver the offsets is considered to be robust as it will be implemented through an existing offsetting process under the BC Act or any subsequent legislative scheme
- Are supported by governance arrangements to ensure the development is consistent with the Appendix A guidelines, including clear roles and responsibilities, notification requirements and compliance processes

37.7 OVERALL OUTCOME UNDER THE PLAN

Urban capable land has generally avoided the vast majority of native vegetation and areas of high biodiversity values, including high condition vegetation, Commonwealth-listed TECs, species habitats, important populations and habitat connectivity. Within the nominated areas (not including excluded lands) this includes:

- 67.2 per cent of native vegetation
- 95.2 per cent of high condition (intact) native vegetation
- 86.1 per cent of critically endangered and endangered Commonwealth-listed TECs
- An average of 77.2 per cent of potential habitat for three species with a very high biodiversity risk weighting (>3), and an average of 77.1 per cent of potential habitat for 31 species with a high biodiversity risk weighting (≥2)
- Of 13 species with important populations identified outside excluded land 11 have important populations represented (either wholly or partially) on land avoided for biodiversity purposes
- Approximately 88.7 per cent of BIO Map core areas and 83.7 per cent of BIO Map corridors

The detailed assessments for Commonwealth listed species and TECs concluded that despite the direct and indirect impacts of development within urban capable land, the commitments under the Plan to address these impacts are adequate, and the Plan would be unlikely to reduce the long-term viability of these matters in the Cumberland subregion.

38 Cumulative Impact Assessment

38.1 INTRODUCTION

The Strategic Assessment Area, due to its proximity to Sydney, has a long history of high human development pressures. Historically, the area has been substantially cleared and developed for agricultural purposes. More recently, agricultural land is increasingly being developed as urban and commercial districts associated with Greater Sydney. This trend is predicted to continue, as Sydney's population is forecast to increase by an additional 1.7 million people by 2036 (GSC, 2018). The natural ecosystems within the Strategic Assessment Area are therefore already exposed to a range of cumulative impacts due to development within the region.

The Plan aims to provide housing and infrastructure to Western Sydney to accommodate the population growth of the city, while protecting and maintaining important biodiversity areas. Through accommodating long-term population growth in a planned and strategic way, the Plan reduces the potential for adverse cumulative impacts to occur within the region. The Plan also includes a number of measures to increase protection of the region's valuable environmental assets, which further reduces the risk of adverse cumulative impacts.

However, while the Plan reduces the risk of cumulative impacts in the region over the long term, there is still a potential for adverse cumulative impacts to occur due to the combined impact of the Plan with other developments in the region.

This Chapter provides an assessment of the cumulative impacts to MNES which may occur due to the combined effect of development under the Plan with other developments within the Strategic Assessment Area.

The terms of reference (ToR) requires:

- Identification of MNES that may be cumulatively impacted by the Plan (Section 3.2)
- An analysis of the likely adverse cumulative impacts to MNES (Section 4.5.3)

The Chapter includes three impact assessment approaches to consider cumulative impacts:

- A quantitative assessment of cumulative impacts of major projects on threatened species and TECs
- A qualitative assessment of cumulative impacts of other projects on threatened species and TECs
- Assessment of cumulative impacts on other MNES

The Chapter is structured as follows:

- The assessment approach used in each of the impact assessment approaches is outlined
- The quantitative impact assessment is presented, which includes an evaluation of impacts to key matters
- The qualitative impact assessment is presented, which includes an evaluation of measures in the Plan to address and minimise cumulative impacts
- The cumulative impacts on other MNES are considered

It is considered that overall the Plan's conservation program adequately avoids, minimises and manages potential cumulative impacts to MNES within the Strategic Assessment Area.

38.2 APPROACH TO THE ASSESSMENT

The approach to the cumulative assessment involved:

- A quantitative assessment of cumulative direct impacts of major projects on threatened species and TECs. This involved:
    - Identifying current major projects within the Strategic Assessment Area
    - Identifying key species and TECs most likely at risk of cumulative direct impacts across the Plan and major projects
    - Evaluating the significance of the cumulative impacts and the adequacy of the commitments under the Plan in the context of these cumulative direct impacts for each key species and TEC

- A qualitative assessment of cumulative impacts to threatened species and TECs more broadly across the Strategic Assessment Area which considers potential direct impacts of smaller-scale developments across Sydney, in addition to potential indirect impacts associated with development more broadly
- An overview and evaluation of potential cumulative impacts to other MNES

38.2.1 QUANTITATIVE ASSESSMENT OF MAJOR PROJECTS

The purpose of the cumulative impact assessment is to identify the MNES most impacted under the Plan that are also impacted by other major projects in the Cumberland subregion to:

- Assess the significance of cumulative impacts across the Plan and these major projects on these matters
- Determine whether the commitments under the Plan to address direct impacts to each matter are adequate in the context of the cumulative impacts on those matters

IDENTIFICATION OF MAJOR PROJECTS

The cumulative assessment considers impacts from current major projects in the Strategic Assessment Area:

- That have impact footprints greater than 100 ha
- That have been approved for development or have been subject to impact assessment for pending approval
- Where clearing for development has not yet occurred or has only occurred over part of the project area to date
- Where data is available on impacts and offsets

Table 38-1 identifies the major projects included in the cumulative impact assessment and data availability for each project. The location of each major project is shown in Figure 38-1.

Note that the Tahmoor South Project, a proposal to expand Tahmoor Mine in the vicinity of Bargo, has not been included in consideration of major projects as its direct impacts to habitat are below 100 ha (as the mine is an underground longwall mine). However, it is recognised that there is potential for indirect impacts to occur over a wide area due to this proposal, including subsidence and hydrological changes (SIMEC, 2020). Consideration of cumulative indirect impacts is included in the qualitative impact assessment in Section 38.2.

IDENTIFICATION OF KEY SPECIES AND ECOLOGICAL COMMUNITIES MOST LIKELY AT RISK

The approach to identify the key species and TECs most likely at risk of cumulative impacts involved:

- Identifying the species/TECs being directly impacted by the Plan that are also being directly impacted by other major projects
- Identifying priority species and TECs which either have the greatest impacts under the Plan, or which have the greatest potential for cumulative impacts with other projects. These included:
    - Species with a high or medium risk rating, as determined through detailed species assessments contained in Chapter 29 and Chapter 30
    - The top 15 species and all TECs directly impacted by the Plan that are also being directly impacted by other major projects
- Assessing the significance of cumulative impacts and determining whether the commitments under the Plan are adequate in the context of the cumulative impacts

The analysis was done based on habitat rather than impacts to records or populations because habitat was most widely available information to enable comparison between the Plan and across the major projects. It is noted that Section 38.2 contains a qualitative assessment of potential cumulative impacts to records or populations.

The species and TECs that are most likely at risk from cumulative impacts and that may need additional commitments under the Plan in the context of those impacts are those matters where:

- The Plan is having a notable impact (it is not within the scope of the Plan to address cumulative impacts from other projects on species/TECs that are subject to negligible or minor impacts under the Plan), AND
- The major projects make a significant contribution to cumulative impacts (species/TECs not substantially impacted by major projects only need to be addressed in terms of the impacts of the Plan). This was considered to be where:

- Major projects have a total impact greater than 100 per cent of the impact of the Plan, or
- Major projects have a total impact greater than 2 per cent of remaining habitat within the Strategic Assessment Area, AND

- There is a significant total cumulative impact from the Plan and major projects – this was considered to be where cumulative impacts were greater than 5 per cent of remaining habitat within the Strategic Assessment Area

Table 38-1: Major projects included in the cumulative impact assessment and data availability

Major project	Comments	Data source	Data used in the cumulative impact assessment			
			Impact data		Offset data	
			TEC	Species habitat	TEC	Species habitat
Western Sydney Airport	Clearing for development of the Western Sydney Airport commenced in November 2018. The project is predicted to be completed in 2024. No data is available on the clearing that has occurred to date	Western Sydney Airport Environmental Impact Statement (DIRD, 2016b)	Extent within development footprint	Known habitat within development footprint	Extent	Known habitat
Existing North West and South West Growth Areas	Clearing for development within the existing North West and South West Growth Areas has commenced. Impacts were determined for the precincts where clearing has not yet occurred or where clearing has commenced but not been completed	Biodiversity Offset Program Annual Report 2018-2019 (DPIE, 2020a)	Extent within South West Growth Area precincts*	Extent within the South West* and North West** Growth Area precincts	Extent within and outside the Growth Areas	No data
M12 Motorway	Construction is expected to start in the 2022 and finish in 2025 (RMS, 2019)	M12 Amendment Report (Transport for NSW, 2020)	Extent within development footprint	Known habitat within development footprint	Ecosystem Credits required for EPBC TEC impacts^	Species Credits required for EPBC species^
The Northern Road	Infrastructure approval was granted in May 2018	The Northern Road Upgrade Biodiversity Offset Strategy (Jacobs Australia, 2019)	Extent within development footprint	Extent within development footprint	Ecosystem Credits required for PCTs associated with EPBC TEC impacts^	Species Credits required for EPBC species^

Major project	Comments	Data source	Data used in the cumulative impact assessment			
			Impact data		Offset data	
			TEC	Species habitat	TEC	Species habitat
Figtree Hill	Construction is proposed to commence in two stages, with stage 1 commencing in 2018/2019 (Eco Logical Australia, 2018c)	Mt Gilead Residential Development – EPBC Preliminary Documentation (EPBC 2015/7599) (Eco Logical Australia, 2018c)	Extent within development footprint	Known and potential habitat within development footprint	Ecosystem Credits required for PCTs associated with EPBC TEC impacts^	Species Credits required for EPBC species^
Bingara Gorge	The ongoing development of Bingara Gorge is expected to occur over 7 years from the time of approval (Eco Logical Australia, 2018a)	Bingara Gorge – EPBC Assessment Report (EPBC 2014/7400) (Eco Logical Australia, 2018a) EPBC Act referral document (EPBC 2014/7400) (Eco Logical Australia, 2014)	Extent within development footprint and 30m buffer	Potential habitat	Secured offsets at Fernhill North West Biobank site and onsite offsets	Pre-existing habitat area at Bingara Gorge known as the Environment Protection and Recreation Lands
Sydney Metro – Western Sydney Airport	The Sydney Metro WSA development is estimated to begin in June 2021 and be completed by December 2026 (AECOM, 2020)	EPBC Act Final Environmental Impact Assessment of off-airport proposed action (EPBC 2020/8687) (M2A, 2021) EPBC Act referral document (AECOM, 2020)	Extent within development footprint off-airport	Extent within development footprint off-airport	Ecosystem Credits required for PCTs associated with EPBC TEC impacts^	Species Credits required for EPBC species^
Oakdale West Estate commercial development	The development is estimated to start in January 2018 and be completed by January 2028 (Cumberland Ecology, 2017a)	Biodiversity Assessment Report (Cumberland Ecology, 2017b), Biodiversity Offset Strategy (Cumberland Ecology, 2017c), EPBC Act referral document (Cumberland Ecology, 2017a)	Extent within development footprint	No species and populations have been assessed as impacted by the Project	Ecosystem Credits required for PCTs associated with EPBC TEC impacts^	No species require offsets
Jacaranda Ponds 35 Subdivision	The development is estimated to start in January 2019 and be completed by January 2029 (Eco Logical Australia, 2018b)	EPBC Act referral document (EPBC 2018/8246) (Eco Logical Australia, 2018b), Biodiversity Certification Assessment Report and Strategy (Eco Logical Australia, 2019)	Extent within development footprint and 30m buffer	The development does not impact any Category 1 flora or fauna species.	Ecosystem Credits required for PCTs associated with EPBC TEC impacts	There are no offsets required for Category 1 flora or fauna species.

*Existing South West Growth Area precincts: Austral, Bringelly, Catherine Fields, Future, Industrial, Kemps Creek, Leppington, Leppington North, Lowes Creek, Marylands, North Bringelly, North Rossmore, Rossmore

**Existing North West Growth Area precincts: Box Hill, Box Hill Industrial, Marsden Park North, Riverstone, Riverstone East, Riverstone West, Shanes Park, Vineyard, West Schofields

^See Table **38-2** for offset credit conversion factor

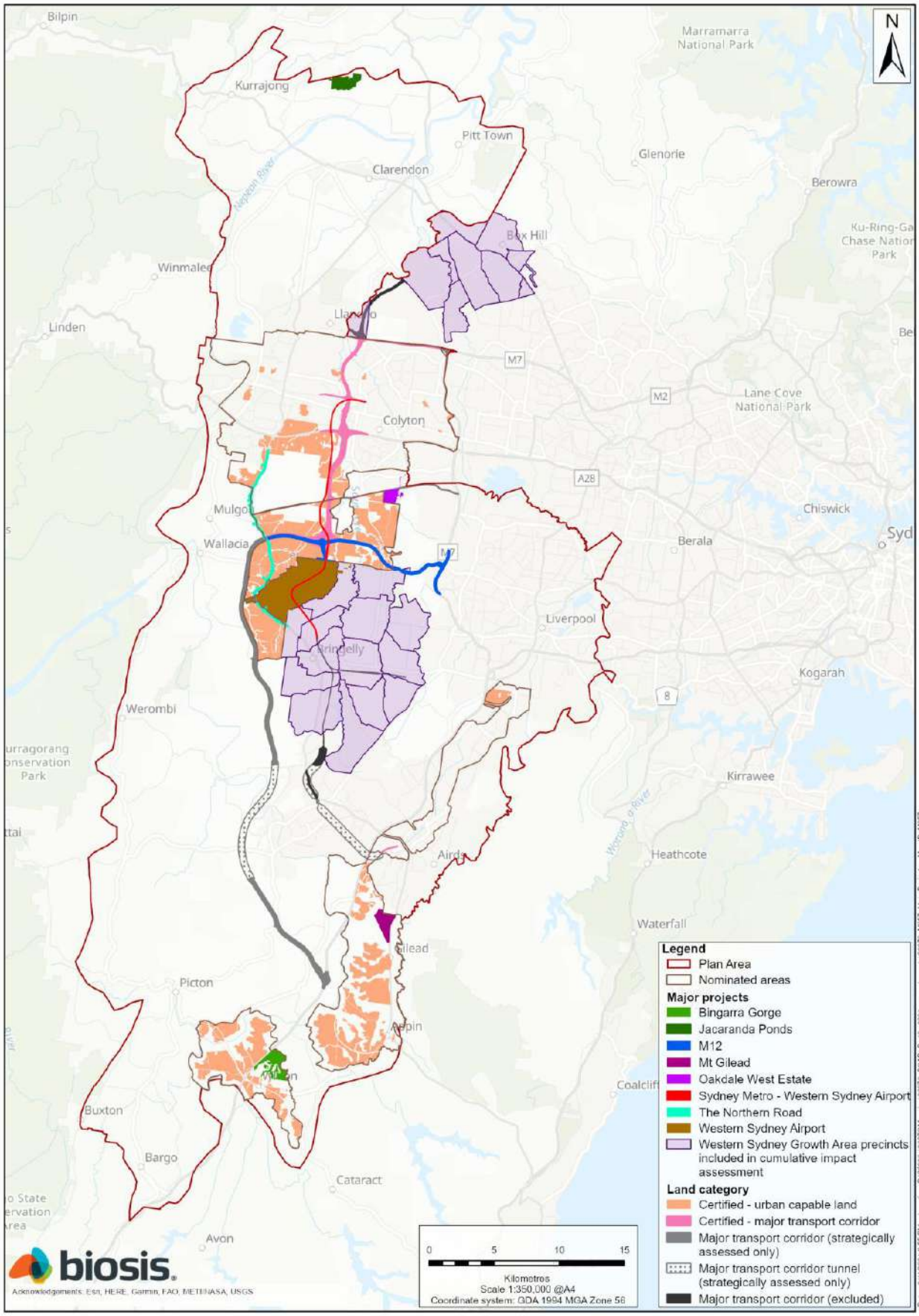

Figure 38-1: Location of major projects included in the cumulative impact assessment

EVALUATION OF CUMULATIVE IMPACTS

The approach to the evaluation of cumulative impacts involved using information in conservation advices, recovery plans and threat abatement plans for each species or TEC to evaluate the significance of cumulative impacts across the Plan and major projects and determine whether measures should be taken under the Plan to reduce these impacts.

The evaluation was undertaken considering the following questions:

- What is the significance of the total cumulative impact across the Plan and major projects, taking into account:
  - Information in conservation advices, recovery plans and threat abatement plans for each species or TEC?
  - Distribution or spread of impacts across the Strategic Assessment Area?
- To what extent is the Plan contributing to cumulative impacts?
- To what extent are the impacts of the Plan known or likely?
- Do the current offset and mitigation measures under the Plan deal adequately with the cumulative impact?
- Whether additional mitigation measures are required to adequately address cumulative impacts?

LIMITATIONS

The cumulative impact assessment has the following key limitations:

- Data in relation to impacts or offsets was not always available for each major project
- Data was not always available in a form that allowed consistent comparison across major projects or the Plan. For example, the Plan assesses species habitat in terms of potential habitat, whereas some major projects assess species habitat in terms of known or likely habitat (as these assessments are done at a finer scale) or a combination of both
- Due to data availability, cumulative impacts were not considered in terms of indirect impacts. Refer to Section 38.2 for evaluation of indirect impacts associated with cumulative impacts more broadly
- Impact data on the existing North West and South West Growth Areas program was based on an assumption that the entire precincts covered in the analysis (see Table 38-1) were impacted, as development footprints were not available for the analysis. This is likely to greatly overestimate the impacts on potential habitat from this program
- A number of major projects have based their offset programs on acquiring biodiversity credits under the BBAM. Where conservation commitments are based on acquiring credits, a conversion factor was needed to describe the intended outcomes in terms of hectares of land conserved (see Table 38-2). This factor is an approximation only

Table 38-2: Offset credit conversion factors

Credit scheme	Number of credits	Equivalent number of hectares
BBAM	10	1

38.2.2 QUALITATIVE ASSESSMENT OF OTHER DEVELOPMENTS

It is recognised that the Cumberland subregion will be subject to many other types of development in the future, including:

- Smaller projects (with footprints under 100 ha), such as smaller-scale infrastructure, residential or commercial developments
- Projects which are not considered as major projects in Section 38.2.1 due to small direct impacts, yet which have potential to result in indirect impacts over substantial areas (such as longwall coal mining)
- Major projects which have not yet been planned or announced

It is not possible to quantitatively estimate the cumulative impacts of these developments and the Plan on Commonwealth-listed species and TECs or other MNES due to either a lack of available data on biodiversity impacts or uncertainty over the extent and location of development. However, future developments are likely to lead to:

- Additional cumulative impacts on MNES that are impacted by the Plan
- Increased demand for offsets that will compete with the demand created by the Plan

Section 38.2 outlines a qualitative analysis of the Plan with regards to the cumulative impacts of minor or future major projects, and considers:

- Whether the design of development under the Plan will assist in minimising potential cumulative impacts from development pressures within the Cumberland subregion
- Whether the Plan contains measures to increase protection of the most valuable environmental assets within the Cumberland subregion, to reduce their vulnerability to future development
- Whether the Plan contains measures which will help to minimise landscape-scale threats which may occur due to cumulative impacts

38.2.3 CUMULATIVE IMPACTS TO OTHER MNES

In addition to threatened species and TECs, it is recognised that a range of other MNES are present within, and in proximity to, the Strategic Assessment Area which may be vulnerable to cumulative impacts. Section 38.5 provides an assessment of the risk of cumulative impacts to other MNES under the Plan.

38.3 QUANTITATIVE ASSESSMENT OF MAJOR PROJECTS

38.3.1 IMPACT ASSESSMENT

DIRECT IMPACTS

Table 38-3 and Table 38-4 identify the priority species and TECs directly impacted by the Plan that are also impacted by major projects.

For each species and TEC, the tables show:

- Impacts from each major project in terms of hectares impacted and as per cent of habitat within the Strategic Assessment Area, and the total impacts
- Total cumulative impacts across the major projects and Plan in terms of:
    - Total impact in hectares
    - Per cent additional impact due to major projects
    - Total impact as per cent of remaining habitat within the Strategic Assessment Area

The table shows that the major projects make a significant contribution to cumulative impacts in relation to most of the identified priority species impacted by the Plan and two TECs. Note that a contribution to cumulative impacts is considered significant when the major projects have a total impact greater than 100 per cent of the impact of the Plan or greater than 2 per cent of remaining habitat within the Strategic Assessment Area.

The total cumulative impact from the Plan and major projects is considered significant where total cumulative impacts were greater than 5 per cent of remaining habitat within the Strategic Assessment Area. A significant total cumulative impact across the Plan and major projects was identified for the following matters:

- Downy Wattle
- White-flowered Wax Plant
- *Micromyrtus minutiflora*
- Spiked Rice-flower
- *Pultenaea parviflora*
- Regent Honeyeater
- Swift Parrot
- Dural Land Snail
- Grey-headed Flying-fox
- Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest
- River-flat Eucalypt Forest on Coastal Floodplains of southern New South Wales and eastern Victoria

Table 38-3: Potential cumulative impacts to priority species impacted by Plan

Species	Total habitat in the SAA	Plan impacts		Major project impacts											Cumulative impacts Plan and major projects		
		Impact (ha)	Impact as % of SAA habitat	Western Sydney Airport (ha)	Existing Growth Areas* (ha)	M12	Figtree Hill	The Northern Road	Bingara Gorge	Sydney Metro – Western Sydney Airport	Oakdale West Estate	Jacaranda Ponds	Total impact (ha)	Total impact as % of SAA habitat	Total impact (ha)	% additional impact due to major projects	Impact as % of SAA habitat
Flora																	
Acacia bynoeana (Bynoe's Wattle)	31,541.6	437.8	1.4%	N/A	565.1	N/A	N/A	N/A	N/A**	1.3	N/A	N/A	566.4	1.8%	**1,004.2**	**56.4%**	**3.2%**
Acacia pubescens (Downy Wattle)	36,224.2	1,377.6	3.8%	5.0	3,586.6	N/A	N/A	N/A	N/A	2.2	N/A	N/A	3,593.8	9.9%	**4,971.4**	**72.3%**	**13.7%**
Cynanchum elegans (White-flowered Wax Plant)	3,322.2	19.6	0.6%	289.9	N/A	N/A	N/A	N/A	N/A	0.6	N/A	N/A	290.5	8.7%	**310.1**	**93.7%**	**9.3%**
Eucalyptus benthamii (Camden White Gum)	4,797.9	47.3	1.0%	N/A	81.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	81.5	1.7%	**128.8**	**63.3%**	**2.7%**
Micromyrtus minutiflora	36,704.5	170.1	0.5%	N/A	2,256.7	N/A	N/A	N/A	N/A	1.3	N/A	N/A	2,258.0	6.2%	**2,428.1**	**93.0%**	**6.6%**
Persoonia nutans	15,043.3	142.5	0.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0%	**142.5**	**0.0%**	**0.9%**
Pimelea curviflora var. *curviflora*	13,011.3	55.3	0.4%	N/A	425.4	N/A	N/A	N/A	N/A	0.6	N/A	N/A	426.0	3.3%	**481.3**	**88.5%**	**3.7%**
Pimelea spicata (Spiked Rice-flower)	34,815.5	974.0	2.8%	247.8	4,922.9	N/A	N/A	N/A	N/A	1.0	N/A	N/A	5,171.7	14.9%	**6,145.7**	**84.2%**	**17.7%**
Pomaderris brunnea (Brown Pomaderris)	26,076.2	206.8	0.8%	N/A	831.2	N/A	N/A	N/A	13.2	N/A	N/A	N/A	844.4	3.2%	**1,051.2**	**80.3%**	**4.0%**
Pultenaea parviflora	20,270.9	221.0	1.1%	247.8	3,525.8	N/A**	N/A	N/A**	N/A	1.3	N/A	N/A	3,774.9	18.6%	**3,995.9**	**94.5%**	**19.7%**

Species	Total habitat in the SAA	Plan impacts		Major project impacts											Cumulative impacts Plan and major projects		
		Impact (ha)	Impact as % of SAA habitat	Western Sydney Airport (ha)	Existing Growth Areas* (ha)	M12	Figtree Hill	The Northern Road	Bingara Gorge	Sydney Metro – Western Sydney Airport	Oakdale West Estate	Jacaranda Ponds	Total impact (ha)	Total impact as % of SAA habitat	Total impact (ha)	% additional impact due to major projects	Impact as % of SAA habitat
Fauna																	
Anthochaera phrygia (Regent Honeyeater)	59,369.2	1,270.5	2.1%	N/A	3,331.1	N/A	N/A	24.4	41.3	N/A	N/A	N/A	3,396.8	5.7%	**4,667.3**	**72.8%**	**7.9%**
Chalinolobus dwyeri (Large-eared Pied Bat)	25,451.4	285.0	1.1%	0.0	414.7	N/A	10.9	N/A	33.0	N/A	N/A	N/A	458.6	1.8%	**743.6**	**0.62**	**2.9%**
Lathamus discolor (Swift Parrot)	59,369.2	1,270.5	2.1%	141.8	3,331.1	N/A	10.9	N/A	33.0	N/A	N/A	N/A	3,516.8	5.9%	**4,787.3**	**0.73**	**8.1%**
Petauroides volans (Greater Glider)	25,609.8	127.2	0.5%	N/A	644.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	644.5	2.5%	**771.7**	**0.84**	**3.0%**
Pommerhelix duralensis (Dural Land Snail)	25,498.5	45.7	0.2%	N/A	3,775.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,775.3	14.8%	**3,821.0**	**0.99**	**15.0%**
Pteropus poliocephalus (Grey-headed Flying-fox)	26,868.8	751.0	2.8%	141.8	2,723.6	62.6	10.9	N/A	33.0	N/A	N/A	N/A	2,971.9	11.1%	**3,722.9**	**0.80**	**13.9%**

* The Strategic Assessment Report for existing North West and South West Growth Areas program notes that impacts may occur to an undetermined quantity of low quality habitat for these species

** Species impacts for some of the major projects were reported against individual plants. The cumulative impact assessment evaluates impacts reported in hectares, impacts to individual plants have not been included

Table 38-4: Potential cumulative impacts to TECs impacted by the Plan

Matter	Total habitat in the SAA	Plan impacts		Major project impacts										Cumulative impacts Plan and major projects		
		Impact (ha)	Impacts as % of SAA habitat	Western Sydney Airport	Existing Growth Areas	M12	Figtree Hill	The Northern Road	Bingara Gorge	Sydney Metro – Western Sydney Airport	Oakdale West Estate	Jacaranda Ponds	Total impact (ha)	Total impact as % of SAA habitat	Total impact (ha)	% additional impact due to major projects	Impacts as % of SAA habitat
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	269.3	8.0	3.0%	N/A	N/A	N/A	N/A	N/A	N/A	4.9	N/A	N/A	4.9	1.8%	**12.9**	**38.2%**	**4.8%**
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	794.4	30.9	3.9%	N/A	1.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.4	0.2%	**32.3**	**4.3%**	**4.1%**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	9,954.3	180.3	1.8%	104.9	503.5	42.5	0.1	15.2	N/A	5.9	2.0	4.7	678.7	6.8%	**859.0**	**79.0%**	**8.6%**
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	8,301.5	180.7	2.2%	N/A	N/A	N/A	5.3	N/A	57.2	N/A	N/A	N/A	62.5	0.8%	**243.2**	**25.7%**	**2.9%**
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	6,667.0	159.2	2.4%	42.1	222.8	3.0	N/A	3.9	N/A	6.2	1.1	N/A	279.2	4.2%	**438.4**	**63.7%**	**6.6%**

OFFSETS FOR MAJOR PROJECTS

Table 38-5 and Table 38-6 show the offset commitments under major projects (ha) for the priority species and TECs impacted by the Plan. For each species and TEC, the tables show:

- Offsets from each major project (in hectares) and the total offsets from major projects
- Total cumulative offsets across the major projects and the Plan in terms of:
    - Total offsets in hectares
    - Total offsets as a per cent of remaining habitat in the Strategic Assessment Area

It is important to note that:

- Under the Plan some species have specific offset targets to secure either a certain number of offset locations or habitat (see Part 2). Other species do not have targets but are likely to benefit from the targets for NSW TECs/PCTs, as those PCTs provide potential habitat for the species. The amount of potential habitat (ha) for each species that will be secured in the SCAs because of the TEC/PCT targets is shown the table (see column 4)
- Some major projects included offsets involving securing of populations rather than habitat. This has not been included in the analysis, as the analysis was done based on habitat

Table 38-5: Offset commitments for priority species impacted by Plan

Matter	Total habitat in the SAA	Plan offsets		Major project offsets (ha)^									Cumulative offsets Plan and major projects		
		Specific target (ha or site locations)	Potential habitat secured through NSW TEC/PCT targets (ha)#	Western Sydney Airport	Existing Growth Areas*	M12	Figtree Hill	The Northern Road	Bingara Gorge	Sydney Metro – Western Sydney Airport	Oakdale West Estate	Jacaranda Ponds	Total - major projects	Total offset (ha)	Offsets as % of SAA habitat
Flora															
Acacia bynoeana (Bynoe's Wattle)	31,541.6	No	4,005.0	N/A	N/A	N/A	N/A	N/A	117.0	3.1	N/A	N/A	120.1	**4,125.1**	**13.1%**
Acacia pubescens (Downy Wattle)	36,224.2	No	4,740.0	N/A	N/A**	N/A	N/A	N/A	N/A	5.4	N/A	N/A	5.4	**4,745.4**	**13.1%**
Cynanchum elegans (White-flowered Wax Plant)	3,322.2	2 offset locations	3,390.2	N/A	N/A	N/A	N/A	N/A	N/A	1.8	N/A	N/A	1.8	**3,392.0**	**102.1%**
Eucalyptus benthamii (Camden White Gum)	4,797.9	No	2,655.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	**2,655.0**	**55.3%**
Micromyrtus minutiflora	36,704.5	No	400.0	N/A	N/A	N/A	N/A	N/A	N/A	4.7	N/A	N/A	4.7	**404.7**	**1.1%**
Persoonia nutans	15,043.3	2 offset locations	1,855.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	**1,855.0**	**12.3%**
Pimelea curviflora var. *curviflora*	13,011.3	No	3,890.0	N/A	N/A	N/A	N/A	N/A	N/A	1.8	N/A	N/A	1.8	**3,891.8**	**29.9%**

Matter	Total habitat in the SAA	Plan offsets		Major project offsets (ha)^									Cumulative offsets Plan and major projects		
		Specific target (ha or site locations)	Potential habitat secured through NSW TEC/PCT targets (ha)#	Western Sydney Airport	Existing Growth Areas*	M12	Figtree Hill	The Northern Road	Bingara Gorge	Sydney Metro – Western Sydney Airport	Oakdale West Estate	Jacaranda Ponds	Total - major projects	Total offset (ha)	Offsets as % of SAA habitat
Pimelea spicata	34,815.5	3 offset locations	2,885.2	N/A	N/A**	N/A	N/A	N/A	N/A	1.8	N/A	N/A	1.8	**2,887.0**	**8.3%**
Pomaderris brunnea (Brown Pomaderris)	26,076.2	No	2,030.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	**2,030.0**	**7.8%**
Pultenaea parviflora	20,270.9	2 offset locations	400.0	N/A	N/A	150.0	N/A	9.0	N/A	3.1	N/A	N/A	162.1	**562.1**	**2.8%**
Fauna															
Anthochaera phrygia (Regent Honeyeater)	59,369.2	No	5,315.2	N/A	N/A	N/A	N/A	188.2	N/A	N/A	N/A	N/A	188.2	**5,503.4**	**9.3%**
Chalinolobus dwyeri (Large-eared Pied Bat)	25,451.4	No	5,315.2	N/A	276.2	N/A	26.0	N/A	117.0	N/A	N/A	N/A	419.2	**5,734.4**	**22.5%**
Lathamus discolor (Swift Parrot)	59,369.2	4,410 of foraging habitat, incl. 100 ha of important habitat	5,315.2	N/A	347.4	N/A	26	N/A	117	N/A	N/A	N/A	490.4	**5,805.6**	**9.8%**

Matter	Total habitat in the SAA	Plan offsets		Major project offsets (ha)^									Cumulative offsets Plan and major projects		
		Specific target (ha or site locations)	Potential habitat secured through NSW TEC/PCT targets (ha)#	Western Sydney Airport	Existing Growth Areas*	M12	Figtree Hill	The Northern Road	Bingara Gorge	Sydney Metro – Western Sydney Airport	Oakdale West Estate	Jacaranda Ponds	Total - major projects	Total offset (ha)	Offsets as % of SAA habitat
Petauroides volans (Greater Glider)	25,609.8	No	4,845.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	**4,845.2**	**18.9%**
Pommerhelix duralensis (Dural Land Snail)	25,498.5	No	4,740.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	**4,740.2**	**18.6%**
Pteropus poliocephalus (Grey-headed Flying-fox)	26,868.8	No	5,325.2	410.0	288.9	N/A	26.0	N/A	117.0	N/A	N/A	N/A	841.9	**6,167.1**	**23.0%**

* The offset commitments for the existing North West and South West Growth Areas included small targets for the protection of these species that have already been met – *Acacia pubescens*, *Pimelea spicata*, Swift Parrot, Large-eared Pied Bat, and Grey-headed Flying Fox

** No specific targets have been set for these species, the program will endeavour to protect at least one population or as many hectares as possible (DPIE, 2020a)

^ The offset targets for species and TECs are based on commitments to protect PCTs under the Plan

Note that habitat data for 'Potential habitat secured through NSW TEC/PCT targets' (column 3) is derived based on PCTs identified under the NSW BAM as being associated with the species, which is likely to overpredict habitat, whereas the 'Total habitat in the SAA' (column 1) is based on habitat mapping done for this project, which is more refined. This means that in some cases, habitat based on PCT associations is greater than total habitat in the SAA (e.g. *Cynanchum elegans* in row 3)

Table 38-6: Offset commitments for TECs impacted by Plan

Matter	Total habitat in the SAA	Plan offsets (ha)	Major project offsets (ha)										Cumulative offsets Plan and major projects	
			Western Sydney Airport	Existing Growth Areas*	M12	Figtree Hill	The Northern Road	Bingara Gorge	Sydney Metro – Western Sydney Airport	Oakdale West Estate	Jacaranda Ponds	Total - major projects	Total offset (ha)	Offsets as % of SAA habitat
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	269.3	20.0	N/A	N/A	N/A	N/A	N/A	N/A	18.1	0.0	N/A	18.1	**38.1**	**14.1%**
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	794.4	125.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	**125.0**	**15.7%**
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	9,954.3	665.0	343.0	2,605.0*	170.4	0.8	103.1	N/A	20.4	10.2	13.8	3,266.7	**3,931.7**	**39.5%**
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	8,301.5	675.0	N/A	132.0	N/A	13.9	N/A	92.5	N/A	N/A	N/A	238.4	**913.4**	**11.0%**
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	6,667.0	570.0	213.5	38.5**	9.9	N/A	16.1	N/A	21.7	2.1	N/A	301.8	**871.8**	**13.1%**

*Note that the commitments under the existing North West and South West Growth Areas are for 1) At least 2400 hectares of Commonwealth-listed Cumberland Plain Woodland or other 'grassy woodland' communities, with preference given to Cumberland Plain Woodland, followed by White Box–Yellow Box–Blakely's Red Gum Grassy Woodland and Derived Native Grassland 2) At least 205 hectares of high quality Commonwealth-listed Cumberland Plain Woodland

** There is no specific offset target, as of June 2019, 38.5 hectares have been protected (DPIE, 2020a)

38.3.2 EVALUATION FOR THREATENED SPECIES AND TECS

KEY MATTERS OF CONCERN

The purpose of the cumulative impact assessment is to identify the key species and TECs under the Plan that are also impacted by other major projects in the Cumberland subregion to:

- Assess the significance of cumulative impacts
- Determine whether the commitments under the Plan are adequate in the context of the cumulative impacts

The species and TECs that are most likely at risk from cumulative impacts and that may need additional commitments under the Plan in the context of those impacts are those matters where (see Section 38.2):

- The Plan is having a notable impact, and
- The major projects make a significant contribution to cumulative impacts, and
- There is a significant total cumulative impact from the Plan and major projects

The species and TECs that meet these criteria are:

- Species
  - Downy Wattle
  - White-flowered Wax Plant
  - *Micromyrtus minutiflora*
  - Spiked Rice-flower
  - *Pultenaea parviflora*
  - Regent Honeyeater
  - Swift Parrot
  - Dural Land Snail
  - Grey-headed Flying-fox
- TECs:
  - Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest
  - River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria

The significance of the cumulative impacts on each of these species and TECs is evaluated below.

Acacia pubescens (Downy Wattle)

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for *Acacia pubescens* is moderate compared to the other major projects (27 per cent of the total impact).

However, the risk of impacts to this species under the Plan is very low, based on the risk assessment approach applied in the detailed species' assessment in Chapter 29.

The Plan will not result in any direct impacts to records or important populations. There is a direct impact to 1,377.6 ha of potential habitat for this species, which amounts to 3.8 per cent of the mapped habitat in the Strategic Assessment Area.

This loss of potential habitat generally relates to small and scattered patches. The likelihood of impacts to higher quality larger patches of habitat within Wianamatta Regional Park is considered to be low because the species has never been recorded on this site, despite significant survey effort.

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan in addition to major projects on *Acacia pubescens* is considered to be moderate because:

- The total cumulative impact is moderate (13.7 per cent of total potential habitat in the Strategic Assessment Area)
- The species is largely restricted to the Cumberland subregion
- The species is not well represented in existing protected lands (7.9 per cent of total potential habitat in the Strategic Assessment Area, or 13 of 97 important populations, occurs in existing protected lands)

Known records for *Acacia pubescens* are distributed across two core areas which have been identified for site management under the NSW Saving our Species (SOS) program:

- One area associated with the Hawkesbury SOS site, comprising approximately 3,736 ha in the north-east of the Strategic Assessment Area, including Windsor Downs, Pitt Town and Scheyville National Park
- The second associated with the Bankstown-Liverpool SOS site, comprising an area of approximately 5,842 ha that straddles the central-east boundary of the Strategic Assessment Area around Lansdowne

These areas are generally not impacted by the Plan or major projects.

It is also important to note that cumulative impacts from other major projects are primarily due to the existing North West and South West Growth Areas, and the impacts associated with these areas are likely to be greatly overestimated (see Section 38.2). This reduces the significance of the total cumulative impacts.

Adequacy of the cumulative offsets

The major projects (Sydney Metro Western Sydney Airport only) provide offsets of 5.4 ha for *Acacia pubescens*.

Due to the risk of impacts from the Plan being very low, the Plan does not include a species-specific commitment to secure offset locations for *Acacia pubescens*. However, the Plan includes a commitment to protect 4,740 ha of NSW TECs/PCTs that are associated with potential habitat for the species.

Given the very low risk of impacts to the species under the Plan, it is considered that the Plan adequately contributes to addressing the cumulative impacts to this species. In particular, the Plan will increase existing levels of protection of habitat for the species in the Strategic Assessment Area from 8 per cent to 21 per cent.

Cynanchum elegans (White-flowered Wax Plant)

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for *Cynanchum elegans* is not significant compared to the other major projects (6.3 per cent of the total impact).

The risk of impacts to this species under the Plan is medium. The Plan will not result in any direct impacts to records or important populations, however, one important population will be fragmented by the OSO at Cobbitty. There is a direct impact to 19.6 ha of potential habitat for this species, which amounts to 0.6 per cent of the mapped habitat in the Strategic Assessment Area. This impact generally relates to small and isolated areas.

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on *Cynanchum elegans* is considered to be low because:

- The total cumulative impact is relatively small (9.3 per cent of total potential habitat in the Strategic Assessment Area)
- The species is not restricted to the Cumberland subregion (the species occurs in eastern NSW from Brunswick Heads on the north coast to the Illawarra region south of Sydney) and therefore the cumulative impacts in the Strategic Assessment Area are less likely to impact species persistence within NSW
- At least 40 populations of the species are known to occur within existing protected lands in NSW, and under the SOS program, current management is considered sufficient to protect *Cynanchum elegans* in NSW in the long-term

Adequacy of the cumulative offsets

The Major Projects (Sydney Metro- Western Sydney Airport only) provide offsets of 1.8 ha for *Cynanchum elegans.*

The Plan includes a species-specific commitment to secure 2 offset locations for *Cynanchum elegans* to address the residual impacts of the development. The Plan also includes a commitment to protect 3,390.2 hectares of NSW TECs/PCTs that are associated with potential habitat for the species.

Given the low contribution of the Plan to cumulative impacts, it is considered that the Plan adequately contributes to addressing the cumulative impacts to this species. In particular, the Plan will:

- Secure 2 offset locations for *Cynanchum elegans*
- Increase existing levels of protection of habitat for the species in the Strategic Assessment Area from 13 per cent to 115 per cent

Micromyrtus minutiflora

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for *Micromyrtus minutiflora* is not significant compared to the other major projects (7.0 per cent of the total impact).

The risk of impacts to this species under the Plan is very low. The Plan will not result in any direct impacts to records or important populations. The most notable impacts to potential habitat occur due to the OSO within Wianamatta Regional Park. The likelihood of impacts in this location is considered low because:

- The species has not been recorded in the area despite the area forming part of a Regional Park which is managed by the NSW National Parks and Wildlife Service and would be well traversed
- The species was not observed as part of surveys conducted through sections of suitable habitat within the OSO corridor as part of this Assessment Report

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on *Micromyrtus minutiflora* is considered to be moderate. Although 6.6 per cent of total potential habitat for the species in the Strategic Assessment Area is cumulatively impacted, the species:

- Is restricted to the north-western parts of the Cumberland Plain
- Not well represented in existing protected lands (only 5.5 per cent of total potential habitat in the Strategic Assessment Area occurs in existing protected lands)

It is important to note that the cumulative impact from other major projects is primarily due to the existing North West and South West Growth Areas, and the impacts associated with these areas are likely to be greatly overestimated (see Section 38.2). This reduces the significance of the total cumulative impacts.

Adequacy of the cumulative offsets

The major projects (Sydney Metro- Western Sydney Airport only) provide offsets of 4.7 ha for *Micromyrtus minutiflora.*

The Plan includes a commitment to protect 400 hectares of NSW TECs/PCTs that are associated with potential habitat for the species.

Given the low contribution of the Plan to cumulative impacts, and the very low risk of impacts to the species under the Plan, it is considered that the Plan adequately contributes to addressing cumulative impacts to this species. In particular, the Plan will increase existing levels of protection of habitat for the species in the Strategic Assessment Area from 5 per cent to 7 per cent.

Pimelea spicata (Spiked Rice-flower)

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for *Pimelea spicata* is moderate compared to the other major projects (15.8 per cent of the total impact).

Furthermore, the risk of impacts to this species under the Plan is high, based on the risk assessment approach applied in the detailed species' assessment in Chapter 29

The Plan will result in direct impacts to one important population and 974 ha of potential habitat for the species, which is 2.8 per cent of potential habitat across the Strategic Assessment Area.

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on *Pimelea spicata* is considered to be high because:

- The total cumulative impact is moderate (17.7 per cent of total potential habitat in the Strategic Assessment Area)
- The risk of impacts to this species under the Plan is high
- The species is relatively restricted in NSW, with the majority of known populations of the species occurring in the Cumberland subregion
- The species is not well represented in existing protected lands (only approximately 9.1 per cent of total potential habitat in the Strategic Assessment Area occurs in existing protected lands)

It is important to note that the cumulative impact from other major projects is primarily due to the existing North West and South West Growth Areas, and the impacts associated with these areas are likely to be greatly overestimated (see Section 38.2). This reduces the significance of the total cumulative impacts.

Adequacy of the cumulative offsets

The major projects (Sydney Metro – Western Sydney Airport only) provide offsets of 1.8 ha for *Pimelea spicata.*

The Plan includes a species-specific commitment to secure 3 offset locations for *Pimelea spicata* to address the residual impacts of the development. In addition to this commitment, the Plan includes a commitment to protect 2,885.2 hectares of NSW TECs/PCTs that are associated with potential habitat for the species.

It is considered that the Plan adequately contributes to addressing cumulative impacts to this species. In particular, the Plan will:

- Secure 3 offset locations for *Pimelea spicata*
- Increase existing levels of protection of habitat for the species in the Strategic Assessment Area from 9 per cent to 17 per cent

Pultenaea parviflora

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for *Pultenaea parviflora* is low compared to the other major projects (5 per cent of the total impact).

Despite this, the risk of impacts to this species under the Plan is high. The Plan will result in direct impacts to several important populations. There will be direct impacts on 221 ha of potential habitat for the species, which is 1.1 per cent of potential habitat across the Strategic Assessment Area. Habitat loss is generally to small patches exposed to edge effects, however, in Wianamatta Regional Park habitat loss will result in some fragmentation.

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on *Pultenaea parviflora* is considered to be moderate because:

- The total cumulative impact is moderate (19.7 per cent of total potential habitat in the Strategic Assessment Area)
- The species is restricted to the Cumberland subregion
- The Strategic Assessment Area is the core location for the species. Records occur in the northern half of the Strategic Assessment Area, with the majority of records occurring in the locality of Londonderry/Marsden Park
- The species is not well represented in existing protected lands (only 10.9 per cent of total potential habitat in the Strategic Assessment Area occurs in existing protected lands)

It is important to note that the cumulative impact from other major projects is primarily due to the existing North West and South West Growth Areas, and the impacts associated with these areas are likely to be greatly overestimated (see Section 38.2). This reduces the significance of the total cumulative impacts.

Adequacy of the cumulative offsets

The major projects provide total offsets of 162 hectares of potential habitat for *Pultenaea parviflora*.

The Plan includes a species-specific commitment to secure 2 offset locations for *Pultenaea parviflora* to address the residual impacts of the development. In addition to this commitment, the Plan includes a commitment to protect 400 hectares of NSW TECs/PCTs that are associated with potential habitat for the species.

It is considered that the Plan adequately contributes to addressing cumulative impacts to this species. In particular, the Plan will:

- Secure 2 offset locations for *Pultenaea parviflora*
- Increase existing levels of protection of habitat for the species in the Strategic Assessment Area from 11 per cent to 13 per cent

Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*)

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for Regent Honeyeater and Swift Parrot is high compared to the other major projects (about 27 per cent of the total impact for both species).

The risk of impacts to these species under the Plan is low for Regent Honeyeater and medium for Swift Parrot. The Plan will result in the removal of 1,270.5 ha of potential foraging habitat for both these species, which amounts to 2.1 per cent of potential habitat across the Strategic Assessment Area.

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on Regent Honeyeater and Swift Parrot is considered to be low because:

- Total cumulative impact is relatively low (7.9 per cent and 8.1 per cent of total potential habitat in the Strategic Assessment Area respectively)
- The species are not restricted to the Cumberland subregion (both species have a broad range during their non-breeding seasons) and the Strategic Assessment Area is outside identified breeding locations for both species

It is important to note that the cumulative impact from other major projects is primarily due to the existing North West and South West Growth Areas, and the impacts associated with these areas are likely to be greatly overestimated (see Section 38.2). This reduces the significance of the total cumulative impacts.

Adequacy of the cumulative offsets

The major projects provide total offsets of 188.2 hectares of potential habitat for Regent Honeyeater and 490.4 hectares of potential habitat for Swift Parrot.

The Plan includes a species-specific commitment to secure 4,410 ha of potential foraging habitat for Swift Parrot to address the residual impacts of the development. In addition, the Plan includes a commitment to protect 5,315.2 ha of NSW TECs/PCTs that are associated with potential habitat for both species.

The Plan also includes a commitment to incorporate a requirement in Development Control Plans to retain large trees (>50cm DBH) in urban areas, which are likely to provide high sources of nectar and therefore comprise primary foraging habitat for both these species.

It is considered that the Plan adequately contributes to addressing cumulative impacts to this species. In particular, the Plan will increase existing levels of protection of habitat for the species in the Strategic Assessment Area from 11 per cent to at least 20 per cent.

Dural Land Snail (*Pommerhelix duralensis*)

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for Dural Land Snail is small compared to the other major projects (1 per cent of the total impact).

Furthermore, the risk of impacts to this species under the Plan is very low. The Plan will not result in any direct impacts to records or important populations. There is a direct impact to 45.7 ha of potential habitat for this species, which amounts to 0.2 per cent of the potential habitat within the Strategic Assessment Area. It is noted that there are no known records of the species in the vicinity of impacted habitat.

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on Dural Land Snail is considered to be low because, while the total cumulative impact is moderate (15.0 per cent of total potential habitat in the Strategic Assessment Area), records occur predominantly along the north-east fringes of the Cumberland subregion and generally outside areas that are cumulatively impacted, and the Strategic Assessment Area is not recognised as a key location for the species.

It is important to note that the cumulative impact from other major projects is primarily due to the existing North West and South West Growth Areas, and the impacts associated with these areas are likely to be greatly overestimated (see Section 38.2). This reduces the significance of the total cumulative impacts.

Adequacy of the cumulative offsets

Offsets for Dural Land Snail are only provided under the Plan (no offsets are provided through major projects).

Due to the risk of impacts being very low, the Plan does not include a species-specific commitment to offset known habitat or populations of Dural Land Snail. However, the Plan includes a commitment to protect 4,740.2 hectares of NSW TECs/PCTs that are associated with potential habitat for the species.

Given the very low risk of impacts to the species under the Plan, it is considered that the Plan adequately contributes to addressing cumulative impacts to this species.

Grey-headed Flying-fox (*Pteropus poliocephalus*)

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on potential habitat for Grey-headed Flying Fox is moderate compared to the other major projects (20.2 per cent of the total impact).

Despite this, the risk of impacts to this species under the Plan is low. The Plan will not result in any direct impacts to Grey-headed Flying-fox camps. There are direct impacts to 751 ha of potential foraging habitat, which amounts to 2.8 per cent of the potential habitat within the Strategic Assessment Area. The significance of this loss is considered to be low, because:

- Development will proceed in stages over the life of the Plan. Impacts will be at a rate of approximately 20 ha of habitat clearing per year. The annual loss of habitat will not be large

- There are large areas of habitat that support the highest nectar rank vegetation communities within 20 km of the nationally important and high priority camps (including large areas outside the Strategic Assessment Area)

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on Grey-headed Flying Fox is considered to be moderate because:

- Total cumulative impact is moderate (13.9 per cent of total potential habitat in the Strategic Assessment Area)
- The Strategic Assessment Area supports a large number of Grey-headed Flying-fox camps (12 camps in total), including two nationally important camps in Bingara Reserve in Macquarie Fields and in Windsor to the north of GPEC
- In addition, 16 camps occur within 20 km of the Strategic Assessment Area, including two nationally important camps

The nationally important camp and high priority camp in the Strategic Assessment Area have significant mapped foraging resources (highest nectar rank) within 20 km. Much of this occurs outside the Strategic Assessment Area and is unlikely to be cumulatively impacted by the Plan or major projects as it largely comprises defence or protected lands.

Adequacy of the cumulative offsets

The major projects provide total offsets of 841 hectares of potential habitat for Grey-headed Flying Fox.

A species-specific commitment has been made under the Plan for Grey-heading Flying Fox to address potential impacts to foraging habitat from the development. The commitment is to incorporate a requirement in Development Control Plans to retain large trees (>50cm DBH) in urban areas, which are likely to provide high sources of nectar and therefore comprise primary foraging habitat for this species. In addition to this commitment, the Plan includes a commitment to protect 5,325.2 hectares of NSW TECs/PCTs that are associated with potential foraging habitat for these species.

Given the low risk of impacts to this species under the Plan, it is considered that the Plan adequately contributes to addressing cumulative impacts to this species. In particular, the Plan, together with the major projects, will increase existing levels of protection of habitat for the species in the Strategic Assessment Area from 13 per cent to 33 per cent.

Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest

Nature and extent of impacts under the Plan

The Plan's contribution to cumulative impacts on Cumberland Plain Woodland is moderate compared to the other major projects (21.0 per cent of the total impact).

However, the Plan is not considered to have notable impacts on this TEC. The Plan will directly impact 180.3 hectares of the TEC, which amounts to 1.8 per cent of the remaining TEC in the Strategic Assessment Area. A total of 84.1 per cent of the impacted TEC is in thinned condition. Most of the impacted TEC is of lower viability, and only 12.9 ha of higher viability TEC will be impacted (0.3 per cent of higher viability TEC in the Strategic Assessment Area).

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on Cumberland Plain Woodland is considered to be low because:

- The total cumulative impact is relatively low (8.6 per cent of total potential habitat in the Strategic Assessment Area)
- The TEC is relatively well represented in existing protected lands (21.1 per cent of total TEC in the Strategic Assessment Area occurs in existing protected lands). Note that this figure will significantly increase once the proposed offset in Orchard Hills for Stage 1 of the Western Sydney Airport is secured

Adequacy of the cumulative offsets

The major projects provide total offsets of 3,266.7 hectares of Cumberland Plain Woodland. Under the existing North West and South West Growth Areas program offsets of 2,605.0 hectares will be provided. It is important to note that the commitments under the program are for:

- At least 2,400 hectares of Commonwealth-listed Cumberland Plain Woodland or other 'grassy woodland' communities, with preference given to Cumberland Plain Woodland, followed by White Box–Yellow Box–Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- At least 205 hectares of high-quality Commonwealth-listed Cumberland Plain Woodland

A TEC-specific commitment has been made under the Plan to address residual impacts on Cumberland Plain Woodland. The commitment is to secure 665 hectares of the TEC in conservation lands.

It is considered that the Plan adequately contributes to addressing cumulative impacts to this species. In particular, the Plan, together with the major projects (noting the qualification above), will increase existing levels of protection for the TEC in the Strategic Assessment Area from 21 per cent to 60 per cent.

River-flat eucalypt forest on coastal floodplains

Nature and extent of impacts under the Plan

The Plans contribution to cumulative impacts on River-flat eucalypt forest is high compared to the other major projects (36.3 per cent of the total impact).

The Plan is not considered to have notable impacts on this TEC. The Plan will directly impact 159.2 hectares of the TEC, which amounts to 2.4 per cent of the total TEC within the Strategic Assessment Area. Of the impacted TEC, 59.9 per cent is in thinned condition, and 21.3 per cent is in scattered condition. The majority of the impacted TEC is of lower viability, with only 11.5 per cent of high viability TEC directly impacted by the Plan (1.4 per cent of all higher viability TEC within the Strategic Assessment Area).

Significance of cumulative impacts

The significance of the cumulative impacts across the Plan and major projects on River-flat eucalypt forest is considered to be low because:

- The total cumulative impact is relatively low (6.6 per cent of total occurrence within the Strategic Assessment Area)
- The TEC is relatively well represented in existing protected lands (10 per cent of total TEC in the Strategic Assessment Area occurs in existing protected lands).

Adequacy of the cumulative offsets

The major projects provide total offsets of 301.8 hectares for River-flat Eucalypt Forest.

A TEC-specific commitment has been made under the Plan to address residual impacts on River-flat Eucalypt Forest. The commitment is to secure 570 hectares of the TEC in conservation lands.

It is considered that the Plan adequately contributes to addressing cumulative impacts to this species. In particular, the Plan, together with the major projects, will increase existing levels of protection for the TEC in the Strategic Assessment Area from 10 per cent to 23 per cent.

38.3.3 CONCLUSION IN RELATION TO THREATENED SPECIES AND TECS

While cumulative impacts to some species are considered to be moderate, the commitments under the Plan, together with the offsets through the major projects, are considered to adequately address these cumulative impacts. It is also considered that the Plan makes an adequate and substantial contribution to addressing these impacts.

38.4 QUALITATIVE ASSESSMENT OF OTHER DEVELOPMENTS

38.4.1 OVERVIEW OF CUMULATIVE IMPACT RISKS

In addition to current known major projects, there is a risk of cumulative impacts from:

- Smaller projects (with footprints under 100 ha), such as smaller-scale infrastructure, residential or commercial developments
- Projects which are not considered as major projects in Section 38.2.1 due to small direct impacts, yet which have potential to result in indirect impacts over substantial areas (such as longwall coal mining)
- Major projects which have not yet been planned or announced

While projects which fit into the above categories have not been identified as major projects, it is nonetheless recognised that the combined footprint and impacts of these projects have the potential to be substantial, particularly given the high development pressures in Sydney. These projects have potential to result in the following cumulative impacts to threatened species and TECs within the Strategic Assessment Area:

- Direct impacts to and/or fragmentation of populations and/or habitat
- Increased threat pressures from indirect impacts

Furthermore, high development pressures in Sydney will increase the demand for offset sites for threatened matters in the region. However, the Strategic Assessment Area has historically been heavily cleared, and there are limited areas remaining areas of biodiversity. For species and TECs which are endemic to the Strategic Assessment Area, there will be a finite availability of offsets which will eventually constrain permissible development of protected matters.

How the Plan has addressed the risks associated with direct impacts, fragmentation, indirect impacts and offset availability is discussed below.

38.4.2 CUMULATIVE DIRECT IMPACTS AND FRAGMENTATION

Most high value biodiversity areas within the Strategic Assessment Area are currently vulnerable to future development. The vast majority (greater than 75 per cent) of the remaining native vegetation within the Cumberland Plain is privately owned. At 2011, approximately 8 per cent of native vegetation in the Cumberland Plain was protected in existing formal reserves (DECCW, 2011).

The Plan minimises the risk of future cumulative direct impacts and fragmentation by increasing protection of remaining biodiversity areas. Increased protection will be delivered in multiple ways, as follows:

- Protection of a minimum of 5,325 hectares of native vegetation in the Strategic Assessment Area to conserve biodiversity values in perpetuity (Commitment 8) in new conservation lands
- The establishment of several new conservation reserves for Koala (Commitments 10 and 11)
- Increased protection of avoided lands and the Strategic Conservation Area under the State Environmental Planning Policy (SEPP) (Strategic Conservation Planning) and other measures (see Part 2)

The location of conservation lands and reserves, avoided lands and the SCA have been developed to include areas of the most viable and best connected remnant vegetation within the Strategic Assessment Area. This increased protection will improve outcomes for multiple MNES within the Strategic Assessment Area over the long term.

38.4.3 CUMULATIVE INDIRECT IMPACTS

The Strategic Assessment Area is already subject to existing indirect impacts from existing development. Many of these threatening processes operate at a landscape scale, and current management programs for these threats are often spatially limited and/or under resourced, meaning the threats are generally not being adequately managed. Even without delivery of the Plan, these threatening processes are predicted to intensify in the future due to the high development pressures in the region.

The Plan includes a range of measures to minimise and manage indirect impacts. These measures not only minimise the risk of indirect impacts occurring under the Plan, but they also contribute to minimising and managing the existing landscape threats which already occur within the Strategic Assessment Area. These measures include:

- Commitment 15 to manage priority weeds in the Cumberland subregion
- Commitment 16 to manage priority pest animals in the Cumberland subregion
- Commitment 17 to manage fire in the Cumberland subregion
- Commitment 18 to support new or existing programs to control key diseases
- Commitment 19 to support new or existing programs to help threatened species and TECs adapt to climate change
- Commitment 20 to provide opportunities to the residents of Western Sydney to participate in conservation

38.4.4 OFFSET AVAILABILITY

The large scale of the Strategic Assessment Area means that protected matters which have limited distributions and may have limited offset availability have been considered in full, rather than through a partial assessment over a small proportion of the species' range.

The distribution of the SCA, which will be protected under the planning package of the Plan, has been developed with specific regard for offset availability for potentially limited matters. Subsequently, there are adequate offsets within the SCA to meet offset requirements of the Plan (refer to Chapter 41, Section 41.5 for further analysis).

Furthermore, for some matters, the amount of habitat protected within the SCA exceeds the offset requirements for these matters under the Plan. Through including these areas in the SCA, the Plan minimises impacts to these areas due to future development and helps to ensure offset availability within the region for other developments.

38.4.5 EVALUATION

Overall, the Plan is considered to minimise the risk of adverse cumulative impacts to biodiversity values, as:

- The Plan will increase the protection of remaining areas with biodiversity values within the Strategic Assessment Area, thereby decreasing the risk of future development in these areas
- The Plan includes a range of measures which will address and minimise existing landscape-scale threatening processes which are exacerbated by development
- By increasing protection from development over areas of biodiversity value in the SCA, the Plan assists in ensuring availability of offsets for other developments into the future

38.5 CUMULATIVE IMPACTS ON OTHER MNES

Table 38-7 summarises the impacts of the Plan on other MNES and the potential for cumulative impacts resulting from additional urban or other development in the surrounding area.

Detailed assessments of the impacts of the Plan on each of these MNES are set out in Chapters 32, 33, and 34.

Table 38-7: Potential cumulative impacts from the Plan and major projects on other MNES

Other MNES	Summary of impact of Plan and potential for cumulative impacts from additional development in the Cumberland subregion
Migratory species	**Migratory birds** Cumulative impacts are unlikely as potential impacts on migratory species from Plan are considered to be negligible. Nine species listed in the migratory bird referral guidelines (DoE, 2015) have been observed within the Strategic Assessment Area. Potential impacts to the nine species from the Plan are considered to be negligible. No important habitat will be lost, and the risk of indirect impacts is negligible. Only one of the species (White-throated Needletail) has been observed in ecologically significant numbers in the Cumberland subregion. This species is almost exclusively aerial and found over a wide range of habitats including extensively modified and urban areas, and therefore the development under the Plan is considered unlikely to disrupt this species' use of the Strategic Assessment Area. See Chapter 32 for a detailed assessment of the impacts of the Plan on migratory birds. **Migratory shorebirds** Cumulative impacts are unlikely as potential impacts on migratory species from Plan are considered to be negligible. Twenty-one species of migratory shorebirds have been recorded in the Cumberland subregion. Two of those have been recorded at a site level in important numbers – Sharp-tailed Sandpiper and Latham's Snipe. No important habitat will be lost, and the risk of indirect impacts such as degradation of habitat and disturbance of birds is considered to be low. See Chapter 32 for a detailed assessment of the impacts of the Plan on migratory shorebirds.
Ramsar	One Ramsar site is relevant to the Plan – Towra Point Nature Reserve. Towra Point Nature Reserve is located outside of the Strategic Assessment Area approximately 23 km from the nearest nominated area. A small part of the Strategic Assessment Area is located within the Georges River sub-catchment that flows directly into Botany Bay and the waters surrounding Towra Point Nature Reserve. This includes 170 ha of land for urban development within parts of GMAC and 9 ha of land within major transport corridors. Potential cumulative impacts on Towra Point Nature Reserve from further development in the Cumberland subregion relate to: • Increased number of visitors to Towra Point Nature Reserve due to increased populations in the surrounding area • Further development in the Georges River sub-catchment and associated potential impacts on water quality due to urban run-off Cumulative impacts from the Plan and other development in the surrounding area are unlikely to be notable. The Botany Bay catchment currently supports an existing population of approximately 2 million people, and therefore has already experienced considerable levels of development (OEH, 2012; SMCMA, 2011). It is likely that additional development will continue to occur within this catchment over the next 36 years. However, it is not possible to predict the locations, nature or timing of these potential future developments, and as such the exact cumulative impact upon the hydrological character of the catchment cannot be quantified at this time. Despite this, the contribution of development within the Strategic Assessment Area to overall cumulative impacts on Towra Point Nature Reserve is likely to be small. The Plan provides for up to 179 ha of development within the Botany Bay catchment. The total size of the catchment is 1,165 km^2 (OEH, 2012; SMCMA, 2011). The urban capable land and major transport corridors within the catchment therefore account for only 0.15 per cent of the total catchment area. It is unlikely that development across this small area of the catchment area will result in significant impacts to the wetland. Furthermore, development in the catchment area will not all occur at the same time, reducing the potential for a large increase in urban run-off carrying large quantities of sediment or pollutants into the catchment in any one event. Development under the Plan will occur over 36 years in stages, and other development in the catchment will also occur over many years. Most

Other MNES	Summary of impact of Plan and potential for cumulative impacts from additional development in the Cumberland subregion
	developments are subject to similar mitigation and management requirements under the EP&A Act that manage construction impacts, hydrological changes and water quality impacts. The characteristics of Towra Point Nature Reserve also contribute to the resilience of the wetland and decrease its susceptibility to cumulative impacts. In particular, as the wetland is a tide-dominated estuary environment, the site is subject to regular flushing which significantly reduces the likelihood of build-up of pollutants at the site. Further, Towra Point Nature Reserve has a high level of adaptive site management consistent with best practice, which further protects the site from potential future impacts from wider landscape changes. Pressures from increased visitor numbers to the Towra Point Nature Reserve are already occurring due to existing high population densities in proximity to the wetland. As a result, Towra Point Nature Reserve already implements a wide range of ongoing and comprehensive management measures to protect the reserve from disturbances associated with human visitation and recreational use. Therefore, the potential risk to the ecological character of Towra Point Nature Reserve as a result of an increased number of visitors is considered minimal. See Chapter 33 for a detailed assessment of the impacts of the Plan on Towra Point Nature Reserve.
World and National Heritage	There are three World and/or National Heritage listed sites in or near the Strategic Assessment Area that could potentially be impacted by development under the Plan. The Greater Blue Mountains World Heritage Area (GBMWHA) is located close to the nominated areas. The other heritage sites are further from the urban capable land and major transport corridors and are unlikely to be impacted. Potential cumulative impacts on GBMWHA from further development in the surrounding area relate to increased number of visitors to GBMWHA due to increased populations in the surrounding area. The potential impacts from increased visitors are: • Disturbance from people, vehicles and horses • Increased frequency of fires • Removal of bushrock and fallen timber • Introduced plants • Development or increased maintenance of visitor or management facilities or infrastructure The population of Sydney is already growing, and the overarching Strategic Plan and the plans of management for each individual reserve within the GBMWHA recognise the pressure from increasing visitors as a major management challenge. The management plans set out a range of management actions and monitoring programs that will support adaptive management of the threats related to increased visitors to GBMWHA over the life of the Plan (see Chapter 34). The protection arrangements for each of the reserves are considered adequate to manage potential cumulative impacts due to increased populations from further development in the surrounding area. See Chapter 34 for a detailed assessment of the impacts of the Plan on World and National Heritage sites.

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CUMBERLAND PLAIN ASSESSMENT REPORT

PART 6B: ATTACHMENT

ATTACHMENT A - ECOLOGICAL CHARACTER OF TOWRA POINT

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	N/A
CONTENT:	Kim Spragg, John Horan, Heather Tolley, Peter Hemphill (Open Lines)
REVIEWED BY:	
OPEN LINES:	Peter Hemphill, Heather Tolley (Open Lines)
ACCREDITED ASSESSOR:	N/A
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VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 6B Attachment Contents

A. Ecological character of Towra Point

This section draws heavily on the ecological character description (ECD) for Towra Point (DECCW & SMCMA, 2010) and attempts to summarise the key points to facilitate impact assessment. As outlined in the ECD, wetlands are dynamic, changing, and interactive systems. Some components and interactions that contribute to the ecological character of Towra Point exist outside of the Ramsar site boundaries in the adjacent Towra Point Aquatic Reserve. Certain components of the Aquatic Reserve are therefore included in the following description although they may not occur within the Site boundary.

COMPONENTS AND PROCESSES

The components and processes that contribute to the ecological character of Towra Point are:

- Geomorphology
- Hydrology
- Physiochemical environment
- Biota
- Climate

GEOMORPHOLOGY

Towra Point was formed as a result of dynamic wind, wave, and tidal processes over time. The key drivers of geomorphology at Towra Point are:

- Geology and morphology
- Topography and microtopography
- Sedimentation

GEOLOGY AND MORPHOLOGY

The basis of Towra Point was formed from the dynamic movement of marine sand from Botany Bay and fluvial mud from the Georges River. Freshwater swamps formed in the lower lying areas as sea levels rose. River born sediments were deposited in areas with lower rates of water movement, such as Quibray and Woolooware bays. This provided the nutrient rich sediments necessary to support mangrove and salt marsh communities. Progressive erosion of Towra Beach followed by the accretion on the western side of Towra Point formed a sand spit.

Since its listing in 1984, there have been a range of anthropogenic and natural processes that continue to alter Towra Point's geomorphology. Towra Spit Island was formed in 1991 due to erosion by wind and waves. Accretion of sediment reconnected the island to the mainland in 1997, allowing land based predators access to important bird roosting and nesting habitat. The sediment connecting Towra Spit Island to the mainland was dredged in 2004 and needs to continuously be managed to maintain the ecological value of the Island.

TOPOGRAPHY AND MICROTOPOGRAPHY

Towra Point is generally a low-lying area. The elevation varies a little, providing environmental conditions that have led to the type and distribution of flora and fauna in the wetland depending on their tolerance to salt water. There are sand dunes located in the northern centre part of Towra Point. They surround terrestrial vegetation and reach a height of up to 5 m. Low lying areas and mudflats provide favourable environmental conditions for mangroves. Natural processes intensified by anthropogenic changes continue to change the topography, such as the erosion at Towra Beach.

SEDIMENTATION

The sediments in Botany Bay are made up of different sized marine sand, mud, and products of living organisms and biological processes. The erosion and accretion of sediments is caused by the natural processes of wind, waves, and currents. This movement depends on the size and type of sediment, the depth and velocity of water and vegetation cover. Most of the sediment from the Georges River is released into the ocean with a small amount entering the low energy systems of Woolooware and Weeney bays. A significant proportion of the sediment from Quibray bay has been moved around Towra Point to the Elephants Trunk.

Before Botany Bay underwent anthropogenic changes, sand transport in the bay occurred in a south-easterly direction. It now occurs in a westerly direction, causing increased erosion at Towra Beach.

The sedimentation processes of erosion and accretion facilitate the movement and colonisation of vegetation. It also creates mudflats that provide favourable habitat for migratory birds and mangroves.

LIMITS OF ACCEPTABLE CHANGE (LAC)

Maintaining the natural cycle of erosion and accretion has been identified as an aim for the limits of acceptable change for geomorphology. It focuses on maintaining the separation of Towra Spit Island from the mainland. The LAC for geomorphology is the same as those set for the little tern because the spit is an important breeding and roosting habitat for migratory birds including the little tern. The LAC is the 'successful annual breeding in one out of every two years' of the little tern.

HYDROLOGY

Towra Point Ramsar site and its surrounds are a dynamic system that rely on hydrological processes. The key components of hydrology at Towra Point are:

- Tides
- Wave action
- Groundwater

TIDES

Botany Bay is a tide dominated estuary that experiences semi-daily tides. Two high and low tides of equal size occur per lunar day, making it a well flushed system. Tidal movement is key to maintaining good water quality in the system.

The tidal currents are fairly slow and cannot solely cause sediment movement without the assistance of wave energy to suspend the sediments first.

The dynamic nature of hydrology means the tides have a direct influence on the following:

- Geomorphology: with the help of wave energy, tides facilitate sediment movement through the system by means of erosion and accretion
- Groundwater: tidal flooding determines groundwater properties such as salinity
- Physiochemical environment: the bay's physiochemical environment consists mostly of saltwater, with some freshwater on the surface from the river discharge and rainfall. Tides regulate the saltwater to freshwater ratio and consequently, the salinity levels. Tidal movement also ensures that excess nutrients, pollutants, and suspended sediment entering the system via the Georges river is flushed out and does not accumulate in the system
- Biota: tides facilitate the movement of phytoplankton and crab larvae. These are important food sources for zooplankton, invertebrates, fish, and birds. High tides help restock these food sources, while low tides expose mudflats that are important foraging habitat for birds at Towra Point. Tides also assist in seed disbursal

Anthropogenic changes prior to the listing of Towra Point under the Ramsar Convention have caused changes to tidal actions. These changes are included in the Site's baseline condition described in the ECD as they occurred prior to listing. These changes include a causeway that was built through the middle of Towra Point in 1952 that prevents undisturbed tidal flow through the wetland.

Further anthropogenic changes to parts of Botany Bay after the site's listing, such as dredging at the bay's entrance, have again impacted tidal speeds and water quality.

WAVE ACTION

Wave action is a product of the transfer of wind energy to surface water. Waves in Botany Bay are largely influenced by storms that originate from the south-east and enter the bay from the same direction. Wave direction entering into Botany Bay has shifted from impacting the north-west shore to impacting more to the southern shore. This is a result of the construction of Sydney Airport and Sydney Port on the northern shoreline and dredging that also occurred in that area of the bay in the 1960s. The change in direction and intensity of waves entering the bay have caused higher rates of

erosion to occur in areas such as Towra Point Beach. These changes have also meant that storms have a greater impact, demonstrated by the intrusion of salt water into Towra Lagoon following severe storms in 1974.

Mudflats are created through the accretion of sediment in low energy areas. Increased wave energy entering the system has the potential to erode mudflats causing the resuspension of these sediments, and result in reduced light availability for seagrass.

GROUNDWATER

The groundwater table is fed by surface water filtering through the soil. Factors that influence water table levels are tides, rainfall, surface layer evaporation, transpiration from plants, and groundwater extraction. Groundwater is critical in providing plants with freshwater and nutrients, particularly during periods of low rainfall.

Towra Point is situated on the Botany Bay Sand Aquifer that extends from Centennial Park in the north, to Botany Bay and Kurnell Peninsula in the south, and west to Rockdale. It is a shallow aquifer, approximately two meters deep. Long term changes in ground water levels can impact the topography above the aquifer, reducing surface elevation. This would alter the extent of tidal inundation and therefore the extent and distribution of the flora and fauna that are supported at Towra Point.

The northern section of the aquifer is most frequently used for residential and industrial water extraction. Botany Bay Industrial Park is located in this section and drains into the aquifer. This has resulted in the contamination of groundwater by volatile chlorinated hydrocarbons in particular. The groundwater in the aquifer flows in a north-westerly direction. Towra Point is therefore unlikely to be directly affected by contamination in the northern zone but rather from the southern zone. The southern part of the aquifer covers a relatively small area, which includes Towra Point. The importance of Towra Point in the process of groundwater recharge and filtering of contaminants for the Botany Bay Sand Aquifer will grow as more of the surrounding area becomes developed with impermeable surfaces that prevent recharge. Other areas that have the potential to contaminate the aquifer are the Caltex oil refinery located east of Towra Point, Kurnell Landfill Company on Captain Cook Drive, and contaminated runoff from roads and industries in the sub-catchment.

Sandmining next to Towra Point at Kurnell Peninsula continued until 2005. This activity exposed the water table, which increased evaporation and the risk of contamination. It has since been filled with demolition waste.

LIMITS OF ACCEPTABLE CHANGE (LAC)

Limits of acceptable change for groundwater are determined by the relevant water quality guidelines (ANZECC & ARMCANZ, 2000).

PHYSIOCHEMICAL ENVIRONMENT

At Towra Point the physiochemical environment determines water quality, which is vital for sustaining the diverse range of flora and fauna. There are some components that have a big impact on water quality such as chlorophyll-a, pH and dissolved oxygen and are critical to the upper parts of the Botany Bay catchment. However, these components are not considered critical for Towra Point due to the well-flushed nature of Botany Bay.

The key components of the physiochemical environment at Towra Point are:

- Salinity
- Nutrients
- Heavy metals
- Turbidity

SALINITY

The average ocean salinity is 35 parts per million (ppm). The salinity range in the water surrounding Towra Point is 20-35 ppm with an average of 33 ppm. Salinity reduces the risk of algal blooms. Botany Bay is less at risk of algal blooms than the upper parts of the catchment because it is well-flushed and has a high salinity level. The tidal flushing of Botany Bay means that freshwater from the Georges River only has an effect on Towra Point after long periods of rain or after heavy rainfall events in the catchments.

There are three named freshwater ponds at Towra Point. These include Towra Lagoon, Weedy Pond, and Mirrormere Pond. The salinity level of freshwater should be close to zero parts per million. In 1992 Towra Lagoon's salinity was 2 and 9.5 ppm in 2007 as a result of ongoing saltwater intrusion since a large storm event in 1974. This is well above the level of tolerance of many freshwater species. Attempts to restore the lagoon to a freshwater system continue to be made through a number of different means such as sandbagging and sand replenishment at Towra Beach.

The flora at Towra Point have varying levels of salt tolerance. There are distinct vegetation zones that can partially be attributed to soil salinity levels amongst other factors. The salt marsh vegetation zone is due to limiting factors such as light availability, rather than soil salinity levels. The distribution of mangroves has increased landward at Towra Point, indicating that salinity levels have changed since it became Ramsar listed.

NUTRIENTS

Nutrients that are important to ecosystems are nitrogen, phosphorus, carbon, silica, and iron. Nutrients of particular importance to Towra Point are inorganic and organic forms of nitrogen and phosphorus. Forms of phosphorus that are readily available for plant uptake are inorganic orthophosphate and organic compounds containing phosphorus that are water soluble. Other forms of phosphorus are ionic phosphorus that are absorbed by sediment to settle onto seabeds for uptake by seagrass and other primary producers.

Towra Point wetland system has a high nutrient demand and plays an important role in the cycling of nutrients. The source of the majority of nutrients in Botany Bay is the Georges River, where it enters as runoff from the catchment. This includes agricultural runoff, stormwater and sewer overflows, runoff from urban and industrial areas, groundwater discharge, and decomposition of organic matter. Three sewage treatment plants exist in the catchment at Liverpool, Fairfield, and Glenfield. They treat waste water entering the Georges River during wet weather and are susceptible to occasional overflows for different reasons. In the instance of an overflow, high nutrient waste is discharged directly into the waterway and transferred into Botany Bay. Periods of high nutrient concentrations generally occur after recent rainfall.

Excess nutrients combined with a low energy system can result in algal blooms and eutrophication. This is unlikely to occur in Botany Bay due to the high energy nature of the system. However, Woolooware and Weeney bays that are adjacent to Towra Point are at a higher risk of eutrophication as they experience a lower rate of tidal flushing. Terrestrial weed growth increases with increased nutrient levels.

Insufficient data is available on the trend of total nutrient levels in Botany Bay. However, total nitrogen and phosphorus has decreased in Woolooware bay by 50-60% in Woolooware bay from 1984 to 2007.

HEAVY METALS

Wetlands play a critical role in absorbing and filtering heavy metals out of water. Some organisms need small amounts of heavy metals such as copper, iron, and zinc. Greater than trace amounts of these heavy metals can be toxic. Copper, lead and zinc are generally found close to residential and industrial areas. Heavy metals accumulate in organisms and are passed up the food chain. The cultivation of oysters at Woolooware and Quibray bays can be used as an indicator of the low concentration of heavy metals around Towra Point.

Changes in concentrations of heavy metals recorded in Woolooware Bay in 1977 and circa 2007 are displayed in Woolooware Bay is adjacent to Towra Point and along with Weeney Bay experiences less tidal flushing than other areas in Botany Bay. Concentrations of heavy metals recorded in 1977 in Woolooware Bay exceeded the current LAC.

TURBIDITY

Salinity reduces the presence of suspended particles in water, known as turbidity. The sodium and chloride ions bind suspended particles and metal ions causing them to settle. This increases water clarity and as a result water quality.

Seagrass beds in the Ramsar site occur at Weeney Bay. The majority of the seagrass occurs outside the Ramsar site in the Aquatic Reserve. It occurs below the low tide mark to a depth of 3 m in Woolooware Bay, around Towra Spit, off the shoreline from Towra Beach, and in Quibray Bay. Seagrass is a primary producer and has a high light requirement. It relies on high water quality to allow sunlight to filter through in order to photosynthesise. It also has a high nutrient requirement which it utilises from groundwater discharge areas. Too much turbidity and nutrients will cause the seagrass to dieback. The presence of seagrass at Towra Point therefore provides a good indicator of water quality.

Spikes in nutrient levels and turbidity occur following storm events that increase surface runoff from the catchment and wave action in the bay. These levels have been known to exceed the levels set by the water quality guidelines (ANZECC & ARMCANZ, 2000, 2018). They are monitored when they exceed these levels and usually return to normal levels within a number of days.

LIMITS OF ACCEPTABLE CHANGE (LAC)

Water quality guidelines for marine water have been used to determine limits of acceptable change for the physiochemical environment (ANZECC & ARMCANZ, 2000, 2018).

BIOTA

The biota at Towra Point is one of the components and processes that makes the wetland internationally significant. The key components of biota at Towra Point are:

- Flora
- Fauna

FLORA

Towra Point supports a number of regionally significant flora that occur as distinct vegetation zones across the wetland. The critical components of flora at Towra Point are:

- Seagrass
- Mangroves
- Saltmarsh

There are substantial areas of terrestrial vegetation at Towra Point that also play an important role in the wetland system.

Seagrass

Seagrass mostly occurs in the Towra Point Aquatic Reserve, next to Towra Point Ramsar site. Although seagrass exists mainly outside of the official boundary, it contributes to the ecological character of the Site. There are three seagrass species present in and around Towra Point. They are *Posidonia australis*, *Zostera capricorni*, and *Halophila ovalis*. At the time of listing in 1984, seagrass covered an area of approximately 516 ha along the southern shore of Botany bay.

Seagrass provides protection for fish at a critical stage in their life cycle, as well as crustaceans. It is also important in maintaining biodiversity at Towra Point and a critical link in the food chain. The organic matter produced by seagrass is an important food source for invertebrates and bacteria, and subsequently fish and birds. The loss of seagrass would mean the wetland is unable to continue to support the diversity and abundance of fauna present at Towra Point.

Light availability is important to the presence of seagrass. In Botany Bay, seagrass can be found in areas up to three meters deep. Water turbidity is a limiting factor for the distribution of seagrass in the bay. Turbidity determines light availability and is in turn regulated by rainfall and pollution levels.

Seagrass also have a high nutrient requirement. They acquire these nutrients from groundwater discharge and nutrients that have settled on the seabed. Seagrass is important in the cycling of nutrients and stabilising of sediment, which encourages accretion. This helps stabilise the geomorphology of the bay against waves and storms.

Anthropogenic changes to Botany Bay such as the construction of Sydney Airport's third runway have led to the decline of seagrass in the bay. The area of seagrass along the southern shore of Botany Bay was recorded as 458 ha in 2008.

Mangroves

Towra Point supports approximately 40% of the remaining mangroves in the Sydney region. They are also considered the largest and healthiest in the region. This is equivalent to 6% of the extent in NSW. There are two mangrove species present at Towra Point, *Avicennia marina* and *Aegiceras corniculatum*.

Mangroves trap and stabilise sediment as well as providing important nursery habitat for juvenile fish. Areas with seagrass, mangroves, and saltmarsh adjacent to one another (as is seen at Towra Point) support a larger diversity and abundance of species compared to other remnant patches of these flora types in the Sydney region.

Tidal inundation and salinity are determining factors for mangrove distribution. Mangrove distribution has increased since 1984 and is encroaching on the saltmarsh area at Towra Point.

Aerial photographs have been used to retrospectively calculate the area of mangroves at Towra Point at different points in time. In 1983 there was 395.2 ha of mangroves at Towra Point, which is around the time of the Site's listing. In 1999 470.5 ha was recorded using the same methodology. In 2008, 385 ha was recorded. However, this most recent number was generated using a different method and therefore cannot be reliably compared to the previous records.

Saltmarsh

Towra Point supports approximately 60% of saltmarsh areas in the Sydney region and 2% of the NSW extent. It is one of the largest remaining saltmarsh areas in NSW. Several saltmarsh species are found at Towra Point.

The key limiting factor for saltmarsh species is light. They prefer full light. The presence of mangroves and terrestrial trees limit their distribution seaward and landward respectively. The surface features at and around Towra Point combined with hydrological movement are critical for seed dispersal and distribution. Tides spread seeds to other suitable areas that are at an elevation to be influenced by tidal inundation.

Migratory shorebirds use the saltmarsh vegetation at Towra Point as roosting and foraging habitat. It is in close proximity to other foraging areas for these migratory species within Towra Point such as the mudflats. This means these areas are important for migratory birds to preserve energy on their migratory routes. Saltmarsh at Towra Point is also considered important habitat for other species that are regionally significant. For example, crab species that release larvae into the outgoing tides and certain fish species that are considered to be of commercial and economic significance that use these same tides to access this reliable food. The saltmarsh community provides habitat for crabs that release larvae in the outgoing tides that are a food source for birds and fish.

Aerial photographs have been used to retrospectively calculate the area of saltmarsh at Towra Point in 1983 and 1999. It was calculated at 141 ha and 88.1 ha respectively. A different methodology was used in 2008 which recorded saltmarsh over a 134 ha area. The main cause of loss of saltmarsh at Towra Point is mangrove encroachment. The spread of mangroves limits light availability for other plant species. This reduces the area of suitable habitat for saltmarsh.

Terrestrial vegetation

Over 150 species of terrestrial vascular plants are found at Towra Point. In 1983 the area covered by terrestrial vegetation was calculated at approximately 166 ha. This vegetation provides roosting and foraging habitat for fauna species such as the Masked Owl, Greater Broad-nosed Bat, Grey-headed Flying-fox, and a number of honeyeater species.

The magenta Lilly Pilly (*Syzygium paniculatum*) occurs at Towra Point and is one of the three threatened species listed under the EPBC Act for which the site was originally listed.

The plant community types found on the site are:

- Swamp oak forest
- Littoral strand
- Littoral rainforest
- Dune sclerophyll forest
- Bangalay forest with swamp oak (*Casuarina glauca*)

Surveys conducted around 2006 mapped 185 ha of terrestrial vegetation at Towra Point. The vegetation has been found to be in good to average condition with some areas dominated by weeds.

FAUNA

Towra Point is one of the last remaining wetlands of its type in the Sydney region and provides important habitat for a number of threatened and migratory species. The species present at the Site include:

- Macro-invertebrates
- Fish
- Reptiles and amphibians
- Mammals
- Birds

Macro-invertebrates

Macro-invertebrates are an important link in the food chain at Towra Point. Species such as molluscs, polychaetes, and crustaceans are a food source for fish and birds. These species also help to aerate the soil, improving the health of flora. Macro-invertebrates are associated with particular sediment types. They are therefore a good indicator of changes in sediment and disturbance.

Limited information is available about macro-invertebrates at Towra Point at the time of listing. This is still the case in the present day as no targeted studies have been conducted in the area. It has been identified as a knowledge gap.

Fish

Seagrass, saltmarsh and mangroves at Towra Point Ramsar site and the adjacent Aquatic Reserve are important in the provision of food and shelter for numerous fish species; most of which are in the juvenile stage of their life cycle.

75 species of fish were recorded in the seagrass surrounding Towra Point in 1981 and 46 species in the mangroves in 1984. Approximately 25 species of fish considered of economic and recreational importance use Towra Point.

Reptiles and amphibians

Studies at Towra Point in 1984 found 12 reptile and amphibian species. Amongst the amphibians recorded was the Green and Golden Bell Frog (*Litoria aurea)*. It is one of the three threatened species listed under the EPBC Act for which the site was originally listed. This population was identified as a key population in Sydney. The population at Towra Point has reduced as a result of loss of habitat from the intrusion of salt water into Towra Point Lagoon in 1974.

Mammals

A lack of historical data for mammals at Towra Point has been identified and robust surveys are still lacking. A Grey-headed Flying-fox *(Pteropus poliocephalus)* camp occurs on Kurnell Peninsula. The species has a foraging radius of 25 km and has been found in 14 different locations at Towra Point. It is one of the three threatened species listed under the EPBC Act for which the site was originally listed.

Birds

Towra Point supports at least 189 species of birds. This includes 34 migratory bird species listed under international agreements. In 1984 the Site supported at least 1% of the estimated international population of eastern curlew. The site no longer supports this proportion as an increase in the estimated population has occurred. Despite this, the number of visiting curlews recorded at Towra Point having increased.

Towra Point has been identified as part of one of the four most important migratory shorebird habitats in NSW. Migratory shorebirds use Towra Point as a critical stopover on migratory routes from Korea, Japan, China, Russia, Siberia and Alaska during September to April. Number of birds recorded at Towra Point fluctuate from year to year and depending on the season.

Towra Spit Island was formed in 1991 and has since been identified as the second most important little tern *(Sternula albifrons)* nesting site in NSW following the loss of nesting habitat at the location where Sydney Airport's third runway was built.

Loss of migratory shorebird habitat elsewhere in Botany Bay has placed increased pressure on Towra Point.

LIMITS OF ACCEPTABLE CHANGE (LAC)

Limits of acceptable change have been developed for biota where sufficient information is available.

These include hectare thresholds for:

- Seagrass
- Mangroves
- Saltmarsh
- Mixed mangrove and saltmarsh

The LACs for Magenta Lilly Pilly and the Grey-headed Flying-fox are no loss of the species.

The LAC for the green and golden bell frog is the species being recorded every year, or when surveys are undertaken.

The LACs for migratory shorebirds relate to net loss, percentage loss, or breeding success:

- In summer (December to February)
    - *Abundance*: no decline of more than 50% from the baseline condition for Botany Bay (1668 ± 472) in 5 consecutive years
    - *Diversity:* no net loss of species over 5 consecutive years
- In winter (June to August)
    - *Abundance:* no decline of more than 50% from the baseline condition for Botany Bay (604 ± 148) in 5 consecutive years
    - *Diversity:* no net loss of species over 5 consecutive years
- Eastern Curlew: no decline of more than 50% from the baseline condition for Botany Bay (133 ± 77) in 5 consecutive years
- Little tern (breeding numbers): successful annual breeding in one out of every two years

CLIMATE

Climate exists as an ecosystem regulator and plays an important role in maintaining equilibrium. The flora and fauna at Towra Point have adapted to the temperate climate of the region. Climate change and anthropogenic changes around Botany Bay are altering the intensity of climatic parameters. The key components that are regulated by climate are:

- Temperature
- Rainfall
- Storm events

TEMPERATURE

Temperature is a determining factor for species distribution at Towra Point. In 1977 the mean daily temperatures in winter varied from 6.2°C to 17°C and the mean daily temperature range in summer was 18.4°C to 26.2°C. Increases in temperature can increase the rate of evaporation, and as a result levels of soil salinity.

RAINFALL

Rainfall replenishes soil moisture content, offsets surface and soil salinity levels, and assists in the recharge of groundwater levels. It is the primary source of freshwater for Towra Point. In 1977 Towra Point received an average rainfall of 1,100 mm with the most rainfall usually occurring from March to June.

STORMS

Severe storm events have been key to the significant erosion at Towra Beach and the intrusion of salt water into Towra Point Lagoon, prior to 1984. Thunderstorms occurred once a month in winter and three times a month in summer around 1977. More intense storms with stronger winds and more rough, higher seas occur around five times a year. These are the storms that have the greatest detrimental impact on Towra Point as they cause increased rates of erosion.

These changes have the potential to place further stress on the system, forcing components and processes at Towra Point outside of their boundaries of natural variation.

LIMITS OF ACCEPTABLE CHANGE (LAC)

Parameters for climate cannot be managed at a local scale. It has therefore been identified that limits of acceptable change cannot be set for climate for Towra Point Nature Reserve Ramsar site.

SERVICES AND BENEFITS

Components and processes contribute to services and benefits. The services and benefits that are present at Towra Point Ramsar site and contribute to its ecological character as described in the ECD (DECCW & SMCMA, 2010) are:

- Provisioning services
- Regulating services
- Cultural services
- Supporting services

PROVISIONING SERVICES

Provisioning services of Towra Point Ramsar site include:

- Fisheries production: Towra Point and the adjacent Aquatic Reserve provide important habitat for the protection of juvenile fish, crustaceans, and molluscs and are of economic importance when they move to areas that are allowed to be commercially fished. This area also provides habitat for a small number of leases to cultivate Sydney rock oysters
- Trophic relay: the transfer of energy and nutrients at Towra Point to different parts of the estuary through a complex food web is critical to maintaining biodiversity

REGULATING SERVICES

Regulating services of Towra Point Ramsar site include:

- Maintenance of hydrological regimes: Towra Point plays an important role in maintaining the hydrological regimes of Botany Bay and the region. These hydrological processes include rainfall, ties, evapotranspiration, runoff, infiltration and groundwater flow
- Shoreline stabilisation and storm protection: vegetation at Towra Point such as mangroves and seagrass prevent erosion from tides, storms, and high rainfall
- Biological control of pests and disease: Towra Point provides habitat for native predators such as the masked owl, white-bellied sea eagle, and whistling kite that prey on introduced rodents
- Pollution control: mangroves at Towra Point act as sediment traps and contaminant filter. They contribute to the water quality and health of the waterway by providing a buffer between land and water. This helps filter contaminants before entering the waterway

CULTURAL SERVICES

Cultural services of Towra Point Ramsar site include:

- Recreation and tourism: Botany Bay and its tributaries are popular recreational areas for activities such as swimming, boating, and fishing due to their proximity to Sydney. The day-use area at Towra Point is the only publicly accessible area. It is only accessible by boat but is a popular recreational area
- Science and education: access to the majority of Towra Point Ramsar site is by permit only, which are granted for scientific and educational purposes
- Aesthetic amenity: the surrounds of Towra Point Ramsar site are highly developed and urbanised. Towra Point remains an example of the wetland types that used to be more common in the area and provides pleasant views of nature so close to Sydney's CBD
- Aboriginal heritage: the southern shore of Botany Bay is the country of the Gweagal clan of the Dharawal nation. This area is of significance to the Aboriginal people. Middens, rock shelters, engravings and burial sites can be found at Towra Point, indicating its importance to Aboriginal heritage

- Non-Aboriginal heritage: Captain James Cook and the crew of the *Endeavour* sailed into Botany Bay in 1770. Towra Point was the site of some of the first recorded botanical and zoological samples of Australia. The oyster industry in the water surrounding Towra Point is also a part of the cultural heritage of the area

SUPPORTING SERVICES

Supporting services of Towra Point Ramsar site include:

- Hydrological processes: Towra Point is key in maintaining hydrological processes including evapotranspiration, runoff, infiltration, and groundwater. These hydrological processes are also important in conserving the ecological character of the Ramsar site
- Food webs: the biodiversity at Towra Point is as a result of the interactions between organisms and the transfer of nutrients and energy. Critical links in the food chain include seagrass meadows and mangroves as they provide organic matter and detritus which is an important food source for invertebrates. Critical interactions include seed dispersal and pollination by the Grey-headed Flying-fox as well as export of crab larvae from the saltmarsh areas in outgoing tides. Tides play an important role in facilitation the transportation of organic and detritus matter and crab larvae export
- Physical habitat: Towra Point wetland provides particular habitat that can no longer be found elsewhere in the Sydney region. The suitable conditions support remnant habitats, threatened species, and endangered ecological communities. These include but are not limited to a diverse range of shorebirds, seagrass, mangroves, and saltmarsh
- Nutrient cycling: Maintaining a balance of nutrients is critical to the health of the ecosystem. Nutrients enters the system from the catchment in the form of runoff, sewage overflow and stormwater, and groundwater discharge. Flora and fauna found at Towra Point and the surrounding hydrological processes are critical to the cycling of nutrients. Primary producers such as phytoplankton, seagrass, mangroves, and saltmarsh have high nutrient requirements. They convert the nutrients to different forms that are more useable for other species. Botany Bay is a well flushed system, preventing the excess build-up of nutrients or sediment. This is maintained by the semi-diurnal tides
- Primary production: Towra Point supports primary producers such as phytoplankton, mangroves, saltmarsh, seagrass, and terrestrial vegetation. These in turn support a number of other processes
- Sediment trapping and stabilisation: seagrass, saltmarsh, and mangroves at Towra Point trap sediment and filter contaminants
- Biodiversity: the high level of biodiversity at Towra Point is supported by its size in relation to other areas of remnant vegetation in Sydney. Because of its size, the wetland supports a large variety of flora and fauna species. The importance of how the components at Towra Point contribute to its biodiversity are illustrated through the food web
- Special ecological, physical or geomorphic features: The Towra Point saltmarsh community is a threatened community listed under the BC Act. This community along with seagrass and mangroves are part of the features at Towra Point that provide habitat and nourishment for migratory shorebirds on their annual migration routes. This habitat also is an important nursery for fish and crustaceans. Oyster leases and other structures in the bays surrounding Towra Point (Quibray, Weeney, and Woolooware bays) provide additional roosting sites
- Threatened wetland species, habitats and ecosystems: The species and ecosystems supported at Towra Point include
    - 3 threatened species listed under the EPBC Act
    - 23 threatened species listed under the BC Act
    - 5 endangered ecological communities listed under the BC Act
- Priority wetland species: Towra Point Ramsar site and surrounding areas support 30 of the 80 migratory bird species listed a number of bilateral agreements including JAMBA, CAMBA, and ROKAMBA
- Ecological connectivity: Towra Point Ramsar site provides connectivity to other natural areas in the surrounding area that is otherwise highly urbanised. These natural areas include Kamay Botany Bay National Park, Royal National Park, Georges River National Park, Taren Point Shorebird Community, and Heathcote National Park. It also provides connectivity to foraging resources including shorebirds and the Grey-headed Flying-fox.

Part 6B Attachment References

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OPENLINES
Environmental consulting

2021

CUMBERLAND PLAIN ASSESSMENT REPORT

PART 7: EVALUATION OF THE PLAN

CHAPTER 39 – INTRODUCTION

CHAPTER 40 – ECOLOGICAL SUSTAINABLE DEVELOPMENT

CHAPTER 41 – EVALUATION OF THE ADEQUACY OF THE PLAN

PREPARED FOR THE NSW GOVERNMENT DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

DOCUMENT TRACKING

PREPARED BY:	
DATA:	James Shepherd, Callan Wharfe, Rebecca Dwyer, Matthew Hyde (Biosis) Darren James (DAJ Environmental)
CONTENT:	Tom Holden, Peter Hemphill, Heather Tolley, Natasha Buckingham, Mitchell Ross, Stephanie Binks, Heidi Birkby, Christa Shen (Open Lines) Darren James (DAJ Environmental)
REVIEWED BY:	
OPEN LINES:	Peter Hemphill, Tom Holden (Open Lines) Darren James (DAJ Environmental)
ACCREDITED ASSESSOR:	Jane Raithby-Veall (Biosis) BAM Assessor (BAAS18134)
VERSION CONTROL:	
VERSION:	Final This version of the report is the version submitted to regulators in 2021 with the application for biodiversity certification under the BC Act and for endorsement under the EPBC Act. Since then, several changes have been made to the Plan and to species listings under the EPBC Act. These changes are addressed in two addendums to this report.
DATE:	2021

Part 7 Contents

Part 7 List of Tables

39 Introduction

In considering approval of the Plan, the Commonwealth and NSW environment ministers must take into account various matters under the *Biodiversity Conservation Act 2016* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) relating to the development impacts and conservation benefits of the Plan.

This Part:

- Analyses the Plan against the principles of Ecological Sustainable Development (ESD) (see Chapter 40)
- Evaluates the adequacy and acceptability of the Plan in the context of the impacts of the development and in accordance with the regulatory requirements of the BC Act and EPBC Act (see Chapter 41)

This Chapter sets out:

- The regulatory context for evaluating the Plan
- An explanation of the meaning of 'adequate' in the context of the Plan
- The overall approach to the evaluation

39.1 REGULATORY CONTEXT FOR THE EVALUATION

Under both the BC Act and EPBC Act processes, the Assessment Report must evaluate the overall outcomes and acceptability of the Plan in relation to biodiversity values and other protected matters.

39.1.1 BIODIVERSITY CONSERVATION ACT

Under section 8.7 of the BC Act, the NSW Environment Minister may only confer biodiversity certification if satisfied the approved conservation measures under the certification adequately address the likely impacts on biodiversity values.

The Minister must have regard to the BCAR but is not bound by the report. If the Minister decides that the certification is likely to have serious and irreversible impacts on biodiversity values, the Minister must consider those impacts and determine whether any additional measures will minimise those impacts.

The offset rules under the BC Act do not apply to strategic biodiversity certification and the Act enables an applicant to access additional approved conservation measures beyond the retirement of credits. These include:

- Reservation of land under the *National Parks and Wildlife Act 1974* (NPW Act)
- Adoption of development controls under the *Environmental Planning and Assessment Act 1979* (EP&A Act) that conserve or enhance the natural environment
- State infrastructure contributions under the EP&A Act that conserve or enhance the natural environment
- Any other measure determined to be an approved conservation measure by the Environment Minister

The Department has prepared the *Conservation measures in strategic applications for biodiversity certification: Guidance for planning authorities* (strategic certification guidelines) (DPIE, 2020). The strategic certification guidelines are intended to assist planning authorities preparing applications for strategic biodiversity certification to:

- Design conservation measures
- Demonstrate that conservation measures adequately address the likely impacts on biodiversity values of the biodiversity certification of the land

The strategic certification guidelines provide principles for designing conservation measures that will be used by EES to evaluate a strategic application for biodiversity certification and advise the Environment Minister about the adequacy of conservation measures and the likely impacts on biodiversity values.

The strategic certification guidelines include a set of principles that must be considered in evaluating the Plan. These principles are summarised in Table 41-1 and addressed in Chapter 41.

39.1.2 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT

Under the EPBC Act, the Commonwealth Environment Minister:

- May endorse a policy, plan or program if satisfied that the Assessment Report 'adequately addresses the impacts' on protected matters to which the agreement (to undertake a strategic assessment) relates (s146(2)(f))
- May approve the taking of actions in accordance with the endorsed policy, plan or program (s146B(1)) subject to a range of considerations under Part 10 Division 1, Subdivision C, including:
    - General considerations under s 146F, including any matters relevant to MNES that the Minister considers is relevant to the approval, taking into account the principles of ecological sustainable development development
    - Constraints on decision-making discretion under ss 146 G, H, J, K, L and M, including that the Minister must not act inconsistently with the provisions of a recovery plan or threat abatement plan (s 146K)

The Agreement and Terms of Reference (ToR) require the Assessment Report to evaluate the commitments and outcomes for protected matters taking into account likely impacts on protected matters under the Plan. The ToR includes other matters that must be considered in evaluating the Plan. These matters are summarised in Table 41-1.

ToR (section 5.2(4)) also requires the Assessment Report to evaluate the extent to which the Plan meets the endorsement criteria under clause 8 of the Agreement. The endorsement criteria specifies that, in determining whether the Assessment Report adequately addresses the impacts of the Plan, the Commonwealth Minister must have regard to the extent to which the Plan meets the objectives of the EPBC Act, including how the Plan:

- Protects the environment, particularly protected matters
- Promotes ESD through the conservation and ecologically sustainable use of natural resources
- Promotes the conservation of biodiversity
- Provides for the protection and conservation of heritage
- Promotes a co-operative approach to the protection and management of the environment
- Assists in the co-operative implementation of Australia's international environmental responsibilities

The matters required to be addressed by the Agreement and ToR are addressed in Chapter 40 and Chapter 41.

39.2 DEFINING 'ADEQUATE' IN THE CONTEXT OF THE PLAN

The commitments under the Plan are not driven solely by meeting the offset rules of the BC Act or the credit requirements of the Biodiversity Assessment Method (BAM). This recognises that strategic biodiversity certification supports development and planning priorities and provides a range of opportunities to address landscape scale conservation challenges that are not provided by site-by-site assessment processes.

The key commitments under the Plan have been developed in recognition of these opportunities.

The biodiversity benefits of the commitments under the Plan may not be realised and are likely to be undervalued in an evaluation of the Plan that focuses only on the credit balance of the Plan. This is recognised in the strategic certification guidelines (DPIE, 2020) – while Principle 2 (see Section 41.4) requires consideration of the credit output of the Plan, this is only one of eight principles that the guidelines require to be taken into account in evaluating the Plan.

Furthermore, the locations of conservation lands within the Strategic Conservation Area (SCA) to offset the impacts of the Plan will be determined over time, and it has not yet been possible to undertake surveys within the SCA to confirm biodiversity values. It is not therefore possible to determine at this stage the exact amount of credits generated by securing conservation land under the Plan and compare this to the credit requirements of the development.

The Department developed an approach for defining offset targets to ensure that the commitments address the biodiversity values being impacted (see Chapter 8). The adequacy of these offset targets is evaluated in Section 41.4.

39.3 BROAD APPROACH TO THE EVALUATION

Evaluation of the overall outcomes and acceptability of the Plan was undertaken at three levels:

- In relation to the principles of Ecological Sustainable Development (see Chapter 40)

- In relation to the overall adequacy of the Plan in accordance with the strategic certification guidelines (DPIE, 2020) and requirements of the Agreement and ToR (see Chapter 41)
- For individual Commonwealth protected matters under the EPBC Act (see Chapters 29 – 35)

40 Ecological sustainable development

40.1 INTRODUCTION

ESD is defined as:

> *'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'* (COAG, 1992).

This Chapter:

- Sets out the legal and other requirements for assessing ESD
- Sets out the approach used to analyse the principles of ESD
- Provides an analysis of the Plan against each of the principles of ESD:
  - *Principle 1 – integration of social, economic and environmental considerations*
  - *Principle 2 – precautionary principle*
  - *Principle 3 – intergenerational and intragenerational equity*
  - *Principle 4 – conservation of biodiversity and ecological integrity*
  - *Principle 5 – valuation, pricing and incentive mechanisms*
- Provides an analysis of how the commitments respond to a specific set of ESD-related principles set out in the strategic certification guidelines

In analysing the Plan, this Chapter describes how the principles of ESD have been considered and promoted in the development of the Plan, both in guiding the planning process and informing the commitments under the Plan.

40.2 REQUIREMENTS FOR ASSESSING ESD

The assessment of the Plan against the principles of ESD is a requirement under:

- Commonwealth and NSW legislation
- Commonwealth ToR
- Strategic certification guidelines (DPIE, 2020)

40.2.1 LEGISLATION

COMMONWEALTH LEGISLATION

The EPBC Act incorporates the promotion of ESD within the key objectives of the Act, which states (in Part 1, Section 3):

> *"The objects of this Act are … to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources"*

The Act requires that the Commonwealth Environment Minister must consider economic and social matters, including taking the principles of ESD into account, when considering the approval of the taking of actions in accordance with an endorsed program or plan under the EPBC Act (section 146F).

The definition of ESD under Section 3A of the EPBC Act is:

Commonwealth definition of ESD – EPBC Act

Part 1 Preliminary

Section 3A Principles of ecologically sustainable development

The following principles are principles of ecologically sustainable development:

(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;

(b) *if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;*

(c) *the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;*

(d) *the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;*

(e) *improved valuation, pricing and incentive mechanisms should be promoted.*

NSW LEGISLATION

The principles of ESD underpin the central objectives of the BC Act. ESD is integrated into the purpose of the BC Act (section 1.3), which states:

> *"The purpose of this Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development (described in section 6 (2) of the Protection of the Environment Administration Act 1991)"*

The definition of ESD described in section 6(2) of the *Protection of the Environment Administration Act 1991* (POEA Act) is outlined below.

NSW definition of ESD – POEA Act

Part 3 Objectives of the Environment Protection Authority

6 Objectives of the Authority

…

2) *For the purposes of subsection (1) (a), ecologically sustainable development requires the effective integration of social, economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:*

   a) *the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*

      i) *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*

      ii) *an assessment of the risk-weighted consequences of various options,*

   b) *inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,*

   c) *conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,*

   d) *improved valuation, pricing and incentive mechanisms—namely, that environmental factors should be included in the valuation of assets and services, such as:*

      i) *polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*

      ii) *the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*

      iii) *environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems*

COMPARISON OF COMMONWEALTH AND NSW DEFINITIONS

There are some differences in the descriptions of ESD outlined under the EPBC Act and POEA Act. The EPBC Act includes additional detail for the definition of the principle of social, economic and environmental considerations, whilst the POEA Act includes additional detail for the definitions of the precautionary principle and the principle of improved valuation, pricing and incentive mechanisms. Despite this, the meaning of ESD under both Acts is generally consistent, and the evaluation of the Plan against ESD under the following sections cover both Acts.

40.2.2 OTHER REQUIREMENTS

COMMONWEALTH TERMS OF REFERENCE

The ToR require the Assessment Report to: "*…describe how the principles of ecologically sustainable development (as set out in section 3A of the EPBC Act) are considered and promoted in the development of the Plan".*

NSW STRATEGIC ASSESSMENT GUIDELINES

The strategic certification guidelines (DPIE, 2020) require the Assessment Report to explain how the commitments under the Plan respond to a specific set of ESD-related principles in the guidelines. The guidelines state:

> *To effectively integrate social, economic and environmental considerations in biodiversity certification decisions, the conservation measures and biodiversity certification as a whole must respond to the principles of ecologically sustainable development. Principles 1 to 8* [in the strategic certification guidelines] *must be addressed in the* [BCAR] *to demonstrate that the proposed conservation measures adequately address impacts on biodiversity values under section 8.7 of the BC Act. In addressing the principles* [in the strategic certification guidelines], *the BCAR should explain how the conservation measures respond to* [ESD], *particularly but not limited to:*
>
> *(a) Bioregional and State scale conservation outcomes*
> *(b) Maintain diversity and quality of ecosystems and enhance capacity of change for future generations*
> *(c) Support biodiversity in a changing climate*
> *(d) Support conservation and threat abatement actions to slow the rate of biodiversity loss and conserve threatened species and ecological communities in nature*
> *(e) Support and guide prioritised and strategic investment in biodiversity conservation outcomes*
> *(f) Establish a framework to avoid, minimise and offset the impacts of proposed development and land use change*
> *(g) Support public consultation and participation in biodiversity conservation and decision-making about biodiversity conservation*

40.3 APPROACH TO EVALUATION OF ESD

The evaluation of the Plan against each principle is undertaken by:

- Describing what the principle means
- Setting out the available legal and policy guidance to assist interpretation of the requirements of each principle
- Evaluating the Plan in accordance with the requirements of each principle

40.4 ANALYSIS OF PLAN AGAINST THE PRINCIPLES OF ESD

This section provides an evaluation of the Plan against each of the principles of ESD.

40.4.1 PRINCIPLE 1: INTEGRATION OF SOCIAL, ECONOMIC AND ENVIRONMENTAL CONSIDERATIONS

Principle 1 requires decisions to integrate economic, environmental, social and equitable considerations.

Specifically, the EPBC Act defines Principle 1 of ESD as "decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations" (Sec 3A(a)).

Principle 1 has a similar (although less comprehensive) definition in the POEA Act (Section 6(2)).

GUIDANCE TO ASSIST INTERPRETATION OF PRINCIPLE

There are several issues associated with balancing economic, environmental and social considerations (Preston, 2016):

- Environmental, economic, social and equitable considerations are interconnected and interdependent, such that changes in one can affect the capacity to achieve the goals of others

- It may not always be appropriate to accord equal weight to economic, environmental, social and equitable considerations. Doing this assumes that ecological processes can always sustain ongoing development. However, there are thresholds at which environmental processes may deteriorate
- Ecological, economic, social and equitable objectives cannot practically be balanced in all decisions made, or for each area of land. For example, some areas may be set aside completely for environmental objectives, whereas other parcels of land may be utilised for intensive economic development

EVALUATION OF PRINCIPLE

The Plan is considered to be consistent with Principle 1 of ESD as it:

- Supports the delivery of programs and regional strategic plans that integrate economic, social and environmental considerations and objectives and address key planning challenges facing Greater Sydney
- Has been developed through a range of processes that integrate economic, social and environmental considerations

Supports delivery of programs and plans that address key planning challenges facing Greater Sydney

The Plan is needed to support the delivery of:

- Nominated areas program and the development of major transport corridors that deliver key social and economic objectives identified under the *Greater Sydney Region Plan* and *Future Transport 2056*
- Several key regional planning strategies and plans for Western Sydney that integrate economic, social and environmental considerations and address key planning challenges facing Greater Sydney

The need for the Plan is set out in Chapter 6.

The nominated areas program represents the strategic prioritisation and delivery of new development as part of the long-term growth of Greater Sydney. The nominated areas are the key focus for urban development over the coming decades and will be the centres of economic and social activity in Western Sydney. Major transport infrastructure is planned to be delivered to respond to the economic and social needs of Western Sydney over the next 40 years. This Plan includes major transport corridors that will generate economic activity and support employment opportunities in Western Sydney. The key regional planning strategies and plans that the Plan supports the delivery of include:

- Western Sydney City Deal
- Greater Sydney Region Plan
- Western City District Plan
- NSW Koala Strategy in Western Sydney

These strategies and plans are the NSW Governments response to address several key economic, social and environmental planning challenges facing Greater Sydney, including:

- Population growth and housing needs, including housing affordability and choice
- Job opportunities
- Access to transport
- Protecting the natural environment and amenity

By supporting the delivery of programs and regional strategic, the Plan is supporting a planning process that integrates economic, social and environmental considerations and is addressing key planning challenges facing Greater Sydney.

Developed through processes that integrate economic, social and environmental considerations

The Plan was developed through three main processes that ensured economic, social and environmental considerations were effectively integrated in decisions relating to the Plan:

- The strategic assessment process
- A Structured Decision Making process
- A cost-benefit analysis

The strategic assessment process

The Plan was developed through a strategic assessment process. Environmental impact assessment processes such as strategic assessments are a well-recognised mechanism to incorporate environmental considerations alongside economic, social and equitable considerations into policies, plans and programs (Preston, 2016) . The strategic assessment process is discussed further below under section 40.4.4.

Structured Decision Making

The Department applied a structured decision-making process during early development of the Plan to define a high-level biodiversity outcome for the Cumberland subregion that set the context and direction for the development of the Plan. The structured decision-making process provides a systematic method to identify and compare a range of conservation options available to the NSW Government, taking into account social, economic and environmental considerations.

The structured decision-making process is described in Chapter 6.

The key decision for the structured decision-making work integrated social, economic and environmental considerations, and was:

> *"What is the optimal biodiversity outcome for Western Sydney that will enable planned and existing development (including both in and beyond the nominated areas in the Cumberland Plain) to proceed in an affordable and sustainable way?"*

The process found that the best approach to achieving the optimal biodiversity outcome while balancing economic and social considerations is to apply a broad mix of commitments and actions to maximise the biodiversity values that are protected, maximise certainty of delivery and alleviate the pressure on offset supply and demand. This includes:

- Securing one or more new national parks in the Plan Area
- Investing in biodiversity stewardship in the best remaining vegetation in the Plan Area
- Restoring key parts of the landscape within the Plan Area
- Providing dedicated funding for a set of actions to protect Koalas
- Investing a smaller proportion of the funding on biodiversity stewardship outside the Plan Area, within the allowable variation rules under the BC Regulation

This mix of approaches is reflected in the conservation program for the Plan (see Chapter 8).

Cost-benefit analysis

In developing the Plan, the Department commissioned UTS (UTS Institute of Sustainable Futures, 2019) to undertake an indicative social cost-benefit analysis of two potential conservation scenarios under the Plan. The aim of the analysis was to assess whether the scenarios would bring net positive social and economic outcomes for Western Sydney.

A quantitative model was developed to undertake the analysis. The analysis assessed two potential conservation scenarios under the Plan against a base case that assumed ongoing site-by-site assessment and approval of development in Western Sydney through NSW Biodiversity Offsets Scheme (BOS) under the BC Act.

The two potential conservation scenarios reflected the wider array of conservation measures available through the strategic conservation planning option under the BC Act, including:

- Extensions or additions to the reserve system
- Private land conservation secured through Biodiversity Stewardship Agreements
- Restoration of degraded sites, incorporating landscape management
- Threat management measures, including pest and weed management

The results of the analysis indicated that the two potential conservation scenarios under the Plan would bring net positive outcomes for Western Sydney and would be a viable approach for the NSW Government to achieve the dual goals of delivering biodiversity outcomes and facilitating housing supply to support social and economic outcomes.

40.4.2 PRINCIPLE 2: PRECAUTIONARY PRINCIPLE

Principle 2 is articulated in Section 3A(b) of EPBC Act as: "if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation".

The POEA Act, (Section 6(2)(a)) further articulates how the precautionary principle should be interpreted by decision-makers, which applies in the administration of the BC Act:

> *"in the application of the precautionary principle, public and private decisions should be guided by:*
>
> *i. careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
>
> *ii. an assessment of risk-weighted consequences of various options."*

DEFINITION OF SERIOUS AND IRREVERSIBLE ENVIRONMENTAL DAMAGE

Definition under BC Act

Serious and irreversible impacts (SAII) have been specifically defined in NSW under 6.7(2) of the BC Regulation as:

> *An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:*
>
> *(h) it will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or*
>
> *(i) it will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or*
>
> *(j) it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or*
>
> *(k) the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*

EES has developed further guidance for decision-makers on how to apply the principles to NSW-listed threatened ecological communities (TECs) and species (DPIE, 2019). These guidelines identify a list of matters that may be subject to SAII called 'SAII entities'. Table 40-1 identifies the relevant SAII entities that may be impacted by the Plan.

Under the BC Act, the NSW Environment Minister makes the determination regarding SAII, based on:

- BC Regulation principles
- SAII guidance (DPIE, 2019) and the list of potential SAII entities
- Extent of the remaining impact after measures to avoid or mitigate have been taken

Definition under EPBC Act

Section 5.2(3) of the ToR requires that the evaluation of the overall outcomes of the Plan must consider whether there will be SAII on any protected matter.

SAII are not specifically defined at a Commonwealth level. For the purpose of this assessment, where a NSW-listed matter was also Commonwealth-listed Category 1 matter, it was also considered to be an SAII entity potentially subject to serious and irreversible impacts. However, seven Commonwealth-listed matters are not NSW-listed and therefore have not been considered in terms of the principles under 6.7(2) of the BC Regulation. These matters are:

- Red Knot (Endangered, migratory shorebird)
- Curlew Sandpiper (Critically Endangered, migratory shorebird)
- White-throated Needletail (Vulnerable)
- Bar-tailed Godwit (Vulnerable, migratory shorebird)
- Macquarie Perch (Endangered)
- Eastern Curlew (Critically Endangered, migratory shorebird)

- Greater Glider (Vulnerable)

The impacts of the Plan on these matters have been assessed in Chapter 32 (for migratory species) and Chapter 30 (for White-throated Needletail, Macquarie Perch, and Greater Glider). The risk of impacts to these species due to development under the Plan is considered to be negligible or low and therefore these species are not considered to be potentially subject to serious and irreversible impacts under the Plan.

WHEN AND HOW IS THE PRECAUTIONARY PRINCIPLE REQUIRED TO BE IMPLEMENTED?

Principle 2 is required to be applied when two conditions are met (Preston, 2017):

- There is a threat of SAII to the environment
- There is scientific uncertainty as to the environmental damage associated with the threat

Where both these conditions are met, the decision-maker must:

- Assume there will be impacts to the environment
- Put in place avoidance, mitigation and offset measures to manage these impacts

It is possible that SAII may be predicted to occur with a high degree of certainty as a result of a proposal. This may occur where systems are well understood, and causal links can be established with confidence. In these situations, Principle 2 is not triggered, as significant uncertainty is not present (Preston, 2017). While measures will still need to be taken to avoid and minimise damage in these cases, these measures are considered to be 'preventative' measures rather than 'precautionary' measures applied under the precautionary principle (Preston, 2017).

EVALUATION OF PRINCIPLE

The Plan is considered to be consistent with Principle 2 as the Plan or this Assessment Report:

- Identifies matters potentially subject to SAII entities
- Takes steps to avoid impacts to SAII entities to reduce the threat of SAII
- Considers the nature and extent of the threat of SAII by assessing the residual impacts to SAII entities
- For matters where there is some scientific uncertainty around residual impacts, assumes that impacts will occur and puts in place mitigation and offset measures to manage these impacts

Matters potentially subject to serious and irreversible impacts

Table 40-1 identifies the NSW and Commonwealth-listed SAII entities that may be subject to serious and irreversible impacts and that are potentially impacted by the development under the Plan. NSW-listed SAII entities are assessed in Chapter 25 and Commonwealth listed SAII entities are assessed in Chapters 29 to 31.

Table 40-1: NSW and Commonwealth matters that may be subject to serious and irreversible impacts

SAII entities

• TECs:
  ○ Cooks River/Castlereagh Ironbark Forest (NSW and Cth listed)
  ○ Cumberland Plain Woodland (NSW listed)/Cumberland Plain Shale Woodlands and Shale-Gravel Transition forest (Cth listed)
  ○ Shale Sandstone Transition Forest (NSW and Cth listed)
• Flora:
  ○ *Allocasuarina glareicola* (NSW and Cth listed)
  ○ *Hibbertia fumana* (NSW listed)
  ○ *Melaleuca deanei* (NSW and Cth listed)
  ○ *Micromyrtus minutiflora* (NSW and Cth listed)
• Fauna:
  ○ Green and Golden Bell Frog (NSW and Cth listed)

SAII entities
○ Large-eared Pied Bat (NSW and Cth listed) ○ Little Eagle (NSW listed) ○ Red-crowned Toadlet (NSW listed) ○ Square-tailed Kite (NSW listed) ○ Swift Parrot (NSW and Cth listed) ○ White-bellied Sea-Eagle (NSW listed)

Steps taken to avoid serious and irreversible impacts

The Department and Transport for NSW have undertaken a strategic planning process to locate and design the urban capable lands of the nominated areas and major transport corridors to avoid and minimise impacts on biodiversity values. The highest priority for avoidance was critically endangered TECs and species, including SAII entities.

The steps taken to avoid and minimise impacts to biodiversity values and avoidance outcomes for SAII entities are described in Chapter 14. Further details on avoidance outcomes for NSW-listed SAII entities are provided in Chapter 25 and for Commonwealth listed SAII entities in Chapters 29 to 31.

Assessment of threat of serious and irreversible impacts

An assessment of the nature and extent of the residual threat of serious and irreversible impacts on NSW SAII entities is provided in Chapter 25 and Commonwealth listed SAII entities is provided in Chapters 29 to 31.

For some NSW and Commonwealth matters, the nature and extent of impacts cannot be predicted with a high degree of certainty. These matters are identified in Table 40-2. For these matters, the precautionary principle is triggered.

Table 40-2: NSW and Commonwealth TECs and species that trigger the precautionary principle

Matter	Reason for uncertainty
Allocasuarina glariecola	Some uncertainty about likelihood of occurrence and abundance within potential habitat mapped within urban capable land and major transport corridors and therefore extent of likely impacts
Hibbertia fumana	
Hibbertia puberula	
Micromyrtus minutiflora	
Raptors - White-bellied Sea-Eagle, Little Eagle and Square-tailed Kite	Some uncertainty about likelihood of occurrence and abundance within potential breeding habitat mapped within urban capable land and major transport corridors and therefore extent of likely impacts
Koala	Some uncertainty about the nature and extent of impacts, including the importance of various movement corridors and risks of indirect impacts

For the other SAII entities, impacts can be predicted to a relatively high degree of certainty because:

- Knowledge about presence of the TEC or species is more certain
- Nature and extent of the impacts are relatively well understood, including because the risk of impacts is clearly very low, or because the impacts can be relatively easily predicted

Although the precautionary principle is not triggered for these matters, a range of 'preventative' measures relevant to these matters will be implemented under the Plan to offset and mitigate the impacts of the development (see Chapter 25 for NSW SAII entities and Chapters 29 to 31 for Commonwealth listed TECs and species).

Mitigation of impacts where there is scientific uncertainty

For the SAII entities in Table 40-2, the Plan assumes that the potential impacts of the development under the Plan will occur and puts in place commitments and mitigation measures that mitigate and offset these impacts (see Chapter 25 for NSW-listed SAII entities and Chapters 29 to 31 for Commonwealth-listed SAII entities). This is consistent with the precautionary principle and is expected to adequately reduce the risk of impacts to these matters to an acceptable level.

40.4.3 PRINCIPLE 3: INTERGENERATIONAL AND INTRAGENERATIONAL EQUITY

Principle 3 is articulated in Section 3A(c) of EPBC Act as: "The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".

The POEA Act provides the same definition for Principle 3.

GUIDANCE TO ASSIST INTERPRETATION OF PRINCIPLE

Principle 3 contains two key elements (Preston, 2016):

- Intergenerational equity – this relates to equity between current and future generations
- Intragenerational equity – this relates to equity within current generations

There are three sub-principles that inform the basis of intergenerational and intragenerational equity (Preston, 2016):

- Conservation of options – this provides that each generation should conserve the diversity and robustness of the resource base to ensure future generations have the same access to alternatives and options when solving problems
- Conservation of quality – this provides that the quality of natural and cultural environments should be maintained, so they are passed on in the same or better condition than they were received
- Conservation of access – this provides that each generation has the right to reasonable and equitable access to natural and cultural resources to improve their own social and economic wellbeing

EVALUATION OF PRINCIPLE

The Plan is considered to be consistent with Principle 3 of ESD as it conserves alternatives and options in relation to environmental resources, maintains the quality of natural and cultural environments, and conserves access to natural and cultural resources by establishing a conservation program (see Chapter 8 for details) that:

- Avoids and minimises impacts on high biodiversity value areas
- Mitigates indirect and prescribed impacts
- Conserves flora and fauna and associated habitat
- Manages landscape threats
- Builds knowledge and research to improve management of biodiversity

The purpose of the conservation program is to achieve the Plan's objective and conservation outcomes and offset the impacts of the development on biodiversity values. The conservation program has been designed to maximise ecological function and resilience at the landscape scale in the Cumberland subregion.

The key focus of the conservation program is protecting a minimum of 5,325 hectares of native vegetation in the Cumberland subregion to conserve biodiversity values in perpetuity (Commitment 8).

The outcomes of the conservation program are evaluated in Chapter 41. The evaluation suggests the Plan is consistent with Principle 3, as it will substantially increase the protection of high value biodiversity areas in the subregion in perpetuity and therefore contribute to conserving the diversity and robustness of the resource base and maintaining the quality of natural environments in the subregion.

The Plan is proposing to establish a number of new reserves as part of the conservation program (Commitments 10 and 11). These include the Georges River Koala Reserve, as well as investigating:

- A new reserve that will provide an ecological connection between Gulguer Nature Reserve, Bents Basin State Conservation Area and Burragorang State Conservation Area
- A new reserve on Wianamatta (South Creek) that will allow for the restoration of up to 370 hectares of TECs

Reserves provide the highest level of in-perpetuity biodiversity protection and a range of social benefits, such as enabling public access to natural areas and open space. This is consistent with Principle 3, because it provides increased opportunities for residents of Western Sydney to access natural resources and improve social wellbeing.

The conservation program also includes several other commitments that are consistent with Principle 3, including:

- Provide opportunities for the residents of Western Sydney to participate in biodiversity conservation, including Koala conservation (Commitment 20)
- Partner with Aboriginal groups and the community to help maintain distinctive cultural, spiritual, physical and economic relationships with their land and waters in Western Sydney (Commitment 21)

As part of developing the Plan, a 'trend analysis' was undertaken to model long-term changes in native vegetation extent and condition across the Cumberland subregion (see Supporting Document D).

The modelling examined various scenarios that approximate the development impacts of the nominated areas and the benefits of the conservation areas under the Plan. The analysis suggests generally that:

- Existing landscape scale threats across the Cumberland subregion, such as weed invasion, illegal activities, rubbish dumping, disturbance from recreational activities, are causing substantial declines
- Conservation lands to be established under the Plan have the potential to compensate for the impacts of the nominated areas and contribute to addressing the decline of native vegetation from existing landscape scale threats
- High intensity restoration of native vegetation provides significant potential for conservation outcomes

The trend analysis further suggests that the Plan is consistent with Principle 3 as it is likely to contribute to maintaining the health, diversity and productivity of the Cumberland subregion for future generations.

It is important to note that this Plan does not cover cultural resources other than areas of biodiversity value and matters of national environmental significance such as World Heritage and National Heritage sites. Other cultural resources, such as archaeological, built, and Aboriginal cultural heritage are regulated in NSW under other legislation and are subject to separate assessment and approval processes that are not part of this Plan.

40.4.4 PRINCIPLE 4: CONSERVATION OF BIODIVERSITY AND ECOLOGICAL INTEGRITY

Principle 4 is articulated in Section 3A(d) of EPBC Act as: *the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making*.

The POEA Act provides the same definition for Principle 4.

GUIDANCE TO ASSIST INTERPRETATION OF PRINCIPLE

Section 528 of the EPBC Act provides the following definition of biodiversity:

> *Biodiversity means the variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part) and includes:*
>
> *a) diversity within species and between species; and*
>
> *b) diversity of ecosystems.*

The Biodiversity Indicator Program for NSW (OEH, 2019b) defines ecological integrity as:

> *Ecological integrity is about maintaining the diversity and quality of ecosystems and enhancing their capacity to adapt to change and provide for the needs of future generations. It covers the extent, condition and connectivity of habitats; the effectiveness of on-ground conservation actions; and how well ecosystems respond to change, including climate change…*

As Commonwealth and NSW legislation articulates that Principle 4 should be a 'fundamental consideration' in decision making, courts have recognised that Principle 4 is one to which "significant weight should be assigned" (Preston, 2016). Although it is recognised that priority is to be given to the conservation of biodiversity and ecological integrity, this does not mean that a project must be refused if it is likely to impact on these matters (Preston, 2016).

EVALUATION OF PRINCIPLE

The Plan is considered to be consistent with Principle 4 of ESD as it:

- Has a conservation objective and strong conservation outcomes and establishes a comprehensive conservation program that is designed to achieve this objective and outcomes

- Has been developed through a strategic assessment process that ensured biodiversity was given fundamental consideration in decisions relating to the Plan

It is also important to note that the legislation regulating approval of the Plan requires decision-makers to provide significant consideration to biodiversity. For example:

- Under the BC Act, the NSW Environment Minister must be satisfied that the approved conservation measures under the biodiversity certification adequately address the likely impacts on biodiversity values
- Under the EPBC Act, the Commonwealth Environment Minister can only approve the taking of actions in accordance with the endorsed Plan subject to a range of constraints on decision-making, including to not act inconsistently with a recovery plan or threat abatement plan for a protected matter (s 146K)

Conservation objective and conservation program

The Plan includes an objective to *"To deliver biodiversity outcomes and support the ecological function of the Cumberland Plain, improve liveability and facilitate urban development in Western Sydney"* and strong conservation outcomes related to maintaining and enhancing biodiversity and other environmental values in the Cumberland subregion (see Chapter 8).

The environmental outcomes of the Plan are:

> *The extent and condition of native vegetation and Threatened Ecological Communities increases and improves in the strategic conservation area in the Cumberland subregion*
>
> *Populations of targeted threatened species persist and the condition of suitable habitat improves in the strategic conservation area in the Cumberland subregion*
>
> *Condition of important koala habitat is improved, connectivity between koala sub-populations is maintained, threats to koalas are managed and the koala population in South Western Sydney persists and thrives*
>
> *Areas of high biodiversity value in the nominated areas are protected and threats to species and ecological communities from increased urbanisation is managed*

As described in Section 40.4.3, the Plan establishes a conservation program to deliver this objective and these conservation outcomes. The outcomes of the conservation program are evaluated in Chapter 41.

The evaluation concludes that the Plan will:

- Avoid substantial areas of high biodiversity value and SAII entities
- Adequately offset the impacts of the development on biodiversity values
- Protect significant areas of high biodiversity value in the Cumberland subregion that are likely to maintain and enhance ecological function and processes, such as habitat connectivity
- Has the potential to contribute to addressing the decline of native vegetation from existing landscape scale threats

The evaluation suggests that biodiversity has been given fundamental consideration in decisions relating to the Plan, as the Plan will deliver substantial conservation outcomes for the Cumberland subregion.

Strategic assessment

The development of the Plan was informed by a strategic assessment process that ensured biodiversity was given fundamental consideration in decisions relating to the Plan.

A strategic assessment process provides an improved mechanism to address key landscape-scale conservation challenges over a site-by-site assessment and approval process. Strategic assessments can have the following benefits:

- Enable effort to be focused on the highest biodiversity value areas of the landscape
- Address ecological function and landscape-scale ecological processes, such as habitat connectivity
- Manage threats at a landscape scale that can maximise benefits to multiple species
- Be designed and implemented strategically, such as by consolidating offsets into large and more viable patches
- Be implemented ahead of impacts occurring from development, to help reverse any trend of decline

The strategic assessment process substantially informed the conservation program under the Plan by:

- Providing a comprehensive information base on biodiversity values to inform the development of the Plan
- Identifying key risks to biodiversity values from the impacts of the development
- Informing avoidance, mitigation and offset measures needed to adequately manage and offset impacts
- Informing conservation priorities, including offset priorities and targets

40.4.5 PRINCIPLE 5: VALUATION, PRICING AND INCENTIVE MECHANISMS

Principle 5 is articulated in Section 3A(e) of EPBC Act as: *improved valuation, pricing and incentive mechanisms should be promoted*.

The POEA Act (Section 6(2)(d)) further articulates how Principle 5 should be interpreted by decision-makers:

> *improved valuation, pricing and incentive mechanisms—namely, that environmental factors should be included in the valuation of assets and services, such as:*
>
> *i. polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
>
> *ii. the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
>
> *iii. environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

Preston (2016) notes that Principle 5 is designed to account for environmental damage caused by market failure. Market failure occurs where the output of one entity acts as a negative input into one or more other entities without accompanying payment of compensation. Negative outputs are referred to as negative externalities.

Principle 5 emphasises the promotion of mechanisms to internalise the costs of negative externalities. The rationale for this is if the real value of environmental resources is included in the total costs for using those resources, then environmental resources will be more sustainably used and the risk of exploitation will be reduced.

GUIDANCE TO ASSIST INTERPRETATION OF PRINCIPLE

The element in relation to Principle 5 subject to most guidance relates to the 'polluter pays' principle. This principle is the best-known means for internalising external environmental costs. The principle says that those who generate pollution and waste should bear the costs of containment, avoidance or abatement (Preston, 2016).

Under this principle, the polluter should pay for the costs of (Preston, 2016):

- Preventing pollution or reducing pollution to comply with relevant laws and standards
- Preventing, controlling, abating and mitigating pollution
- Making good any environmental damage caused by pollution
- Making reparation (including compensatory damages and compensatory restoration) for irremediable injury

Evaluation of the Plan in relation to Principle 5 is based on considering whether the Plan has developed mechanisms to achieve internalisation of negative externalities associated with the development under the Plan.

EVALUATION OF PRINCIPLE

The Plan is considered to be generally consistent with Principle 5 of ESD as environmental factors have been included in the valuation of assets and services. This has been achieved through:

- Applying the polluter pays principle
- Achieving environmental goals in cost-effective ways

Polluter pays principle

The conservation program under the Plan includes commitments to:

- Avoid areas of high biodiversity value (preventing or reducing 'pollution')
- Mitigate threats (controlling, abating and mitigating 'pollution')
- Offset impacts (making good any environmental damage caused by 'pollution')

The Plan is consistent with the polluter pays principle as the Department will establish arrangements to recover costs of the conservation program from developers (a development levy) within the nominated areas through the Special Infrastructure Contributions (SICs) program or other contribution type. This will include:

- Establishing a Trust or other financial arrangement to administer receipts and expenditure to implement the Plan
- Establishing arrangements to determine how funding decisions will be made, administered and reported

Funding arrangements are described in Chapter 9.

These arrangements will ensure those who generate 'pollution and waste' bear the costs of 'containment, avoidance or abatement' by imposing the costs of the conservation program on developers.

It is important to note that to date the NSW Government has committed $114 million in the first five years to implement the Plan, including a set of priority conservation actions (see Part 2). The SIC or other contribution type will therefore not account for the full cost of the conservation program and therefore the costs of avoiding, mitigating and offsetting impacts are not borne solely by developers (rather NSW taxpayers). This approach ensures the Plan balances environmental objectives with economic and social objectives in 'facilitating urban development in Western Sydney' (such as through supporting housing supply and reducing pressure on housing affordability).

Cost-effective environmental goals

The Plan achieves environmental goals to minimise the costs of development and maximise benefits to biodiversity by:

- Using a strategic assessment process to assess and approve the Plan
- Using an existing market-based mechanism to help deliver the conservation program
- Identifying priority conservation areas to maximise benefits to biodiversity at least cost

Strategic assessment process

Strategic assessments provide a cost-effective mechanism to assess and seek approval for development. Access Economics undertook a cost-benefit analysis of seven strategic assessments based on net present value (NPV) over a 30-year period (2010-11 to 2039-40), comparing site-by-site assessment processes with the alternative strategic assessment process. The analysis (Access Economics, 2011) found that strategic assessments provide a net benefit of:

- $4.5 million for the Australian Government
- $0.57 million for State governments
- $5.92 billion for developers, reflecting the commercial benefits from reducing uncertainty, risk and delays

Across all entities, the NPV of the net benefit for the seven programs was estimated as $5.93 billion.

The cost benefit analysis undertaken for the Plan (UTS Institute of Sustainable Futures, 2019) also indicated that the two potential conservation scenarios under the Plan would bring net positive social and economic outcomes for Western Sydney when assessed against the base case of site-by-site assessments.

Use of market-based mechanisms

The Plan uses an existing market-based mechanism under the BC Act, the Biodiversity Offsets Scheme, to deliver a substantial part of the conservation program through Biodiversity Stewardship Agreements (BSAs).

BSAs are voluntary cooperative agreements between a private landholder and the NSW Government. BSAs are registered on the title of a property to provide in-perpetuity protection of biodiversity values. Landholders are

responsible to ongoing management of the land using funding provided by the NSW Government. The Biodiversity Conservation Trust (BCT) will be responsible for the delivery and management of BSAs under the Plan.

By using the Biodiversity Offsets Scheme, the Plan ensures efficient delivery of conservation areas because:

- Land is not required to be purchased – land purchase is very expensive in Western Sydney
- The process is competitive – the BCT is more likely to enter into agreements with landholders who can deliver conservation outcomes at the least cost (where other factors are equal)
- BSAs are voluntary, meaning that only willing landholders, who may be more likely to deliver conservation outcomes effectively, will participate in the process and enter agreements with the BCT

Identifying priority conservation areas to maximise benefits

The Department developed a Conservation Priorities Method that was used to identify the SCA within which conservation lands will be secured under the Plan. The method is summarised in Chapter 8.

The priorities method combines spatial information about biodiversity values with an analysis of constraints and opportunities to identify an optimal mix of potential conservation areas to offset the impacts of the development. It builds strategic conservation planning in the Cumberland subregion over the last decade, including the Cumberland Plain Recovery Plan (DECCW, 2011) and Biodiversity Investment Opportunities Map (OEH, 2015).

Use of the method aims to ensure that the conservation areas secured under the Plan maximise biodiversity benefits for a given cost of implementing the conservation program. The SCA represents the areas in the Cumberland subregion containing habitat for biodiversity values impacted by the development that are considered most likely to be viable in the long-term and maximise ecological function and connectivity across the landscape.

40.5 ANALYSIS OF COMMITMENTS AGAINST ESD-RELATED PRINCIPLES IN THE STRATEGIC CERTIFICATION GUIDELINES

The strategic certification guidelines (DPIE, 2020) require the Assessment Report to explain how the commitments under the Plan respond to a specific set of ESD-related principles in the guidelines (see Section 40.2). The ESD-related principles to be addressed are:

- Bioregional and state scale conservation outcomes
- Maintain diversity and quality of ecosystems and enhance capacity of change for future generations
- Support biodiversity in a changing climate
- Support conservation and threat abatement actions to slow the rate of biodiversity loss and conserve threatened species and ecological communities in nature
- Support and guide prioritised and strategic investment in biodiversity conservation outcomes
- Establish a framework to avoid, minimise and offset the impacts of proposed development and land use change
- Support public consultation and participation in biodiversity conservation and decision-making about biodiversity conservation

Table 40-3 summarises how the Plan addresses each of these ESD factors.

Table 40-3: Summary of the how the commitments respond to ESD-related principles in the strategic certification guidelines

ESD-related principle	Summary of how the commitments respond to principle
Bioregional and state scale conservation outcomes	The conservation program and associated commitments ensures bioregional and state scale conservation outcomes as it: • Has been designed to maximise ecological function and resilience at the landscape scale in the Cumberland subregion • Establishes reserves that will contain the regional-scale ecosystems impacted by the biodiversity certification • Will substantially increase the protection of high value biodiversity areas in the Cumberland subregion in perpetuity and therefore contribute to conserving the

ESD-related principle	Summary of how the commitments respond to principle
	diversity and robustness of the resource base and maintaining the quality of natural environments at a state level • Includes a conservation objective to "deliver biodiversity outcomes and support the ecological function of the Cumberland Plain" and strong conservation outcomes related to maintaining and enhancing biodiversity and other environmental values in the Cumberland subregion • Will result in an overall benefit to ecosystems, species and ecological values (e.g. connectivity) that are important at a bioregional and state scale The conservation program is described in Chapter 8 and is evaluated in Chapter 41, including an assessment of the feasibility of the conservation outcomes in Section 41.10 (Theme 8).
Maintain diversity and quality of ecosystems and enhance their capacity to adapt to change and provide for the needs of future generations	The conservation program and associated commitments ensure both intergenerational and intragenerational equity by establishing a conservation program that conserves environmental resources, maintains the quality of natural and cultural environments, and conserves access to natural and cultural resources. The program ensures that the following sub-principles of intergenerational and intragenerational equity (Preston, 2016) are met: • Conservation of options – this provides that each generation should conserve the diversity and robustness of the resource base to ensure future generations have the same access to alternatives and options when solving problems • Conservation of quality – this provides that the quality of natural and cultural environments should be maintained, so they are passed on in the same or better condition than they were received • Conservation of access – this provides that each generation has the right to reasonable and equitable access to natural and cultural resources to improve their own social and economic wellbeing This is discussed in Section 40.4.3 (Principle 3: Intergenerational and intragenerational equity).
Support biodiversity in a changing climate	The conservation program and associated commitments support conservation of biodiversity in a changing climate. Section 41.11 (Theme 9) provides an analysis of the extent to which the commitments under the Plan facilitate adaptation of biodiversity to climate change. This analysis includes both quantitative and qualitative evaluations.
Support conservation and threat abatement actions to slow the rate of biodiversity loss and conserve threatened species and ecological communities in nature	The conservation program and associated commitments support conservation and threat abatement actions to slow the rate of biodiversity loss and conserve threatened species and ecological communities in nature as the program: • Has a conservation objective and strong conservation outcomes designed to conserve species and communities (see Section 40.4.4). The trend analysis (see Supporting Document D and Box 1) demonstrated that the conservation lands to be secured under the Plan have the potential to compensate for the impacts of the Plan and contribute to addressing the decline of native vegetation from existing landscape scale threats • Includes a range of commitments to manage threats to biodiversity in strategic locations in the Cumberland subregion and to reduce threats to land secured within the SCA, including to: o Deliver weed and pest control programs o Undertake fire management o Support new or existing disease control programs o Support new or existing programs to help threatened species and TECs adapt to climate change Conservation and threat abatement actions are discussed in Chapter 8.
Support and guide prioritised and strategic investment in	The commitments will lead to the securing of 5,325 ha of native vegetation in the Cumberland subregion. This will be secured within the SCA, which represents the areas in the subregion containing habitat for biodiversity values impacted by the development that

ESD-related principle	Summary of how the commitments respond to principle
biodiversity conservation outcomes	are considered most likely to be viable in the long-term and maximise ecological function and connectivity across the landscape. The Plan will establish arrangements to fund delivery of the Plan's commitments and actions through contributions from residential, commercial and industrial developers in the nominated areas (Commitment 24) The funding mechanisms are described in Chapter 9 and evaluated in Section 41.10 (Theme 8).
Implement the avoid, minimise and offset hierarchy to achieve the smallest possible impacts of the proposed development and land use change	The Plan implements the avoid, minimise and offset hierarchy by: • Avoiding and minimising impacts to biodiversity values. The Plan achieves substantial avoidance outcomes for biodiversity values and includes commitments to ensure the avoidance to be achieved is certain and protection of avoided land is strengthened through development controls. The avoidance outcomes of the Plan are discussed in Chapter 14 • Implementing mitigation measures to ensure indirect impacts of the development are adequately mitigated. The Plan includes commitments to ensure indirect impacts are mitigated and identifies specific mitigation measures to address biodiversity values at risk of impacts. Mitigation measures are discussed in Chapter 15 • Establishing offsets to ensure the direct impacts of the development are adequately compensated. The method to determine offsets is described in Part 2. The adequacy of offsets is evaluated in Section 41.4.
Support public consultation and participation in biodiversity conservation and decision- making about biodiversity conservation.	The Plan includes commitments that aim to increase the capacity of the community to participate in biodiversity conservation and support research to improve understanding of threats and land management issues. These commitments will support public consultation and participation in biodiversity conservation and decision making and include: • Commitment 20 – to 'Provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation including koala conservation'. As part of this commitment, the Department will develop an Education and Engagement Implementation Strategy to guide implementation of an education and engagement program. This aims to help the Plan achieve its conservation objectives by increasing communities understanding of the environment and biodiversity. The Department will partner with environment groups, education facilities and councils to deliver this program. The Department will also establish an engagement program to educate landholders within the SCA and promote the opportunities and benefits of BSAs • Commitment 21 – to 'Partner with Aboriginal communities in Western Sydney to deliver biodiversity conservation and support economic opportunities arising from the delivery of the Plan'. As part of this commitment, the Department will co-design a 10-year Aboriginal Engagement and Implementation Strategy and will seek to establish partnerships with NSW Aboriginal Land Council and Local Aboriginal Land Councils, an advisory group, and Aboriginal networks to implement the strategy. This aims to ensure Aboriginal people are at the forefront of implementing the Plan and can benefit from the economic opportunities arising from the Plan's implementation • Commitment 22 – to 'Invest in research priorities that will support the implementation of the Plan and help to deliver the Plan's outcomes'. As part of this commitment, the Department will develop a Research Program Implementation Strategy to guide long term research funding that will help achieve the Plan's biodiversity outcomes; including the identification of research partners, the potential establishment of a small-scale competitive grant program and development of decision-making criteria for funding research programs under the Plan. Key outcomes of the strategy include: o Research into changing community attitudes and behaviour to biodiversity and conservation values o Research into the connections between biodiversity and Aboriginal culture and practices in Western Sydney

ESD-related principle	Summary of how the commitments respond to principle
	• Commitment 23 – to 'Support rehabilitation measures to help maintain koala health and welfare'. As part of this commitment, the department will invest in the *NSW Koala Strategy* and other potential partners to implement the koala health and welfare program in South Western Sydney. This program includes a range of deliverables including provision of grants for community wildlife organisations for resources and carer recruitment and training

41 Evaluation of the adequacy of the Plan

This Chapter:

- Identifies evaluation themes consistent with the regulatory requirements of the BC Act and EPBC Act
- Identifies assumptions and limitations of the evaluation
- Evaluates the adequacy and acceptability of the Plan against each theme
- Identifies how the Plan meets the Commonwealth's endorsement criteria
- Provides an overall conclusion about the adequacy and acceptability of the Plan

41.1 EVALUATION THEMES

The evaluation has been undertaken on the basis of a set of themes that are drawn from the strategic certification guidelines (DPIE, 2020) relevant to the BC Act and the ToR relevant to the EPBC Act (see Chapter 39).

The requirements of the strategic certification guidelines and ToR are similar or overlap in some cases. Where requirements are similar, they have been grouped and addressed together as a theme for this evaluation.

Table 41-1 identifies the requirements and how they have been grouped and addressed together.

The evaluation involved an analysis of the commitments and actions (including the implementation arrangements) under the Plan against each of the key themes identified in Table 41-1.

For each theme, the evaluation:

- Describes the context and method used to undertake the evaluation
- Provides an analysis of the theme
- Provides a conclusion in relation to the theme

Table 41-1: Summary of requirements and theme groupings for evaluating the adequacy of commitments in the Plan

Theme	**NSW requirements** ('draft guidelines for planning authorities')	**Commonwealth requirements (ToR)**
Theme 1: *Are serious and irreversible impacts avoided and minimised?*	Impacts on SAII entities are avoided and minimised (Principle 1)	Whether there will be SAII on any protected matter (ToR, section 5.2(3))
Theme 2: *Do the commitments address the values being impacted?*	Commitments address the biodiversity values being impacted (Principle 2)	How protected matters will be conserved, protected and managed within the Strategic Assessment Area and other areas related to the Plan (ToR, section 4.6(1))
		Extent to which commitments involving offsets meet the principles of the EPBC Environmental Offsets Policy, 2012 (ToR, section 4.6(3))
		Extent to which protected matters are represented in areas to be protected through the commitments or in existing protected areas (ToR, section 5.2(1))

Theme	NSW requirements ('draft guidelines for planning authorities')	Commonwealth requirements (ToR)
Theme 3: *Do the commitments address the most important values?*	Commitments prioritise important biodiversity values (Principle 3)	-
Theme 4: *Do the commitments improve values and ecological function in the long-term?*	Commitments improve biodiversity values and landscape function in the long-term (Principle 4)	Extent to which the Plan maintains and improves landscape connectivity (ToR, section 4.6(4))
		Extent to which the areas to be protected through the commitments or existing protected areas ensure long-term viability of protected matters (ToR, section 5.2(2))
Theme 5: *Are the commitments additional to existing requirements?*	Commitments are additional to existing conservation obligations (Principle 5)	-
Theme 6: *Do development controls proposed as commitments conserve the environment?*	Development controls that conserve or enhance the natural environment must be new or represent a significant upgrade (Principle 6)	-
Theme 7: *Are proposed new national parks consistent with the CAR reserve framework?*	Any proposed new national parks are consistent with the comprehensiveness, adequacy and representativeness (CAR) reserve framework (Principle 7)	-
Theme 8: *Will the Plan be effectively implemented and will outcomes be certain?*	Delivery of commitments is timely and certain (Principle 8)	Extent to which the commitments are enforceable and achievable over the life of the Plan (Agreement, clause 8.2)
		Adequacy of the commitments in protecting protected matters, including the effectiveness of implementation and funding arrangements (ToR, section 4.6(2))
		Likely effectiveness of the commitments in protecting and managing protected matters (ToR, section 5.3(2))
		Key uncertainties and risks associated with implementing the Plan, including implementation effectiveness and capacity (ToR, section 6.1(4))
		Adequacy of the adaptive approach to implementation of the Plan (ToR, section 6.2)

Theme	NSW requirements ('draft guidelines for planning authorities')	Commonwealth requirements (ToR)
		Adequacy of monitoring, reporting, review and auditing of the Plan (ToR, section 7.1)
Theme 9: *Does the Plan facilitate adaptation to climate change?*	-	Extent to which the Plan has considered adaptation to climate change (ToR, section 4.6(5))
		Extent to which the commitments facilitate adaptation of biodiversity to climate change (ToR, section 5.3(1))

41.2 ASSUMPTIONS AND LIMITATIONS

There are several assumptions and limitations of the analysis. The key ones are:

- The evaluation of themes was often based on biodiversity values contained in the SCA. Not all land within the SCA will be secured for conservation. However, as the location and boundaries of conservation lands are not yet final due to the large scale of the Plan Area and the voluntary mechanisms proposed to secure conservation lands under the Plan, the analysis of the SCA is considered an appropriate approach for evaluating the themes
- Surveys have not been done within the SCA (though some ground truthing was undertaken – see Sub-Plan A) – biodiversity values are based on broad scale mapping of TECs and species habitat, or existing native vegetation (PCT) maps for NSW matters that are not also Commonwealth matters
- BAM plot data has not been collected within the SCA – calculations for theme 2 were based on BAM plot data within the nominated areas and the assumption that these represent the data in the SCA
- The general limitations with the data used in the Assessment Report as described in Chapter 13

41.3 THEME 1: ARE SERIOUS AND IRREVERSIBLE IMPACTS AVOIDED AND MINIMISED?

41.3.1 CONTEXT AND METHOD

The ToR requires the Assessment Report to consider whether there will be serious and irreversible impacts on any protected matter (ToR, section 5.2(3)). The strategic certification guidelines (Principle 1) requires that the Plan specifically avoids and minimises impacts to SAII entities.

The processes to avoid and minimise impacts on biodiversity values under the Plan are described in detail Chapter 14. This section summarises these avoidance processes and outcomes in relation to SAII and for each of the different types of development under the Plan (urban capable land, major transport corridors and essential infrastructure).

41.3.2 ANALYSIS

The NSW and Commonwealth-listed SAII entities that may be subject to serious and irreversible impacts and that are potentially impacted by the development under the Plan are:

- TECs:
  - Cooks River/Castlereagh Ironbark Forest (NSW and Cth listed)
  - Cumberland Plain Woodland (NSW listed)/Cumberland Plain Shale Woodlands and Shale-Gravel Transition forest (Cth listed)
  - Shale Sandstone Transition Forest (NSW and Cth listed)
- Flora:
  - *Allocasuarina glareicola* (NSW and Cth listed)
  - *Hibbertia fumana* (NSW listed)

  - *Melaleuca deanei* (NSW and Cth listed)
  - *Micromyrtus minutiflora* (NSW and Cth listed)
- Fauna:
  - Green and Golden Bell Frog (NSW and Cth listed)
  - Large-eared Pied Bat (NSW and Cth listed)
  - Little Eagle (NSW listed)
  - Red-crowned Toadlet (NSW listed)
  - Square-tailed Kite (NSW listed)
  - Swift Parrot (NSW and Cth listed)
  - White-bellied Sea-Eagle (NSW listed)

URBAN CAPABLE LAND

The planning and avoidance process to identify the location of urban and industrial development, intensive plant agriculture and infrastructure within urban capable land in the nominated areas was an iterative one that began early in the assessment process before the final data on biodiversity values was completed.

The urban capable land was identified in three phases (see Chapter 14):

- Strategic planning to locate the nominated areas
- Initial development of footprints through Land Use and Infrastructure Implementation Plans (LUIIP)
- Iterative refinement of the footprints through development of the Plan and assessment of impacts

The avoidance process gave highest priority to SAII entities (see Box 1, Chapter 14).

The avoidance outcome achieved through this process is consistent with the guidance under the BAM and requirements of the ToR. The process was detailed and robust and based on the best available data on biodiversity values and achieved substantial avoidance outcomes for native vegetation, high (intact) condition native vegetation, the most endangered TECs and potential habitat for species with a very high and high biodiversity risk weighting (>3).

Table 41-2 and Table 41-3 summarise the avoidance outcomes for each SAII entity within the nominated areas. Avoidance outcomes are discussed in more detail in Chapter 25 for NSW-listed SAII entities and in Chapter 31 for Commonwealth-listed TECs and Chapters 29 and 30 for Commonwealth-listed species.

Avoidance effort for SAII entities has generally focused on TECs and potential habitat in higher condition (see Table 41-2 and Table 41-3) and/or of higher long-term viability (see Chapter 31). In many cases, impacts to larger patches are avoided. Where these impacts do occur, they are often on the edges of larger, contiguous patches associated with waterways and gullies and gorges, which minimises fragmentation and impacts on habitat connectivity, particularly in Wilton and GMAC (see Chapter 25 and Chapters 29 to 31 for more details).

Despite this overall conclusion, for some SAII entities, about half or less of the TEC or potential species habitat was avoided and residual impacts remain. This includes:

- Cumberland Plain Woodland
- Cooks River/ Castlereagh Ironbark Forest
- *Allocasuarina glareicola* and *Micromyrtus minutiflora*
- Green and Golden Bell Frog
- Swift Parrot

For these TECs, the scale of impacts is not substantial when considering the extent of these TECs across the Plan Area and the majority of intact condition and/or higher long-term viability TECs has generally been avoided (see Chapter 31). The offsets proposed by the Plan for these TECs (Commitment 8) will substantially increase the level of protection of these TECs in the Plan Area and address key threats identified in BioNet profiles and Conservation Advices.

For *Allocasuarina glareicola* and *Micromyrtus minutiflora* there are no impacts to records or important populations of the species (for each species, one important population occurs on excluded lands and will not be impacted).

While there will be direct impacts to small areas of Green and Golden Bell Frog habitat in GPEC, recent surveys along Ropes Creek indicate a population does not exist in that locality (see Supporting Document I).

For the Swift Parrot, the Plan provides a commitment (Commitment 9) to secure offsets of 100 ha of important habitat for the species to address residual impacts. The Plan also includes a range of other measures to mitigate risks to the species and increase its protection within the Plan area.

MAJOR TRANSPORT CORRIDORS

Avoidance and minimisation for major transport corridors is being undertaken in two stages (see Chapter 14):

- Strategic planning to determine the locations of the major transport corridors
- Future detailed design to determine the location of the infrastructure within the transport corridor footprint

The strategic planning process to determine the location of the major transport corridors is considered to have resulted in adequate avoidance and minimisation outcomes for biodiversity values. The process involved a detailed set of steps that considered environmental constraints, including biodiversity values, alongside other infrastructure, social and economic outcomes to balance overall planning outcomes. In making decisions on corridor selection, infrastructure agencies undertake a constraints analysis and multi-criteria comparison of options. Key factors considered included:

- Proximity to current and planned locations of employment
- The cost of infrastructure provision including roads, water, sewerage, public transport, schools and health facilities
- The economic and social cost to communities of having poor access to employment and services, including transport
- Environmental constraints, including biodiversity values

In some cases, infrastructure, social and economic considerations outweighed biodiversity considerations, including in relation to the location of the OSO through Wianamatta Regional Park. It is important to note that this decision was undertaken in close consultation with EES (formerly the Office of Environment and Heritage).

Commitment 3 and Commitment 4 will ensure the future detailed design to determine the location of the infrastructure within the major transport corridors will lead to additional avoidance and minimisation outcomes for biodiversity values, including SAII entities. These commitments are considered adequate to ensure the corridors avoid and minimise the risk of unacceptable impacts on biodiversity values. These commitments will ensure:

- For the major transport corridors (strategically assessed only) outside the nominated areas, impacts are avoided and minimised in accordance with the NSW State Significant Infrastructure (or equivalent) approvals process and BAM under the BC Act (or equivalent). The assessment process is considered to be robust as it will be undertaken under NSW planning and assessment laws current at the time the development is proposed
- Avoidance outcomes are achieved consistent with the Plan's 'avoidance criteria' (see Chapter 14) or are assessed and determined in accordance with the BAM (for the major transport corridors outside the nominated areas)
- Impacts to known key biodiversity values within the corridors are avoided and minimised where possible, including specific species and habitat, and/or specific locations of high biodiversity value
- Avoidance of biodiversity values as well as the costs of offsets is taken into account in the evaluation of the route options (e.g. multi-criteria analysis) during the planning phase of each project
- Governance arrangements are in place to ensure avoidance outcomes achieved and the residual impacts of the infrastructure within the transport corridor footprints are reported transparently to DPIE

The commitments and processes to be put in place to ensure major transport corridors avoid and minimise impacts to biodiversity values, including SAII entities, are described in more detail in Chapter 14.

ESSENTIAL INFRASTRUCTURE

The Plan is seeking approval under the EPBC Act for essential infrastructure to occur within the nominated areas outside urban capable land but not excluded land (i.e. within avoided land) (see Part 2).

Essential infrastructure will be subject to a future process of avoidance and minimisation as part of the strategic planning and detailed design phase of each project. Each project will be managed through the NSW planning and approvals framework under the EP&A Act as current at the time of the project.

Appendix A of the Plan and Commitment 2.1 and 2.2 are considered adequate to ensure essential infrastructure avoids and minimises the risk of unacceptable impacts on biodiversity values, including SAII entities. These requirements will ensure:

- Only a limited amount of essential infrastructure development can occur within avoided land. This development must be necessary to support the urban and industrial development under the Plan. This limited scope reduces the potential for impacts to biodiversity values from the development
- Implementation of assessment and ongoing environmental management processes, including:
    - An environmental impact assessment process to be applied prior to construction to assess and manage the impacts of the development. The assessment process is considered to be robust as it will be undertaken under NSW planning and assessment laws current at the time the development is proposed
    - An environmental management and compliance process to be applied during construction and operation to ensure activities comply with assessment requirements and mitigation measures are implemented effectively
- Avoidance outcomes are achieved consistent with the Plan
- Cumulative direct impacts to Commonwealth-listed TECs identified at risk of impacts in this Assessment Report (see Chapter 37) are limited within each nominated area to levels that are considered acceptable
- Avoidance and minimisation of impacts to known populations of Commonwealth-listed species identified at risk of impacts in this Assessment Report (see Chapter 37) are prioritised for avoidance
- Governance arrangements are in place to ensure the Department is notified of the essential infrastructure development. This is supported through the notification requirements of the SEPP and EP&A Regulation

Furthermore, the impacts of each project will be assessed under the BC Act and BAM (where triggered under the Act), which requires an avoid, mitigate and offset process to be applied to ensure avoidance outcomes are acceptable.

Implementation of the requirements in the Appendix A guidelines and the commitments are supported by the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development. These guidelines include development controls that apply to essential infrastructure in avoided land, including controls relating to avoiding and minimising impacts to biodiversity values, including several SAII entities (these matters were identified at risk from essential infrastructure in Chapter 37).

The commitments and processes to be put in place to ensure essential infrastructure avoids and minimises impacts to biodiversity values, including SAII entities, are described in more detail in Chapter 14.

Table 41-2: Assessment of avoidance outcomes for SAII TECs within the nominated areas

SAII entity	Listing	Summary of TEC avoidance within nominated areas (without excluded lands)				Comment on avoidance outcomes within the nominated areas
		Total in nominated areas (ha)	Total avoided (ha / %)	Avoided for biodiversity reasons (ha / %)	Avoided for other reasons (ha / %)	
Cooks River/ Castlereagh Ironbark Forest	NSW	63.4 ha	25.8 ha / 40.7%	25.7 ha / 40.5%	0.2 ha / 0.2%	Between 40 - 45% of the TEC has been avoided For the NSW-listed TEC, of the 34.9 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (18.9 ha or 54.2%) has been avoided (see Chapter 25) For the Commonwealth-listed TEC, of the 34.6 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (18.9 ha or 54.6%) has been avoided (see Chapter 31)
	Cth	55.6 ha	24.7 ha / 44.5%	24.6 ha / 44.3%	0.1 ha / 0.2%	
Cumberland Plain Woodland	NSW	1,252.8 ha	321.3 ha / 25.6%	269.9 ha / 21.5%	51.4 ha / 4.1%	Between 25 - 45% of the TEC has been avoided For the NSW-listed TEC, of the 89.4 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (57.9 ha or 64.8%) has been avoided (see Chapter 25) For the Commonwealth-listed TEC, of the 32 ha of intact condition TEC within the nominated areas (not including excluded land), the majority (22.3 ha or 69.6%) has been avoided (see Chapter 31)
	Cth	247.2 ha	111.5 ha / 45.1%	85.9 ha / 34.8%	25.6 ha / 10.3%	
Shale Sandstone Transition Forest	NSW	2,640.2 ha	2,180.5 ha / 82.6%	1,929.2 ha / 73.1%	251.3 ha / 9.5%	Between 81% - 91% of the TEC has been avoided For the NSW-listed TEC, of the 1,492.6 ha of intact condition TEC within the nominated areas (not including excluded land), the vast majority (1,446.8 ha or 96.9%) has been avoided For the Commonwealth-listed TEC, of the 1,485 ha of intact condition and 1,362.1 ha of high viability TEC within the nominated areas (not including excluded land), 1,437 ha of intact condition (or 97.1%) and 1,330.6 ha of high viability (or 97.7%) TEC, have been avoided Commitment 2.1 limits the cumulative direct impacts over the life of the Plan from essential infrastructure to this TEC
	Cth	2,197.4 ha	2,016.7 ha / 91.8%	1,769.1 ha / 80.5%	247.6 ha / 11.3%	

Table 41-3: Assessment of avoidance outcomes for SAII species within the nominated areas

SAII entity	Summary of habitat avoidance (without excluded lands)				Comment on avoidance outcomes
	Total in nominated areas (ha)	**Total avoided (ha / %)**	**Avoided for bio. reasons (ha / %)**	**Avoided for other reasons (ha / %)**	
Flora					
Allocasuarina glareicola	32.3 ha	14.9 ha / 46.1%	14.8 ha / 45.7%	0.1 ha / 0.3%	About half the potential habitat has been avoided There are no impacts to records or important populations of the species (one important population occurs on excluded lands and will not be impacted)
Hibbertia fumana	1,299 ha	1,225.3 ha / 94.3%	1,083.7 ha / 83.4%	141.6 ha / 10.9%	Almost all potential habitat has been avoided There are no impacts to records of the species
Melaleuca deanei	1,750.3 ha	1,644.1 ha / 93.9%	1,545.2 ha / 88.3%	98.9 ha / 5.6%	Almost all potential habitat has been avoided There are no impacts to records of the species
Micromyrtus minutiflora	69 ha	37.3 ha / 54%	37.1 ha / 53.7%	0.2 ha / 0.3%	Over half the potential habitat has been avoided There are no impacts to records or important populations of the species (one important population occurs on excluded lands and will not be impacted)
Green and Golden Bell Frog	24.6 ha	11.3 ha / 45.8%	11.2 ha / 45.7%	<0.1 ha / 0.1%	About half the potential habitat has been avoided. It is important to note that much of the potential habitat mapped comprises existing urban areas (houses and roads), as the mapping was done by applying a buffer to records along Ropes Creek (see Chapter 25) There will be direct impacts to potential habitat in GPEC. However, recent surveys along Ropes Creek indicate a population does not exist in this locality
Large-eared Pied Bat*	882.2 ha	876.5 ha / 99.3%	452 ha / 51.2%	424.5 ha / 48.1%	Almost all potential breeding habitat has been avoided An important population has been partially avoided. Population 424 occurs as a single important population across the Plan Area and surrounds. The majority of records occur outside of nominated areas. Nine records occur within excluded lands and 2 records are located on avoided lands within central GMAC
Little Eagle*	2,935.5 ha	2,907.3 ha / 99%	2,237.5 ha / 76.2%	669.8 ha / 22.8%	Almost all potential breeding habitat has been avoided There are no impacts to known breeding sites (stick nests)

SAII entity	Summary of habitat avoidance (without excluded lands)				Comment on avoidance outcomes
	Total in nominated areas (ha)	**Total avoided (ha / %)**	**Avoided for bio. reasons (ha / %)**	**Avoided for other reasons (ha / %)**	
Red-crowned Toadlet	869 ha	859.7 ha / 98.9%	645.1 ha / 74.2%	214.6 ha / 24.7%	Almost all potential habitat has been avoided There are no impacts to records of the species
Square-tailed Kite*	2,919.2 ha	2,874.6 ha / 98.5%	2,220.2 ha / 76.1%	654.4 ha / 22.4%	Almost all potential breeding habitat has been avoided There are no impacts to known breeding sites (stick nests)
Swift Parrot	83.7 ha important areas	40.4 ha / 48%	19.9 ha / 49%	20.6 ha / 51%	Approximately half of important areas have been avoided No avoidance of potential important areas has occurred, although it is recognised that only a small area of potential important areas is located within the nominated areas Approximately 75 per cent of potential foraging habitat for the species has been avoided There are no impacts to breeding areas as the species breeds in Tasmania The Plan includes a commitment (Commitment 9) to secure 4,410 ha of potential foraging habitat for the Swift Parrot, including 100 ha of important habitat to offset residual impacts
	2.8 ha potential important areas	0 ha / 0% potential important areas	0 ha / 0% potential important areas	0 ha / 0% potential important areas	
	4,514.3 ha potential foraging habitat	3,414.6 ha / 75.6% potential foraging habitat	2,568.8 ha / 56.9% potential foraging habitat	845.8 ha / 18.7% potential foraging habitat	
White-bellied Sea Eagle*	1,616.6 ha	1,598.9 ha / 98.9%	1,031.8 ha / 63.8%	567.2 ha / 35.1%	Almost all potential breeding habitat has been avoided There are no impacts to known breeding sites (stick nests)

*Impacts relate to potential breeding habitat only

41.4 THEME 2: DO THE COMMITMENTS ADDRESS THE VALUES BEING IMPACTED?

41.4.1 CONTEXT AND METHOD

NSW REQUIREMENTS

The BC Act requires an assessment of the impacts on biodiversity values of the development and the number and class of credits that would be required to be retired if the offset rules under the BC Act applied.

However, the Act does not require that the 'value' of the commitments be calculated in terms of credits and provides broad discretion around defining commitments.

The conservation measures guidelines (DPIE, 2020) specify that it should be explained how the biodiversity values that benefit from the commitments are relevant to the values impacted, and provides that commitments should aim to secure land that contains vegetation and species 'equivalent to the biodiversity values being impacted'.

The Plan includes offset targets (see Chapter 8) for each impacted NSW-listed TEC, which will be delivered within the SCA through a range of commitments, including reserves and biodiversity stewardship agreements.

The analysis of Theme 2 involved an assessment of the adequacy of the offset targets for each impacted NSW listed TEC by examining three key questions:

- Do all impacted TECs have offset targets?
- Are offset targets equivalent to the biodiversity values being impacted?
- Can the SCA deliver the offset targets?

The question:

- 'Are the offset targets equivalent to the biodiversity values being impacted?' was addressed by undertaking an analysis of the credit requirements of the BAM
- Of whether the SCA can deliver the offset targets was addressed by considering the available land within the SCA for offsets and restoration actions, and the overall balance between impacts and offset availability

Both analyses used NSW TECs/PCTs as a surrogate for all biodiversity values and did not examine species outcomes in detail.

Analysis of BAM credit requirements

The purpose of this analysis was to examine whether the offset targets are equivalent to the biodiversity values being impacted. The analysis only covered the impacts within the nominated areas, as BAM plot data that is needed to calculate the credits required for impacts outside the nominated areas was not collected. The offset targets for this analysis were therefore reduced to only account for the nominated area impacts. The approach involved:

- Calculating the number of credits that would be required to be retired to offset the impacts per vegetation zone within the nominated areas. This was done as part of the Assessment Report in accordance with the BAM
- Estimating the number of credits generated within the SCA per vegetation zone. As surveys of the SCA have not been undertaken, this was done on the basis of the BAM plot data gathered in the nominated areas, which was input into the stewardship component of the BAM Calculator
- Determining the amount (ha) of each vegetation zone needed in the SCA to meet the estimated credit requirements of the BAM and comparing this to the offset targets

There are several limitations to the analysis:

- The analysis was based on plot data predominantly collected within development lands rather than within the SCA. Plots completed within the SCA may change the results of the analysis (e.g. if high levels of African Olive is present within an offset site in the SCA, credit generation is likely to decrease)
- In estimating the number of credits potentially generated within the SCA per vegetation zone, an assumption was made that active management would be undertaken on the offset sites to the highest standard allowed by the BAM Calculator. This is considered to be a reasonable assumption as landholders in NSW are often choosing to undertake active management at offset sites in order to generate the highest possible credits (and associated income from selling those credits). However, this may not be likely or possible on all offset sites

COMMONWEALTH REQUIREMENTS

The ToR requires an analysis of the extent to which commitments involving offsets meet the principles of the EPBC Act Environmental Offsets Policy (DSEWPC, 2012). The policy includes eight principles (see Table 41-4) and is accompanied by the EPBC offsets assessment guide (available on the DAWE website). The guide provides a 'balance sheet' approach to estimate the impacts and offsets for threatened species and ecological communities under the EPBC Act.

Offsets are defined as measures that compensate for the residual adverse impacts of an action on the environment (DSEWPC, 2012). Under the offsets policy and guide, suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the environment that is protected by national environmental law and affected by the proposed action (DSEWPC, 2012).

The analysis was undertaken by applying the EPBC offsets assessment guide to principles 1, 3 and 4 of the EPBC Act offsets policy. The other principles are addressed elsewhere in the Assessment Report as shown in Table 41-4.

Consistent with the approach used to analyse matters listed under the BC Act for this theme, the analysis of Commonwealth matters focused on EPBC Act TECs as a surrogate for biodiversity values more broadly and did not examine species outcomes in detail. The impacts assessed, however, include those areas being strategically assessed in addition to the areas being certified. The appropriateness of offsets for species are discussed in Chapters 29 and 30.

Table 41-4: Principles in the EPBC offsets policy

Principle **Suitable offsets must…**	**Approach to analysis**
1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the development	Offsets assessment guide was applied to each Commonwealth listed TEC
2. Be built around direct offsets but may include other compensatory measures	This is described in Part 2
3. Be in proportion to the level of statutory protection that applies to the protected matter	Offsets assessment guide was applied to each Commonwealth listed TEC
4. Be of a size and scale proportionate to the residual impacts on the protected matter	Offsets assessment guide was applied to each Commonwealth listed TEC
5. Effectively account for and manage the risks of the offset not succeeding	Implementation arrangements for the conservation program under the Plan include a process to track delivery of offsets and implement an adaptive response if the delivery of offsets

Principle Suitable offsets must…	Approach to analysis
	is not keeping pace with development impacts (see section 41.10) The Plan includes a monitoring, evaluation, reporting and improvement program (see Part 2 and section 41.10) that will monitor and evaluate the delivery of commitments and actions and the achievement of the Plan's outcomes and implement an adaptive response where necessary to ensure successfully delivery of the conservation program, including offsets
6. Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs	This is evaluated under Theme 5
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable	Implementation arrangements for the conservation program under the Plan include a process to track delivery of offsets and implement an adaptive response if the delivery of offsets is not keeping pace with development impacts (see section 41.10) The Plan includes a monitoring, evaluation, reporting and improvement program (see Part 2 and section 41.10) that will evaluate the efficiency and effectiveness of the delivery of commitments and actions, including offsets, and report on progress of delivery The method to determine the location of the SCA (the Conservation Priorities Method) where offsets will be secured was based on sound conservation planning principles and is set out in Part 2 and in Appendix D of the Plan. Confirmation of the values present at offset sites and the management of offset sites secured as BSAs under the conservation program will be undertaken in accordance with the requirements of the BAM (an agreed method underpinned by science)
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	This is evaluated under Theme 8

Applying the EPBC Act offsets assessment guide

An assessment using the offsets assessment guide was completed for the Commonwealth-listed TECs impacted by the development under the Plan, including:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- Cooks River/Castlereagh Ironbark Forest
- Coastal Swamp Oak (*Casuarina glauca*) Forest
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
- Shale Sandstone Transition Forest
- Western Sydney Dry Rainforest and Moist Woodland on Shale

To complete the assessment the data entered into the offsets assessment guide was derived from a range of sources, most notably the plot data (and associated vegetation integrity score) captured for each vegetation zone

assessed in the BAM assessment. The BAM vegetation integrity score data provides a robust data set and improves the reliability of the calculations completed within the offsets assessment guide.

Assessment of impacts

For the assessment of impacts under the offsets assessment guide (impact calculator), the impacts to each TEC (i.e. total quantum of impact) were calculated for each condition state impacted, including intact, thinned and scattered trees (where relevant). The results for each condition state were then summed to calculate a total quantum of impact for the TEC.

The data entered into the impact calculator is provided in Table 41-5 and includes:

- The status for each TEC
- The area of impact for each TEC condition state consistent with the area calculated in this report
- The quality of the community entered as a score between 0 and 10. The quality data entered for each TEC condition state is based on the vegetation integrity score obtained through the application of the BAM and the associated BAM plots and vegetation integrity scores. As vegetation integrity is measure out of 100 for each TEC condition state the vegetation integrity score was divided by ten and then rounded (following standard rounding rules) to obtain a score out of 10

The total quantum of impact for each TEC condition state is also provided in Table 41-5. The highest total quantum of impact amounts relate to thinned Shale Sandstone Transition Forest, thinned Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, and thinned River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria due to the amount of clearing recorded or the relatively high vegetation quality scores.

Assessment of offsets

As the exact location of offsets under the Plan is currently not known, and therefore the condition of vegetation protected is also unknown, it was not possible to conduct an assessment per condition state for the offset calculator. Therefore, a single assessment was conducted using the offset calculator for each TEC. As condition states on offset sites are likely to vary this approach is considered appropriate.

The data entered into the offset calculator is provided in Table 41-6 and includes:

- The area of proposed offset based on the targets defined under the Plan for each EPBC TEC
- A risk-related time horizon set at the maximum of 20 years and a time until ecological benefit of 10 years
- The start quality of the TEC based on the vegetation integrity score obtained through the application of the BAM and the associated BAM plots and vegetation integrity scores. As a single assessment was completed for each TEC the average vegetation integrity score calculated across the intact, thinned and scattered tree condition states was used to derive the start quality. Consistent with the impact calculator the score was divided by 10 and rounded (using standard rounding rules) to calculate a score out of 10
- The future quality (without offset) of the TEC. In all cases this was one less than the start quality calculated, unless the start quality of the vegetation was 7 or above, where the future quality (without offset) was reduced by two
- The future quality (with offset) of the TEC. To calculate the expected improvement of an offset site the BAM plot data was entered into the stewardship side of BAM credit calculator, as described in above. The improvement predicted by the BAM credit calculator was used to estimate the likely improvement of the EPBC TEC. Consistent with the impact calculator the score was divided by 10 and rounded (using standard rounding rules) to calculate a score out of 10. The analysis revealed that one EPBC TEC (River-flat eucalypt forest on coastal floodplains) could achieve an average future quality (with offset) of 10/10 based on the data entered. As such a high condition level would be difficult to achieve within the Cumberland subregion this score was manually reduced to 9/10
- A risk of loss (without offset) of 20 per cent and a risk of loss (with offset) of 5 per cent
- The confidence in result for both the change in habitat quality and averted loss set to 85 per cent

Table 41-5: Attributes entered into EPBC offsets assessment guide – impact calculator

Threatened Ecological Community	Condition	EPBC Act Status	Quantum of impact (hectares)	Quantum of impact (quality)	Justification	Total quantum of impact (adjusted hectares)
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Intact	Critically Endangered	24.3	6 / 10	Impacts of 24.3 ha are calculated to intact condition CPW. Average vegetation integrity of PCT 724, PCT 849 and PCT 850 from BAM plots conducted in intact condition is 58/100, rounded to 6/10 for use in the EPBC offsets assessment guide	14.59
	Thinned		151.6	4 / 10	Impacts of 151.6 ha are calculated to thinned condition CPW. Average vegetation integrity of PCT 724, PCT 849 and PCT 850 from BAM plots conducted in thinned condition is 40/100, rounded to 4/10 for use in the EPBC offsets assessment guide	60.65
	Scattered trees		4.3	3 / 10	Impacts of 4.3 ha are calculated to scattered tree condition CPW. Average vegetation integrity of PCT 724, PCT 849 and PCT 850 from BAM plots conducted in scattered tree condition is 25.6/100, rounded to 3/10 for use in the EPBC offsets assessment guide	1.29
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Intact	Critically Endangered	15.7	5 / 10	Impacts of 15.7 ha are calculated to intact condition CRCIF. Average vegetation integrity of PCT 725 from BAM plots conducted in intact condition is 49/100, rounded to 5/10 for use in the EPBC offsets assessment guide	7.85
	Thinned		13.4	4 / 10	Impacts of 13.4 ha are calculated to thinned condition CRCIF. Average vegetation integrity of PCT 725 from BAM plots conducted in thinned condition is 43/100, rounded to 4/10 for use in the EPBC offsets assessment guide	5.38
	Scattered trees		1.7	2 / 10	Impacts of 1.7 ha are calculated to scattered tree condition CRCIF. Average vegetation integrity of PCT 725 from BAM plots conducted in scattered tree condition is 20/100, rounded to 2/10 for use in the EPBC offsets assessment guide	0.34

Threatened Ecological Community	Condition	EPBC Act Status	Quantum of impact (hectares)	Quantum of impact (quality)	Justification	Total quantum of impact (adjusted hectares)
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Thinned	Endangered	7.5	5 / 10	Impacts of 7.5 ha are calculated to thinned condition CSOF. Average vegetation integrity of PCT 1800 from BAM plots conducted in thinned condition is 47/100, rounded to 5/10 for use in the EPBC offsets assessment guide	3.74
	Scattered trees		0.5	4 / 10	Impacts of 0.5 ha are calculated to scattered tree condition CSOF. Average vegetation integrity of PCT 1800 from BAM plots conducted in scattered tree condition is 41/100, rounded to 4/10 for use in the EPBC offsets assessment guide	0.2
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Intact	Endangered	30.1	8 / 10	Impacts of 30.1 ha are calculated to intact condition RFEF. Average vegetation integrity of PCT 835 from BAM plots conducted in intact condition is 77/100, rounded to 8/10 for use in the EPBC offsets assessment guide	24.07
	Thinned		95.3	6 / 10	Impacts of 95.3 ha are calculated to thinned condition RFEF. Average vegetation integrity of PCT 835 from BAM plots conducted in thinned condition is 57/100, rounded to 6/10 for use in the EPBC offsets assessment guide	57.18
	Scattered trees		33.9	7 / 10	Impacts of 33.9 ha are calculated to scattered tree condition RFEF. Average vegetation integrity of PCT 835 from BAM plots conducted in scattered tree condition is 69/100, rounded to 7/10 for use in the EPBC offsets assessment guide	23.7
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Intact	Critically Endangered	42.6	7 / 10	Impacts of 42.6 ha are calculated to intact condition SSTF. Average vegetation integrity of PCT 1395 from BAM plots conducted in intact condition is 73/100, rounded to 7/10 for use in the EPBC offsets assessment guide	29.83
	Thinned		124.5	6 / 10	Impacts of 124.5 ha are calculated to thinned condition SSTF. Average vegetation integrity of PCT 1395 from BAM plots conducted in thinned condition is 64/100, rounded to 6/10 for use in the EPBC offsets assessment guide	74.73

Threatened Ecological Community	Condition	EPBC Act Status	Quantum of impact (hectares)	Quantum of impact (quality)	Justification	Total quantum of impact (adjusted hectares)
	Scattered trees		13.6	3 / 10	Impacts of 13.6 ha are calculated to scattered tree condition SSTF. Average vegetation integrity of PCT 1395 from BAM plots conducted in scattered tree condition is 30/100, rounded to 3/10 for use in the EPBC offsets assessment guide	4.07
Western Sydney Dry Rainforest and Moist Woodland on Shale	Intact	Critically Endangered	0.04	5 / 10	Impacts of 0.04 ha are calculated to intact condition WSDRF. Average vegetation integrity of PCT 830 from BAM plots conducted in intact condition is 48/100, rounded to 5/10 for use in the EPBC offsets assessment guide	0.02

Table 41-6: Attributes entered into EPBC offsets assessment guide – offsets calculator

EPBC offsets assessment guide attribute	Value entered	Justification
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest		
Time horizon – Risk-related time horizon (years)	20 years	The offset sites identified, conserved and managed under the Plan will either be dedicated as a reserve under the *National Parks and Wildlife Act 1974* or protected under a Biodiversity Stewardship Agreement (BSA). The longest possible risk-related time horizon of 20 years was therefore selected
Time horizon – Time until ecological benefit (years)	10 years	All offset sites will be funded and managed in perpetuity. The initial phase of active management is likely to lead to a reasonably rapid improvement in site condition in the short to medium term due to the implementation of up-front management activities such as fencing, weed management and supplementary planting. Over the longer term the level of improvement is likely to be more gradual as the sites enter a maintenance phase 10 years has been entered as the time until ecological benefit as the initial phase of active management is expected to increase site condition noticeably in the short to medium term
Start area and quality - Start area (hectares)	665 hectares	The target committed to in the Plan for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
Start area and quality - Start quality (scale of 0 – 10)	4 / 10	Average vegetation integrity of PCT 724, PCT 849 and PCT 850 from BAM plots conducted in all condition states is 41/100, rounded to 4/10 for use in the EPBC offsets assessment guide
Future area and quality without offset – Risk of loss (%)	20%	The lands identified as potential offset sites within the SCA are generally located in western Sydney and are predominantly zoned for rural land uses. Should lands not be protected and managed as offset sites there will be an ongoing risk of loss of the biodiversity values of these lands due to ongoing agricultural practices and continued weed encroachment, grazing pressure and inappropriate access. A risk of loss of 20% is considered appropriate
Future area and quality without offset – Future quality (scale of 0 – 10)	3 / 10	If land is not protected and managed as a reserve or BSA it is highly likely that land will continue to degrade through weed encroachment, grazing pressure and inappropriate access etc. A reduction of 1/10 has been applied
Future area and quality with offset – Risk of loss (%)	5%	All offset land under the Plan will be protected as a reserve or BSA. The risk of loss is therefore considered to be low
Future area and quality with offset – Future quality (scale of 0 – 10)	8 / 10	Average vegetation integrity increase of PCT 724, PCT 849 and PCT 850 from BAM plots conducted in all condition states (assuming active management is undertaken) is 37/100, rounded to 4/10 for use in the EPBC offsets assessment guide. This increase results in a future quality of 8/10 (i.e. increase from the current condition of 4/10 to 8/10)

EPBC offsets assessment guide attribute	Value entered	Justification
Confidence in result (change in habitat quality and averted loss) (%)	85%	There is a relatively high level of confidence in the data entered into the EPBC offsets assessment guide. Much of the data entered is based on plot data collected and the calculations performed as part of the BAM. The BAM provides a scientifically robust and repeatable method to conduct biodiversity assessment. In addition, offset sites are to be protected and managed through reservation or a BSA. The offset sites will be fully funded and managed through an approved management plan
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion		
Time horizon – Risk-related time horizon (years)	20 years	The offset sites identified, conserved and managed under the Plan will either be dedicated as a reserve under the *National Parks and Wildlife Act 1974* or protected under a Biodiversity Stewardship Agreement (BSA). The longest possible risk-related time horizon of 20 years was therefore selected
Time horizon – Time until ecological benefit (years)	10 years	All offset sites will be funded and managed in perpetuity. The initial phase of active management is likely to lead to a reasonably rapid improvement in site condition in the short to medium term due to the implementation of up-front management activities such as fencing, weed management and supplementary planting. Over the longer term the level of improvement is likely to be more gradual as the sites enter a maintenance phase 10 years has been entered as the time until ecological benefit as the initial phase of active management is expected to increase site condition noticeably in the short to medium term
Start area and quality - Start area (hectares)	125 hectares	The target committed to in the Plan for Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion
Start area and quality - Start quality (scale of 0 – 10)	4 / 10	Average vegetation integrity of PCT 725 from BAM plots conducted in all condition states is 37/100, rounded to 4/10 for use in the EPBC offsets assessment guide
Future area and quality without offset – Risk of loss (%)	20%	The lands identified as potential offset sites within the SCA are generally located in western Sydney and are predominantly zoned for rural land uses. Should lands not be protected and managed as offset sites there will be an ongoing risk of loss of the biodiversity values of these lands due to ongoing agricultural practises and continued weed encroachment, grazing pressure and inappropriate access. A risk of loss of 20% is considered appropriate
Future area and quality without offset – Future quality (scale of 0 – 10)	3 / 10	If land is not protected and managed as a reserve or BSA it is highly likely that land will continue to degrade through weed encroachment, grazing pressure and inappropriate access etc. A reduction of 1/10 has been applied
Future area and quality with offset – Risk of loss (%)	5%	All offset land under the Plan will be protected as a reserve or BSA. The risk of loss is therefore considered to be low

EPBC offsets assessment guide attribute	Value entered	Justification
Future area and quality with offset – Future quality (scale of 0 – 10)	8 / 10	Average vegetation integrity increase of PCT 725 from BAM plots conducted in all condition states (assuming active management is undertaken) is 36/100, rounded to 4/10 for use in the EPBC offsets assessment guide. This increase results in a future quality of 8/10 (i.e. increase from the current condition of 4/10 to 8/10)
Confidence in result (change in habitat quality and averted loss) (%)	85%	There is a relatively high level of confidence in the data entered into the EPBC offsets assessment guide. Much of the data entered is based on plot data collected and the calculations performed as part of the BAM. The BAM provides a scientifically robust and repeatable method to conduct biodiversity assessment. In addition, offset sites are to be protected and managed through reservation or a BSA. The offset sites will be fully funded and managed through an approved management plan
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community		
Time horizon – Risk-related time horizon (years)	20 years	The offset sites identified, conserved and managed under the Plan will either be dedicated as a reserve under the *National Parks and Wildlife Act 1974* or protected under a Biodiversity Stewardship Agreement (BSA). The longest possible risk-related time horizon of 20 years was therefore selected
Time horizon – Time until ecological benefit (years)	10 years	All offset sites will be funded and managed in perpetuity. The initial phase of active management is likely to lead to a reasonably rapid improvement in site condition in the short to medium term due to the implementation of up-front management activities such as fencing, weed management and supplementary planting. Over the longer term the level of improvement is likely to be more gradual as the sites enter a maintenance phase 10 years has been entered as the time until ecological benefit as the initial phase of active management is expected to increase site condition noticeably in the short to medium term
Start area and quality - Start area (hectares)	20 hectares	The target committed to in the Plan for Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
Start area and quality - Start quality (scale of 0 – 10)	4 / 10	Average vegetation integrity of PCT 1800 from BAM plots conducted in all condition states is 44/100, rounded to 4/10 for use in the EPBC offsets assessment guide
Future area and quality without offset – Risk of loss (%)	20%	The lands identified as potential offset sites within the SCA are generally located in western Sydney and are predominantly zoned for rural land uses. Should lands not be protected and managed as offset sites there will be an ongoing risk of loss of the biodiversity values of these lands due to ongoing agricultural practises and continued weed encroachment, grazing pressure and inappropriate access. A risk of loss of 20% is considered appropriate
Future area and quality without offset – Future quality (scale of 0 – 10)	3 / 10	If land is not protected and managed as a reserve or BSA it is highly likely that land will continue to degrade through weed encroachment, grazing pressure and inappropriate access etc. A reduction of 1/10 has been applied

EPBC offsets assessment guide attribute	Value entered	Justification
Future area and quality with offset – Risk of loss (%)	5%	All offset land under the Plan will be protected as a reserve or BSA. The risk of loss is therefore considered to be low
Future area and quality with offset – Future quality (scale of 0 – 10)	7 / 10	Average vegetation integrity increase of PCT 1800 from BAM plots conducted in all condition states (assuming active management is undertaken) is 30/100, rounded to 3/10 for use in the EPBC offsets assessment guide. This increase results in a future quality of 7/10 (i.e. increase from the current condition of 4/10 to 7/10)
Confidence in result (change in habitat quality and averted loss) (%)	85%	There is a relatively high level of confidence in the data entered into the EPBC offsets assessment guide. Much of the data entered is based on plot data collected and the calculations performed as part of the BAM. The BAM provides a scientifically robust and repeatable method to conduct biodiversity assessment. In addition, offset sites are to be protected and managed through reservation or a BSA. The offset sites will be fully funded and managed through an approved management plan
Shale Sandstone Transition Forest in the Sydney Basin Bioregion		
Time horizon – Risk-related time horizon (years)	20 years	The offset sites identified, conserved and managed under the Plan will either be dedicated as a reserve under the *National Parks and Wildlife Act 1974* or protected under a Biodiversity Stewardship Agreement (BSA). The longest possible risk-related time horizon of 20 years was therefore selected
Time horizon – Time until ecological benefit (years)	10 years	All offset sites will be funded and managed in perpetuity. The initial phase of active management is likely to lead to a reasonably rapid improvement in site condition in the short to medium term due to the implementation of up-front management activities such as fencing, weed management and supplementary planting. Over the longer term the level of improvement is likely to be more gradual as the sites enter a maintenance phase 10 years has been entered as the time until ecological benefit as the initial phase of active management is expected to increase site condition noticeably in the short to medium term
Start area and quality - Start area (hectares)	675 hectares	The target committed to in the Plan for Shale Sandstone Transition Forest in the Sydney Basin Bioregion
Start area and quality - Start quality (scale of 0 – 10)	6 / 10	Average vegetation integrity of PCT 1395 from BAM plots conducted in all condition states is 56/100, rounded to 6/10 for use in the EPBC offsets assessment guide
Future area and quality without offset – Risk of loss (%)	20%	The lands identified as potential offset sites within the SCA are generally located in western Sydney and are predominantly zoned for rural land uses. Should lands not be protected and managed as offset sites there will be an ongoing risk of loss of the biodiversity values of these lands due to ongoing agricultural practises and continued weed encroachment, grazing pressure and inappropriate access. A risk of loss of 20% is considered appropriate

EPBC offsets assessment guide attribute	Value entered	Justification
Future area and quality without offset – Future quality (scale of 0 – 10)	5 / 10	If land is not protected and managed as a reserve or BSA it is highly likely that land will continue to degrade through weed encroachment, grazing pressure and inappropriate access etc. A reduction of 1/10 has been applied
Future area and quality with offset – Risk of loss (%)	5%	All offset land under the Plan will be protected as a reserve or BSA. The risk of loss is therefore considered to be low
Future area and quality with offset – Future quality (scale of 0 – 10)	9 / 10	Average vegetation integrity increase of PCT 1395 from BAM plots conducted in all condition states (assuming active management is undertaken) is 32/100, rounded to 3/10 for use in the EPBC offsets assessment guide. This increase results in a future quality of 9/10 (i.e. increase from the current condition of 6/10 to 9/10)
Confidence in result (change in habitat quality and averted loss) (%)	85%	There is a relatively high level of confidence in the data entered into the EPBC offsets assessment guide. Much of the data entered is based on plot data collected and the calculations performed as part of the BAM. The BAM provides a scientifically robust and repeatable method to conduct biodiversity assessment. In addition, offset sites are to be protected and managed through reservation or a BSA. The offset sites will be fully funded and managed through an approved management plan
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria		
Time horizon – Risk-related time horizon (years)	20 years	The offset sites identified, conserved and managed under the Plan will either be dedicated as a reserve under the *National Parks and Wildlife Act 1974* or protected under a Biodiversity Stewardship Agreement (BSA). The longest possible risk-related time horizon of 20 years was therefore selected
Time horizon – Time until ecological benefit (years)	10 years	All offset sites will be funded and managed in perpetuity. The initial phase of active management is likely to lead to a reasonably rapid improvement in site condition in the short to medium term due to the implementation of up-front management activities such as fencing, weed management and supplementary planting. Over the longer term the level of improvement is likely to be more gradual as the sites enter a maintenance phase 10 years has been entered as the time until ecological benefit as the initial phase of active management is expected to increase site condition noticeably in the short to medium term
Start area and quality - Start area (hectares)	570 hectares	The target committed to in the Plan for River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
Start area and quality - Start quality (scale of 0 – 10)	7 / 10	Average vegetation integrity of PCT 835 from BAM plots conducted in all condition states is 67/100, rounded to 7/10 for use in the EPBC offsets assessment guide

EPBC offsets assessment guide attribute	Value entered	Justification
Future area and quality without offset – Risk of loss (%)	20%	The lands identified as potential offset sites within the SCA are generally located in western Sydney and are predominantly zoned for rural land uses. Should lands not be protected and managed as offset sites there will be an ongoing risk of loss of the biodiversity values of these lands due to ongoing agricultural practises and continued weed encroachment, grazing pressure and inappropriate access. A risk of loss of 20% is considered appropriate
Future area and quality without offset – Future quality (scale of 0 – 10)	5 / 10	If land is not protected and managed as a reserve or BSA it is highly likely that land will continue to degrade through weed encroachment, grazing pressure and inappropriate access etc. A reduction of 1/10 has been applied
Future area and quality with offset – Risk of loss (%)	5%	All offset land under the Plan will be protected as a reserve or BSA. The risk of loss is therefore considered to be low
Future area and quality with offset – Future quality (scale of 0 – 10)	9 / 10	Average vegetation integrity increase of PCT 835 from BAM plots conducted in all condition states (assuming active management is undertaken) is 26/100, rounded to 3/10 for use in the EPBC offsets assessment guide. This increase results in a future quality of 10/10 (i.e. increase from the current condition of 7/10 to 10/10). Assuming a condition of 10/10 may not be achievable in the context of the Cumberland subregion 9/10 was entered into the EPBC offsets assessment guide
Confidence in result (change in habitat quality and averted loss) (%)	85%	There is a relatively high level of confidence in the data entered into the EPBC offsets assessment guide. Much of the data entered is based on plot data collected and the calculations performed as part of the BAM. The BAM provides a scientifically robust and repeatable method to conduct biodiversity assessment. In addition, offset sites are to be protected and managed through reservation or a BSA. The offset sites will be fully funded and managed through an approved management plan
Western Sydney Dry Rainforest and Moist Woodland on Shale		
Time horizon – Risk-related time horizon (years)	20 years	The offset sites identified, conserved and managed under the Plan will either be dedicated as a reserve under the *National Parks and Wildlife Act 1974* or protected under a Biodiversity Stewardship Agreement (BSA). The longest possible risk-related time horizon of 20 years was therefore selected
Time horizon – Time until ecological benefit (years)	10 years	All offset sites will be funded and managed in perpetuity. The initial phase of active management is likely to lead to a reasonably rapid improvement in site condition in the short to medium term due to the implementation of up-front management activities such as fencing, weed management and supplementary planting. Over the longer term the level of improvement is likely to be more gradual as the sites enter a maintenance phase 10 years has been entered as the time until ecological benefit as the initial phase of active management is expected to increase site condition noticeably in the short to medium term
Start area and quality - Start area (hectares)	0.2 hectares	The target committed to in the Plan for Western Sydney Dry Rainforest and Moist Woodland on Shale

EPBC offsets assessment guide attribute	Value entered	Justification
Start area and quality - Start quality (scale of 0 – 10)	3 / 10	Average vegetation integrity of PCT 830 from BAM plots conducted in all condition states is 34/100, rounded to 3/10 for use in the EPBC offsets assessment guide
Future area and quality without offset – Risk of loss (%)	20%	The lands identified as potential offset sites within the SCA are generally located in western Sydney and are predominantly zoned for rural land uses. Should lands not be protected and managed as offset sites there will be an ongoing risk of loss of the biodiversity values of these lands due to ongoing agricultural practises and continued weed encroachment, grazing pressure and inappropriate access. A risk of loss of 20% is considered appropriate
Future area and quality without offset – Future quality (scale of 0 – 10)	2 / 10	If land is not protected and managed as a reserve or BSA it is highly likely that land will continue to degrade through weed encroachment, grazing pressure and inappropriate access etc. A reduction of 1/10 has been applied
Future area and quality with offset – Risk of loss (%)	5%	All offset land under the Plan will be protected as a reserve or BSA. The risk of loss is therefore considered to be low
Future area and quality with offset – Future quality (scale of 0 – 10)	6 / 10	Average vegetation integrity increase of PCT 1395 from BAM plots conducted in all condition states (assuming active management is undertaken) is 27/100, rounded to 3/10 for use in the EPBC offsets assessment guide. This increase results in a future quality of 6/10 (i.e. increase from the current condition of 3/10 to 6/10)
Confidence in result (change in habitat quality and averted loss) (%)	85%	There is a relatively high level of confidence in the data entered into the EPBC offsets assessment guide. Much of the data entered is based on plot data collected and the calculations performed as part of the BAM. The BAM provides a scientifically robust and repeatable method to conduct biodiversity assessment. In addition, offset sites are to be protected and managed through reservation or a BSA. The offset sites will be fully funded and managed through an approved management plan

41.4.2 ANALYSIS

NSW REQUIREMENTS

Do all impacted PCTs have offset targets?

Each impacted PCT has an associated offset target and therefore the commitments are addressing each value being impacted (see Table 41-8). The SCA also contains substantial areas of each impacted PCT (see Table 41-8).

Are offset targets equivalent to the biodiversity values being impacted?

The Department developed an approach for defining offset targets to ensure that the commitments address the biodiversity values being impacted. The offset target method determined offset targets on the basis of the amount (ha) of each impacted matter, the conservation status of the impacted matter and the condition of the impacted matter.

Credit analysis

To determine whether the offset targets are equivalent to the biodiversity values being impacted, the Department undertook an analysis based on the estimated credit requirements of the BAM.

It is important to note that this analysis only took into account the impacts within the nominated areas, including the impacts from urban development and the major transport corridors.

Table 41-7 shows:

- The credits required to be retired to offset the impacts of each impacted PCT within the nominated areas
- The amount of offset land (ha) needed to generate the required credits to offset the impacts on each PCT under the high intensity management scenario. The range of values shown in the table (columns 4 and 5) reflect the different amounts of credits generated at the offset site for the different condition states of each vegetation zone that is part of a PCT (e.g. based on the BAM data collected within the nominated areas, the area to offset 1 ha of impact to PCT 725 intact condition state requires 3.1 ha of PCT 725 scattered trees, while the amount of thinned condition PCT 725 is 2.2 ha)
- The offset targets (these account only for impacts within the nominated areas)
- The difference (ha) between the amount of offset land needed to generate the required credits to offset the impacts on each PCT and the current offset targets

The table shows that the total offset target for PCTs (5,325 ha) is estimated to be broadly within the range required to satisfy the BAM credit requirements (between 4,124 ha and 8,573 ha). However, the offset target is at the lower end of the range, which suggests that high intensity management for a proportion of offset sites may potentially be needed to ensure the Plan satisfies the BAM credit requirements (noting this is not a requirement of the BC Act).

The offset targets are estimated to generally satisfy the minimum credit requirements of the BAM for seven of the nine impacted PCTs. However, the offset targets are estimated not to meet the minimum credit requirements of the BAM for two PCTs:

- PCT 781: there is an estimated shortfall of about 6.4 ha
- PCT 835: there is an estimated shortfall of about 192.0 ha

See the following section (‘Can the SCA deliver the offset targets?’) for information about these two PCTs and whether there is enough of each PCT in the SCA to potentially satisfy the BAM credit requirements.

Table 41-7: Analysis of adequacy of offset targets for impacts within the nominated areas on the basis of credits

Impacted PCTs	Area impacted (ha)	Total credits required	Minimum amount of PCT needed to generate required credits (high intensity management scenario)^ (ha)	Maximum amount of PCT needed to generate required credits (high intensity management scenario)^ (ha)	Offset target (ha)*	Difference between offset target and minimum amount of PCT needed to generate required credits (ha)
724	108.3	1,852	185.6	265.4	285	99.4
725	37.6	827	75.2	103.4	115	39.8
781	4.2	131	16.4	16.4	10	-6.4
830	0.1	2	0.1	0.3	0.2	0.1
835	185.9	5,576	697.0	929.3	505	-192.0
849	677.2	13,697	1,245.2	3,424.3	2,150	904.8
850	254.3	4,692	426.6	1,173.3	735	308.4
1395	459.8	12,700	1,411.1	2,540.0	1,455	43.9
1800	26.2	605	67.2	121.0	70	2.8
Total	**1,753.6**	**40,082**	**4,124.4**	**8,573.3**	**5,325.2**	**1,200.8**

^ High intensity management scenario assumes that all offset sites are subject to ongoing and intensive conservation management

*These offset targets account for development impacts within the nominated areas only (excluding major transport corridors outside the nominated areas). Also, this figure represents the target that is proposed to be met through land-based measures (90 per cent of the total offset target). The other 10 per cent of the offset target will be met through other non-land based measures, such as threat management

Can the SCA deliver the offset targets?

This question is addressed by analysing the available land within the SCA for offsets and restoration actions, and the overall balance between impacts and offset availability for each impacted PCT.

Table 41-8 shows the offset targets for each PCT impacted by the nominated areas and major transport corridors within the nominated areas and the overall balance between offset target and offset availability within the SCA.

The table shows that the majority of PCTs (5 of 9) have enough PCT available within the SCA to meet the offset targets. For 4 of those 5 PCTs, there is significantly more PCT available in the SCA than needed to meet the targets.

For the 5 PCTs with enough PCT available in the SCA, achieving the offset targets would require an average of only 25 per cent of the total amount of each PCT available within the SCA to be secured (i.e. the SCA contains an average of almost four times the amount of PCT needed to meet the offset targets for these PCTs).

Two PCTs have small shortfalls in availability in the SCA:

- PCT 725 – there is a shortfall of about 48 ha
- PCT 1800 – there is a shortfall of about 61 ha

Two PCTs (PCT 724 and PCT 849) have relatively large shortfalls of 196 and 649 ha respectively.

Addressing the shortfall through ecological restoration

The Plan aims to largely address the offset target shortfall for these four PCTs through ecological restoration.

Table 41-8 shows an initial estimate of restoration potential in the SCA for each PCT. This is an initial estimate only, and was made by limited ground-truthing and intersecting a map of pre-1750 native vegetation (Tozer, Turner et al., 2010) with cleared or highly degraded land to identify cleared or degraded areas where PCTs may have previously occurred. The suitability of these areas for restoration will be confirmed during implementation of the Plan, including on the basis of site investigations.

The initial estimate of restoration potential in the SCA indicates restoration has the potential to:

- Negate the shortfall for PCT 849 in the SCA
- Reduce the shortfall for PCT 724 to about 189 ha and PCT 725 to about 22 ha (see Table 41-8)

For PCT 1800, it is important to note the mapping within the Plan Area may be inaccurate as the PCT was not mapped by some regional vegetation maps being used in this assessment, and is likely to be mapped in the Cumberland subregion as part of other PCTs.

Potential shortfalls in PCTs 724 and 725

While restoration may reduce the shortfall of PCT 724 and 725, shortfalls are likely to remain. If the offset targets cannot be met within the SCA, the shortfalls will be reduced by sourcing offsets from outside the SCA or Cumberland subregion for these particular PCTs. This is allowed for by the selection steps in the conservation program.

Potential shortfall in PCT 849

While restoration may negate the offset target shortfall for PCT 849, an additional option to address any residual shortfall for the PCT is by securing the excess amount of PCT 850 in the SCA.

PCT 849 and PCT 850 are both part of Cumberland Plain Woodland, meaning that PCT 849 may be addressed through commitments that secure PCT 850 under the offset rules under the BC Regulation. This option is likely to be feasible as the SCA contains over 2,950 ha of surplus PCT 850 (after the offset target for PCT 850 has been met (see Table 41-8)).

Availability of PCTs in the SCA estimated not to meet BAM credit requirements

Table 41-9 shows the two PCTs whose offset targets are estimated to not meet the minimum credit requirements of the BAM (see above) and whether there is enough PCT in the SCA to potentially satisfy the BAM credit requirements.

The table shows that there are sufficient amounts of each PCT available in the SCA to meet the estimated amount needed to satisfy the minimum BAM credit requirements. This suggests that the SCA has the potential to achieve the minimum BAM credit requirements for these PCTs. As the Plan also has targets for TECs and species, there is the potential for the shortfall in these PCTs to be meet through these other targets.

Table 41-8: Availability of PCTs impacted by the urban capable land and major transport corridors in the nominated areas

Impacted PCTs	Area impacted^ (ha)	Offset target (ha)*	Area of PCT available in the SCA (ha)	Difference between offset target and available PCT in the SCA (ha)	Offset target as percentage of total area of PCT in the SCA (%)	Initial estimate of restoration potential in the SCA (ha)	Residual gap if restoration potential achieved (ha)
724	108.3	285	88.8	-196.2	320.9	7.7	-188.5
725	37.6	115	66.7	-48.3	172.4	26.4	-21.9
781	4.2	10	56.3	46.3	17.8	2.8	49.1
830	0.1	0.2	717.1	716.9	0.0	114.1	831.0
835	185.9	505	884.2	379.2	57.1	1290.5	1669.7
849	677.2	2,150	1,500.8	-649.2	143.3	1918.0	1268.8
850	254.3	735	3,693.2	2,958.2	19.9	2206.5	5164.7
1395	459.8	1,455	5,069.8	3,614.8	28.7	1784.2	5399.0
1800	26.2	70	8.7	-61.3	804.6	0.0	-61.3
Total	**1,753.6**	**5,325.2**	**12,085.6**	**-**	**-**	**7,350.2**	**-**

^This includes all impacts in nominated areas

*These offset targets account for development impacts within the nominated areas only (excluding major transport corridors outside the nominated areas). Also, this figure represents the target that is proposed to be met through land-based measures (90 per cent of the total offset target).

Table 41-9: Availability of PCTs in the SCA estimated not to meet the minimum credit requirements of the BAM

Target PCTs	Minimum amount of PCT needed to generate required credits (high intensity management scenario) (ha)	Offset target*	Difference between offset target and minimum amount of PCT needed to generate required credits (ha)	Area of PCTs in SCA (ha)	Difference between minimum amount of PCT needed to generate required credits (ha) and area of PCT available in SCA (ha)
781	16.4	10.0	-6.4	56.3	39.9
835	697.0	505.0	-192.0	884.2	187.2

*Offset targets for the nominated areas only (excluding major transport corridors outside the nominated areas)

COMMONWEALTH REQUIREMENTS

Consistency with EPBC Act environmental offsets policy

The results of the EPBC Act environmental offsets policy analysis are provided in Table 41-10. Based on the requirements of the offsets assessment guide, all of the TECs meet the offset requirements needed to be consistent with the EPBC Environmental Offsets Policy by achieving a score greater than 90 per cent.

The highest of these is Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (187.4 per cent), followed by Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (176.8 per cent) and Western Sydney Dry Rainforest and Moist Woodland on Shale (161.4 per cent).

The results for Shale Sandstone Transition Forest and Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community are lower, but are still greater than 100 per cent (106.7 per cent and 158.1 per cent respectively).

Only one of the TECs did not achieve a result higher than 100 per cent, being River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (93.2 per cent), however still exceeds the 90 per cent minimum threshold.

Table 41-10: Results of EPBC offsets assessment

EPBC TEC	Condition	Listing Status	EPBC offsets assessment guide – impact calculator			EPBC offsets assessment guide – offsets calculator		
			Total impact (ha)	Total quantum of impact (adjusted ha)	Summed quantum of impact (adjusted ha)	Offset target (90 %) (ha)	Total net present value of the offset (adjusted ha)	% of impact offset
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Intact	Critically Endangered	24.3	14.59	76.53	665	135.3	176.8
	Thinned		151.6	60.65				
	Scattered trees		4.3	1.29				
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Intact	Critically Endangered	15.7	7.85	13.57	125	25.4	187.4
	Thinned		13.44	5.38				
	Scattered trees		1.7	0.34				
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Thinned	Endangered	7.5	3.74	3.94	20	6.2	158.1
	Scattered trees		0.5	0.20				
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Intact	Critically Endangered	30.1	24.07	104.95	570	97.8	93.2
	Thinned		95.3	57.18				
	Scattered trees		33.9	23.70				
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Intact	Critically Endangered	42.6	29.83	108.63	675	115.9	106.7
	Thinned		124.5	74.73				
	Scattered trees		13.6	4.07				
Western Sydney Dry Rainforest and Moist Woodland on Shale	Intact	Critically Endangered	0.04	0.02	0.02	0.2	0.03	161.4

Availability of EPBC TECs in the SCA

A further assessment of Commonwealth-listed TECs was conducted to determine if the offset target for each TEC was present and feasible within the SCA. The results are shown in Table 41-11.

The SC is estimated to have enough available habitat to broadly satisfy the offset required for four of the five TECs.

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland has a relatively small shortfall of 18.1 ha, and as discussed above is not broadly mapped outside the nominated areas. It is expected that this community has a wider distribution outside of the nominated areas and should therefore be available in the SCA.

Cooks River/Castlereagh Ironbark Forest has a shortfall of 72.5 ha. As discussed above and displayed in Table 41-8, 26 ha of restoration potential for PCT 725 is available in the SCA. This additional area of restoration would assist in meeting the offset requirement for Cooks River/Castlereagh Ironbark Forest, with further offsets potentially sourced outside the SCA for this TEC. This would be consistent with the selection steps in the conservation program.

Table 41-11: Area in the SCA of impacted Commonwealth-listed TECs

TEC Name	TEC offset target (ha)	Area of TECs in the SCA	Difference between offset target and area of TECs available in the SCA (ha)
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	20	1.9	-18.1
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	125	52.5	-72.5
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	665	2,129.7	1,464.7
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	570	891.3	321.3
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	675	4,257.7	3,582.7
Western Sydney Dry Rainforest and Moist Woodland on Shale	0.2	474.4	474.2
Total	**2,055.2**	**7,807.5**	**5,752.3**

41.4.3 CONCLUSION

The analysis demonstrates that the commitments broadly address the values being impacted because:

NSW requirements

- Each impacted NSW TEC/PCT has an associated offset target
- The total offset target for NSW TECs/PCTs (5,325 ha) is estimated to be broadly within the range required to satisfy the BAM credit requirements (between 4,154 ha and 8,615 ha)
- The offset targets are estimated to generally satisfy the minimum credit requirements of the BAM for the majority (7 of 9) of the impacted NSW TECs/PCTs
- The majority of NSW TECs/PCTs (5 of 9) have enough PCT available within the SCA to meet the offset targets. For 4 of those 5 PCTs, there is significantly more PCT available in the SCA than needed to meet the targets
- For the 5 NSW TECs/PCTs with enough PCT available in the SCA, achieving the offset targets would require an average of only 25 per cent of the total amount of each PCT available within the SCA to be secured (i.e. the SCA contains an average of almost four times the amount of PCT needed to meet the offset targets for these PCTs)

- For the four NSW TECs/PCTs with a shortfall of available PCTs in the SCA:
  - Two of the PCTs – 725 and 1800 – have only small shortfalls (less than 65 ha)
  - An initial estimate of restoration potential in the SCA indicates restoration has the potential to reduce the shortfall for both PCT 725 PCT 724 to about 22 ha and 189 ha respectively
  - The offset for PCT 1800 is likely to be met as shortfall is generally a result of a lack of available mapping outside of the nominated areas
- While PCT 724 has a large shortfall, offsets may be sourced outside of the SCA for this PCT. This is allowed for by the selection steps in the conservation program
- While PCT 849 has a large shortfall:
  - An initial estimate of restoration potential in the SCA indicates restoration can negate this shortfall
  - The SCA contains over 2,950 ha of surplus PCT 850, which may be secured instead of PCT 849 to meet the shortfall, consistent with the offset rules under the BC Regulation

Commonwealth requirements

- The Commonwealth-listed TEC offset targets meet the requirements of the EPBC Act Environmental Offsets Policy when assessed on the basis of the requirements of the offsets assessment guide
- The SCA contains enough Commonwealth-listed TECs to broadly satisfy the offset target for four of the six TECs. The shortfall for Cooks River/Castlereagh Ironbark Forest (73 ha) could be partially negated through the restoration of PCT 725 within the SCA, which is estimated to be 26 ha
- As described above Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland has a relatively small shortfall of 18.1 ha, and is not broadly mapped outside the nominated areas. It is expected that this community has a wider distribution outside of the nominated areas and should therefore be available in the SCA

In concluding that the commitments broadly address the values being impacted, it is important to note that the Plan will implement several commitments to manage broad landscape threats in strategic locations in the Cumberland subregion, particularly to reduce threats to land secured in the SCA, including:

- Weeds (Commitment 15)
- Pest animals (Commitment 16)
- Fire (Commitment 17)
- Disease (Commitment 18)

These commitments are expected to substantially enhance the biodiversity benefits of securing land in the SCA.

Furthermore, while only initial estimates of restoration potential in the SCA have been made so far, the Plan includes a range of actions to ensure restoration is effective, including developing a Restoration Implementation Strategy (Commitment 13) in consultation with key stakeholders and delivery partners to:

- Provide a clear purpose for undertaking restoration, including how the Plan will meet its restoration target for impacted native vegetation communities
- Identify restoration potential of land within priority sites
- Provide guidance on restoration expectations at priority sites

Despite this overall conclusion that the commitments broadly address the values being impacted, there are several key risks with achieving the offset targets:

- A substantial proportion of private landholders within the SCA must be willing to either voluntarily secure their land as offsets or sell their land to the NSW Government to establish reserves
- The SCA covers large parts of the remaining native vegetation within the Cumberland subregion and there is likely to be demand from other development projects for offsets within these areas. This may reduce the actual availability of offsets within the SCA for the development under the Plan
- Native vegetation mapping within the SCA outside the nominated areas is based broadly on existing maps with rapid assessments conducted at key locations. Detailed site assessment of the SCA may increase or reduce the actual amount of each TEC contained within the SCA

Applying appropriate mechanisms for securing offsets within the SCA will be critical in achieving the offset targets over the life of the Plan. Implementation arrangements for the conservation program are discussed in Section 41.10.

41.5 THEME 3: DO THE COMMITMENTS ADDRESS THE MOST IMPORTANT BIODIVERSITY VALUES?

41.5.1 CONTEXT AND METHOD

The strategic certification guidelines (DPIE, 2020) provide that commitments should prioritise the protection of important biodiversity values and set out a range of matters that commitments should be designed to protect, including:

- Critically endangered TECs and species
- Entities at risk of SAII
- Habitat connectivity (this is addressed in Section 41.6)
- Large contiguous patches of native vegetation (this is addressed in Section 41.6)
- Biodiversity values that are poorly represented in existing reserves within the subregion
- Areas identified as high priority by governments for conservation

The analysis of Theme 3 involved determining the extent to which the SCA contains these categories of matters:

- Habitat for critically endangered TECs and species within the SCA was analysed using GIS on the basis of TEC, PCT and/or species habitat maps developed for this Assessment Report
- Biodiversity values poorly represented in existing reserves were analysed using GIS based on data on the distribution of PCTs in the Cumberland subregion and the boundaries of existing reserves (including reserves under the *National Parks and Wildlife Act 1974* (NP&W Act), BioBank sites and Biodiversity Stewardship Agreements)
- Areas identified as high priority by governments for conservation were analysed using GIS on the basis of BIO Map core and corridors (OEH, 2015) and the EES biodiversity values map (OEH, 2019a)

The analysis also included consideration of the potential feasibility of achieving the offsets targets for species with specific offset targets (see Part 2). This was done by compiling the following information for each species:

- Number of Biodiversity Stewardship sites with 'issued' credits for the species (both Biobanking Public Register and BOS Public Register)
- Number of Biodiversity Stewardship Expressions of Interest (EOI) for the species (only EOIs since January 2017) (both Biobanking Public Register and BOS Public Register)
- Number of Biodiversity Stewardship sites with credits 'pending' for the species (BOS Public Register)
- Number of BioNet and project records in the SCA
- Number of areas in the SCA in which BioNet and project records occur

Note that searches of public registers for this analysis were limited to the Cumberland and adjacent subregions.

41.5.2 ANALYSIS

HABITAT FOR CRITICALLY ENDANGERED TECS AND SPECIES

The SCA was designed to include Commonwealth and NSW-listed TECs and potential habitat for species, including critically endangered and endangered matters, to ensure the offset targets for matters impacted by the development can be met. Offset targets have been established for:

- The five Commonwealth-listed TECs directly impacted under the Plan
- The eight NSW-listed TECs directly impacted under the Plan
- Seventeen Commonwealth and NSW-listed species likely to be at risk of residual adverse impacts from the direct impacts of development under the Plan

Threatened ecological communities

Table 41-12 and Table 41-13 show:

- Each impacted Commonwealth and NSW-listed TEC (critically endangered TECs are highlighted in blue)
- Amount (ha) of each TEC in the SCA
- The offset target specific to the TEC

The tables show that the SCA contains each impacted TEC, and that each TEC has an offset target.

Table 41-12: Area in the SCA of impacted Commonwealth-listed TECs

Associated PCTs	TEC	Cth status	Area of TEC in SCA (ha)	Specific offset target (ha)
1800	Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland	E	2	20
725	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	CE	52	125
724, 849, 850	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	2,129	665
792, 1281, 1395	Shale Sandstone Transition Forest in the Sydney Basin Bioregion	CE	4,257	675
835	River-flat Eucalypt Forest on Coastal Floodplains	CE	891	570

Table 41-13: Area in the SCA of impacted NSW-listed TECs

Associated PCTs	NSW TEC	NSW status	Area of TEC in the SCA (ha)	Specific offset target (ha)
724	Shale Gravel Transition Forest	E	89	285
725	Cooks River/Castlereagh Ironbark Forest	E	67	115
781	Freshwater Wetlands on Coastal Floodplains	E	56	10
830	Moist Shale Woodland	E	717	0.2
835	River-flat Eucalypt Forest	E	884	505
849, 850	Cumberland Plain Woodland	CE	5,194	2,885
1395	Shale Sandstone Transition Forest	CE	5,064	1,455
1800	Swamp Oak Floodplain Forest	E	9	70

Threatened species

Amount of potential habitat for each species in the SCA

Table 41-14 shows:

- Each Commonwealth and NSW-listed species (critically endangered species are highlighted in blue) assessed in this Assessment Report and potentially impacted by the development under the Plan
- Amount (ha) of potential habitat for each species in the SCA
- Any offset targets relevant to the species

In relation to offset targets, some species have specific offset targets to secure areas of known habitat or offset locations (see Chapter 8). Other species do not have specific offset targets but are likely to benefit from the offset targets for NSW TECs and Commonwealth-listed TECs, as those TECs provide potential habitat for the species.

The amount of potential habitat (ha) for each species that will be secured in the SCA because of the NSW TEC offset targets is shown in the last column of Table 41-14.

The table shows that:

- The SCA contains potential habitat for the vast majority of potentially impacted species
- Most species also either have a specific offset target or will benefit from the NSW TEC offset targets, which will lead to the securing of potential habitat in the SCA for these species under the Plan

Table 41-14: Area of potential habitat in the SCA for Cth and NSW listed species assessed in the report

Scientific name	Common name	Cth status	NSW status	Area of potential habitat in SCA based on species mapping (ha)	Offset target	Potential habitat secured through NSW TEC/PCT target based on PCT associations
Acacia bynoeana	Bynoe's Wattle	V	E	6,321.6	No	4,005
Acacia pubescens	Downy Wattle	V	V	3,781.3	No	4,740
Allocasuarina glareicola		E	E	453.7	No	400
Anthochaera phrygia	Regent Honeyeater	CE	CE	17,178	No	5,315.2
Botaurus poiciloptilus	Australasian Bittern	E	E	300.3	No	515
Callocephalon fimbriatum	Gang-gang Cockatoo		V	15,376	No	5,245
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	8,728	No	1,740
Cercartetus nanus	Eastern Pygmy-possum		V	16,927.6	No	4,845
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	11,613.9	No	5,315.2
Commersonia prostrata	Dwarf Kerrawang	E	E	0.2	No	0
Cynanchum elegans	White-flowered Wax Plant	E	E	1,569.3	2 offset locations	3,390.2
Dasyurus maculatus maculatus	Spot-tailed Quoll	E	V	11,894.9	No	5,325.2
Deyeuxia appressa		E	E	0	No	70
Dillwynia tenuifolia			V	6,098.8	3 offset locations	4,005
Epacris purpurascens var. *purpurascens*			V	9,122.8	No	1,570
Eucalyptus benthamii	Camden White Gum	V	V	1,442.5	No	2,655
Genoplesium baueri	Yellow Gnat-orchid	E	E	460.7	No	0

Scientific name	Common name	Cth status	NSW status	Area of potential habitat in SCA based on species mapping (ha)	Offset target	Potential habitat secured through NSW TEC/PCT target based on PCT associations
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea		V	5,451.4	3 offset locations	3,285
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	2,924.3	No	1,855
Haliaeetus leucogaster	White-bellied Sea-Eagle		V	13,699.6	1 offset location	5,325
Heleioporus australiacus	Giant Burrowing Frog	V	V	2,065.6	No	1,855
Hibbertia fumana			CE	1,665.5	1 offset location	400
Hibbertia puberula			E	7,739.8	1 offset location	1,455
Hibbertia puberula subsp. *glabrescens*		CE	CE	0	No	620
Hieraaetus morphnoides	Little Eagle		V	17,566.5	1 offset location	5,325
Hoplocephalus bungaroides	Broad-headed Snake	V	E	3,701.2	No	0
Lathamus discolor	Swift Parrot	CE	E	17,178 (1,103 ha of important habitat)	4,410 ha of potential foraging habitat, including 100 ha of important habitat	5,315.2
Leucopogon exolasius	Woronora Beard-heath	V	V	128.3	No	0
Litoria aurea	Green and Golden Bell Frog	V	E	462.3	No	5,325.2
Lophoictinia isura	Square-tailed Kite		V	17,322.6	1 offset location	5,325
Macquaria australasica	Macquarie Perch	E		0	No	70
Marsdenia viridiflora subsp. *viridiflora* - *endangered population*			E	10,471.8	2 offset locations	5,315
Maundia triglochinoides			V	8.7	No	80

Scientific name	Common name	Cth status	NSW status	Area of potential habitat in SCA based on species mapping (ha)	Offset target	Potential habitat secured through NSW TEC/PCT target based on PCT associations
Melaleuca deanei	Deane's Melaleuca	V	V	7,466.4	No	1,455
Meridolum corneovirens	Cumberland Plain Land Snail		E	13,126.5	3 offset locations	5,245
Micromyrtus minutiflora		V	E	3,518.4	No	400
Myotis macropus	Southern Myotis		V	16,234.6	1 offset location	5,325
Ninox connivens	Barking Owl		V	15,038.1	No	5,315
Ninox strenua	Powerful Owl		V	15,247.2	No	5,315
Persicaria elatior	Tall Knotweed	V	V	113.2	No	585
Persoonia bargoensis	Bargo Geebung	V	E	5,222.1	No	3,605
Persoonia glaucescens	Mittagong Geebung	V	E	1,390.1	No	0
Persoonia hirsuta	Hairy Geebung	E	E	2,566.6	No	4,915
Persoonia nutans	Nodding Geebung	E	E	1,365	2 offset locations	1,855
Petauroides volans	Greater Glider	V		9,661	No	4,845.2
Petaurus norfolcensis	Squirrel Glider		V	16,006.7	No	5,315
Phascolarctos cinereus	Koala	V	V	7,634.8	570 ha of important habitat	5,315.2
Pimelea curviflora var. *curviflora*		V	V	4,371.1	No	3,890
Pimelea spicata	Spiked Rice-flower	E	E	2,031.1	3 offset locations	2,885.2
Pomaderris brunnea	Rufous Pomaderris	V	E	6,954.3	No	2,030
Pommerhelix duralensis	Dural Land Snail	E	E	3,337.3	No	4,740.2
Pseudophryne australis	Red-crowned Toadlet		V	8,400.4	No	1,455
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	5,546.5	No	5325.2
Pterostylis saxicola	Sydney Plains Greenhood	E	E	6,149.1	No	3,605
Pultenaea parviflora		V	E	1,302.7	2 offset locations	400

Scientific name	Common name	Cth status	NSW status	Area of potential habitat in SCA based on species mapping (ha)	Offset target	Potential habitat secured through NSW TEC/PCT target based on PCT associations
Pultenaea pedunculata	Matted Bush-pea		E	8,662.4	2 offset locations	4,740
Rostratula australis	Australian Painted Snipe	E	E	174.4	No	10
Tyto novaehollandiae	Masked Owl		V	15,258.8	No	5,315

Feasibility of achieving species-specific offsets targets

To further understand the potential availability of offsets for species with specific offset targets, the availability of each species in current offset locations was assessed, along with the presence of species records within the SCA.

Table 41-15 provides the following information for each species:

- Number of Stewardship sites with 'issued' credits for the species (both sites listed on the Biobanking public register and Biodiversity Offset Scheme (BOS) register)
- Number of Stewardship site Expressions of Interest (EOI) or 'pending' assessments listed on the Biobanking public register and BOS register (only EOIs since January 2017)
- Number of BioNet and project records in the SCA
- Number of areas in the SCA in which BioNet and project records occur

The data in Table 41-15 indicates that offset sites for 12 of the 17 species with specific offsets are currently available (or are soon to be available) on Biobank or Stewardship sites and/or are well represented within the SCA. The data indicates that sourcing offsets for these species should be achievable under the Plan.

The 5 species highlighted in Table 41-15 are likely to be more difficult to secure on offset sites as they are currently not well represented on existing (or planned) Biobank or Stewardship sites and significant records for the species are not currently known within the SCA. Further consideration of each of these species is provided in Table 41-16.

For these species, populations are known within and/or outside the Cumberland subregion and it is considered that securing the offset targets is possible, including outside the subregion if necessary. Furthermore, the Plan acknowledges that in some cases it may be challenging to meet some of the offset targets in the Plan. Rather than committing to a reduced offset target, the Plan allows for flexibility in reaching those targets through a set of conservation 'selection steps' and principles developed by the Department to guide implementation decisions (see section 41.10).

Table 41-15: Offset targets and potential availability on offset sites

Scientific name	Common name	Specific offset target	Number of Stewardship Sites - current issued*	Number of pending review or Expressions of Interest (since Jan 2017)*	No. of BioNet and project records in the SCA	No. of areas in the SCA in which BioNet and project records occur
Cynanchum elegans	White-flowered Wax Plant	2 offset locations	0	1	8	2
Dillwynia tenuifolia	Dillwynia tenuifolia	3 offset locations	3	0	299	6
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	3 offset locations	6	0	49	2
Haliaeetus leucogaster	White-bellied Sea-Eagle	1 offset location	0	0	27	8
Hibbertia fumana	Hibbertia fumana	1 offset location	1	0	0	0
Hibbertia puberula	Hibbertia puberula	1 offset location	1	0	22	2
Hieraaetus morphnoides	Little Eagle	1 offset location	0	0	20	11
Phascolarctos cinereus	Koala	570 hectares of important habitat	2	0	798	2
Lophoictinia isura	Square-tailed Kite	1 offset location	0	0	10	7
Marsdenia viridiflora subsp. viridiflora - endangered population	Marsdenia viridiflora subsp. viridiflora - endangered population	2 offset locations	0	1	200	2
Meridolum corneovirens	Cumberland Plain Land Snail	3 offset locations	17	5	117	23
Persoonia nutans	Nodding Geebung	2 offset locations	2	0	74	5
Pimelea spicata	Spiked Rice-flower	3 offset locations	1	0	6	4
Pultenaea parviflora	Pultenaea parviflora	2 offset locations	1	0	77	4
Pultenaea pedunculata	Matted Bush-pea	2 offset locations	0	0	4	4
Myotis macropus	Southern Myotis	1 offset location	4	2	176	11

Scientific name	Common name	Specific offset target	Number of Stewardship Sites - current issued*	Number of pending review or Expressions of Interest (since Jan 2017)*	No. of BioNet and project records in the SCA	No. of areas in the SCA in which BioNet and project records occur
Lathamus discolor	Swift Parrot	4,410 ha of potential foraging habitat, including 100 ha of important habitat	0	1	13	9

* Cumberland subregion and surrounding subregions only

Table 41-16: Comment on species not well represented on Biobank/Stewardship sites and the SCA (as indicated by records)

Species	Comment
Cynanchum elegans	This species is widespread along coast and ranges north from the Illawarra. The offset target is likely to be achievable outside the Cumberland subregion if necessary
Hibbertia fumana	The species was known from 2 locations (Bankstown, Moorebank) but is cryptic and may have been confused with other *Hibbertia* species. As a result of recent surveys, populations have been detected over a wider range within greater Sydney stretching from Richmond to Mittagong (OEH, 2020)
Hibbertia puberula	Widely recorded in the Cumberland subregion, particularly within PCT 1081 south of Appin and through Wilton and in the northern and eastern (e.g. Simmos Beach) edge of the Cumberland subregion. Abundant in a local BSA site. Note that many known records are not yet in Bionet
Pimelea spicata	Species occurs in a number of locations in the Cumberland subregion, including four populations (no.'s 31, 34, 534 and 51 – see Chapter 29) within excluded lands and one population (no. 533) within land avoided for biodiversity purposes (in GMAC)
Pultenaea pedunculata	Known from sites at Villawood and Prestons, and north-west of Appin, although the species may be in the Kemps Creek and/or Luddenham/Orchard Hills area (lack of recent fire or soil disturbance in these areas will have reduced seed germination, which may be present in the seedbank). Species also occurs in the Southern Tablelands. The offset target is likely to be achievable outside the Cumberland subregion if necessary

VALUES THAT ARE POORLY REPRESENTED IN EXISTING RESERVES

Representativeness is a key goal of conservation planning. Representativeness refers to the extent to which reserves include a representative sample of the range of biodiversity values within a given area. Representativeness can be measured using surrogates such as habitat types (Margules & Pressey, 2000).

In Australia, the Comprehensive, Adequate and Representative (CAR) criteria is often considered when applying conservation targets (DECCW, 2011). The CAR criteria include a representativeness target of 15 per cent of the pre-1750 distribution of each forest ecosystem included in conservation areas.

The Recovery Plan for the Cumberland Plain (DECCW, 2011) set representative targets for TECs of 15 per cent of remaining area of each TEC. This is equivalent to at least 5 per cent of the pre-1750 distribution of these TECs. These targets acknowledged that the subregion is a highly fragmented landscape and many of the existing vegetation types have been cleared to below 15 per cent of their pre-1750 extent.

This analysis used PCTs within the Plan Area to assess the representativeness of the SCA.

Table 41-17 identifies:

- Total amount of each PCT in the Plan Area (PCTs impacted by the development are highlighted in blue)
- Amount/per cent of total amount in the Plan Area already represented in existing reserves (this includes reserves under the NP&W Act, BioBank sites and Biodiversity Stewardship Agreement sites)
- Amount/per cent of total amount in the Plan Area within the SCA
- Extent to which the SCA contributes to existing levels of representation in the Plan Area

The table indicates that the SCA has the potential to make a substantial contribution to existing levels of representation of PCTs in the Plan Area, including many PCTs that are currently under-represented in existing reserves.

The SCA includes 75 per cent of the 39 PCTs (with an area greater than 5 ha) in the Plan Area. If these PCTs were secured for conservation, the SCA would:

- Contribute to total representation in protected lands in the Plan Area of greater than 15 per cent for 31 PCTs
- Increase representation in protected lands in the Plan Area by greater than 50 per cent for 20 PCTs
- Increase representation in protected lands by greater than 75 per cent for the majority of PCTs that have current levels of representation in existing reserves of less than 15 per cent
- Increase representation in protected lands by an average of 55 per cent for PCTs impacted by the development

For 12 PCTs, there are currently no areas protected in existing reserves. The SCA includes 5 of these 12 PCTs.

It is important to note that protection of land within the SCA will focus on PCTs impacted by the development under the Plan that have offset targets. However, in meeting these offset targets, it is likely that many PCTs not impacted by the development will also be included in conservation lands secured in the SCA.

Table 41-17: Extent to which Plan contributes to protection of representative sample of PCTs in Cumberland subregion (impacted PCTs highlighted in blue)

PCT	Total amount in Plan Area (ha)	Amount in existing reserves* in Plan Area (ha)	Per cent in existing reserves* (%)	Amount in SCA (ha)	Per cent in SCA (%)	Per cent in SCA or existing reserves* (%)	Per cent contribution of SCA to existing levels of representation (%)
724	2154.5	303.6	14.1	88.8	4.1	18.2	29.2
725	1084.8	422.1	38.9	66.7	6.1	45.1	15.8
774	11.4	2.5	22.0	0.0	0.0	22.0	0.0
781	430.2	53.4	12.4	56.3	13.1	25.5	105.5
830	1361.9	130.8	9.6	717.1	52.7	62.3	548.1
835	6965.9	522.9	7.5	884.2	12.7	20.2	169.1
849	11585.8	1361.0	11.7	1524.9	13.2	24.9	112.0
850	8782.0	747.1	8.5	3693.2	42.1	50.6	494.4
877	585.2	67.2	11.5	223.9	38.3	49.7	333.3
883	3727.4	528.6	14.2	264.4	7.1	21.3	50.0
920	6.4	0.0	0.0	0.0	0.0	0.0	0.0
941	101.6	21.7	21.4	0.0	0.0	21.4	0.0
958	165.2	39.7	24.1	54.1	32.8	56.8	136.2
1067	560.7	138.5	24.7	48.1	8.6	33.3	34.7
1081	2784.1	386.6	13.9	1370.6	49.2	63.1	354.5
1083	1.4	0.0	0.0	1.4	98.5	98.5	0.0
1086	43.8	31.3	71.6	24.0	54.9	126.5	76.7
1105	138.6	0.0	0.0	0.0	0.0	0.0	0.0
1126	1.5	0.0	0.0	0.0	0.0	0.0	0.0
1181	4503.7	442.7	9.8	2528.0	56.1	66.0	571.0
1234	41.2	0.0	0.0	0.0	0.0	0.0	0.0
1236	5.2	0.0	0.0	0.0	0.0	0.0	0.0

PCT	Total amount in Plan Area (ha)	Amount in existing reserves* in Plan Area (ha)	Per cent in existing reserves* (%)	Amount in SCA (ha)	Per cent in SCA (%)	Per cent in SCA or existing reserves* (%)	Per cent contribution of SCA to existing levels of representation (%)
1237	2.7	0.0	0.0	0.0	0.0	0.0	0.0
1253	247.5	85.3	34.5	0.0	0.0	34.5	0.0
1281	453.3	29.2	6.4	42.2	9.3	15.8	144.7
1284	11.0	1.3	12.0	0.0	0.0	12.0	0.0
1292	224.2	30.8	13.7	104.9	46.8	60.5	340.7
1319	17.3	17.3	100.0	0.0	0.0	100.0	0.0
1395	12501.2	851.8	6.8	5195.4	41.6	48.4	610.0
1637	62.0	42.4	68.5	25.3	40.8	109.3	59.5
1787	133.9	0.0	0.0	58.1	43.4	43.4	0.0
1789	530.7	0.0	0.0	463.5	87.3	87.3	0.0
1790	1244.7	8.0	0.6	857.8	68.9	69.6	10688.0
1800	412.1	14.9	3.6	8.7	2.1	5.7	58.4
1808	6.7	0.0	0.0	0.0	0.0	0.0	0.0
1816	2.4	0.2	7.3	7.4	306.0	313.3	4211.2
1826	56.4	0.0	0.0	5.8	10.2	10.2	0.0
1841	35.2	0.0	0.0	22.8	64.7	64.7	0.0
1900	43.2	23.4	54.2	46.3	107.3	161.5	197.9

*This includes reserves under the NP&W Act, BioBank sites and Biodiversity Stewardship Agreement sites

HIGH PRIORITIES FOR CONSERVATION

The NSW Government has developed several plans to identify priority areas for conservation or areas that are sensitive to biodiversity impacts in the Cumberland subregion. Two initiatives are:

- BIO Map core and corridors
- Biodiversity values map

BIO Map core/corridors

BIO Map identifies Priority Investment Areas (PIAs) where the protection and management of native vegetation is likely to maximise benefits to biodiversity within the Cumberland subregion. The PIAs comprise:

- Core areas: large areas of native vegetation and habitat where management will be of greatest benefit to the conservation of biodiversity values. These areas represent the habitat in the subregion most likely to support species persistence and interactions between species and landscape scale ecological processes
- Regional biodiversity corridors: linear areas that link core areas and play a crucial role in maintaining connections between species populations that would otherwise be isolated and at greater risk of local extinction

Table 41-18 and Table 41-19 show the amount of BIO Map core areas and corridors within the SCA.

The tables indicate that the SCA contains substantial amounts of BIO Map core and corridors – approximately 32 per cent of the total BIO Map core areas and 28 per cent of the total BIO Map corridors in the Cumberland subregion.

Table 41-18: BIO Map core areas within the SCA

Total area of BIO Map core in subregion (ha)	Area of BIO Map core in SCA (ha)	Per cent of SCA that is BIO Map core (%)	Per cent of total BIO Map core in subregion in SCA (%)
24,196.8	7,803.4	28.7	32.2

Table 41-19: BIO Map corridors within the SCA

Total area of BIO Map corridors in subregion (ha)	Area of BIO Map corridors in SCA (ha)	Per cent of SCA that is BIO Map corridors (%)	Per cent of total BIO Map corridors in subregion in SCA (%)
17,927.5	5,089.6	18.7	28.4

Biodiversity values map

The biodiversity values map identifies land with high biodiversity value that is particularly sensitive to impacts from development and clearing. The BV map is prepared by the Department under Part 7 of the BC Act and identifies land with high biodiversity value that is sensitive to impacts from development and clearing. The map is one of the triggers for determining whether the Biodiversity Offsets Scheme applies to a proposal.

Table 41-20 shows the amount of biodiversity values map areas within the SCA.

Note that EES has recently provided in-principle support for including the vegetation mapped in the SCA in the Biodiversity Values (BV) map (where the vegetation is not already identified on the map) (see Part 2).

The table indicates that the SCA contains substantial amounts of biodiversity values map areas – approximately 25 per cent of the total biodiversity values map area in the Cumberland subregion.

Table 41-20: Biodiversity values map areas within the SCA

Total area of biodiversity values map in subregion (ha)	Area of biodiversity values map in the SCA (ha)	Per cent of the SCA that is within the biodiversity values map (%)	Per cent of total biodiversity values map in subregion within the SCA (%)
44,888.1	11,313.2	41.6	25.2

41.5.3 CONCLUSION

The analysis suggests that the commitments generally prioritise the protection of important biodiversity values as the SCA within which the land-based commitments are intended to be delivered:

- Contain each impacted Commonwealth and NSW-listed TEC, including critically endangered and endangered TECs
- Contain potential habitat for the majority of Commonwealth and NSW-listed species, including critically endangered and endangered species
- Significantly contribute to increasing representation of PCTs in protected lands in the Cumberland subregion
- Include substantial areas of land identified by the NSW Government as priorities for conservation

Furthermore, it is likely that offset sites for the majority of species with specific offsets under the Plan are currently available (or are soon to be available) on Biobank or Stewardship sites and/or are represented within the SCA. The data indicates that sourcing offsets for these species should be achievable under the Plan.

41.6 THEME 4: DO THE COMMITMENTS IMPROVE VALUES AND ECOLOGICAL FUNCTION IN THE LONG TERM?

41.6.1 CONTEXT AND METHOD

The strategic certification guidelines (DPIE, 2020) (Principle 4) requires that commitments should ensure biodiversity values and landscape function are improved in the long term and set out a range of matters that commitments should be designed to protect, including:

- The extent, geometry, ecological function, and adjacent land uses of patches of native vegetation and habitat are compatible with long term viability and resilience
- Habitat for TECs and species are protected (this is addressed in Section 41.5)
- Connections in the landscape, such as habitat corridors and riparian areas are protected
- Key threatening processes and landscape scale threats, such as weeds and pests, are managed
- Areas identified by government as priorities for conservation are protected (this is addressed in Section 41.5)
- Areas likely to provide significant potential for restoration are protected

The analysis of Theme 4 involved determining the extent to which the SCA contains each of these categories of matters. This included analysing:

- The size, shape, and location of habitat in the landscape using GIS and by determining the extent to which large patches make up the total amount of native vegetation contained within the SCA
- Habitat connectivity using GIS based on BIO Map core and corridors and other connected habitat elements
- Management of threats and restoration by discussing the commitments relating to these matters and drawing on the results of the trend analysis (see Supporting Document D)

41.6.2 ANALYSIS

SIZE AND LOCATION OF HABITAT PATCHES

Maximising the likelihood of viability or persistence of biodiversity values is a key goal of conservation planning (Margules & Pressey, 2000) and a key objective of the Cumberland Plain Recovery Plan (DECCW, 2011).

There are well established relationships between the size of a patch of native vegetation and the size and persistence of populations, with large patches generally supporting more persistent populations than smaller patches (Margules & Pressey, 2000). There are also relationships between the size of a patch and species richness, species dispersal, genetic diversity, persistence of large vertebrates, maintenance of near-natural disturbance regimes, and other important ecological functions (Hodgson, Thomas et al., 2009; Lindenmayer, Hobbs et al., 2007).

For this analysis, large patches are considered to be > 50 ha, and moderate patches are considered to be > 20 ha. This was based on findings by Parkes et al (2003) and recommendations of the Comprehensive, Representative and Adequate Advisory Group which suggest that in the Australian context, 50 ha should be considered a minimum 'core' area of vegetation to prevent declines in biodiversity over time (CARSAG, 2004; Parkes, Newell et al., 2003).

The SCA was designed to capture habitat patches in strategic locations in the landscape to maximise likely benefits to biodiversity values (see Chapter 8). This includes habitat patches adjacent to existing reserves or other large patches, or patches connecting or contiguous with other patches of habitat.

Table 41-21 shows the number of large and moderate patches in the SCA and the extent to which large and moderate patches make up the total amount of native vegetation contained within the SCA.

Table 41-22 shows the extent to which the SCA contains the large and moderate patches that occur within the Plan Area.

The tables show that:

- Approximately 93 per cent of the total area of native vegetation in the SCA comprises patches > 50 ha, and there are approximately 31 patches > 50 ha in the SCA
- The SCA contains approximately 36 per cent of the total area of patches > 50 ha in the Plan Area

Table 41-21: Extent to which large patches make up the total amount of native vegetation contained within the SCA

	Total area of patches in SCA (ha) > 50 ha or > 20 ha*	Per cent of total area of native vegetation in SCA comprising patches > 50 ha or > 20 ha (%)*	Total number of patches in SCA > 50 ha or > 20 ha*
Patches > 50 ha	16,642	93%	31
Patches > 20 ha	17,055	95%	79

*Note these figures may include smaller patches that are linked by contiguous areas of native vegetation, such as riparian corridors

Table 41-22: Extent to which the SCA contains the largest patches within the Plan Area

	Total area of native vegetation patches in Plan Area (ha)	Per cent of total area of patches in Plan Area wholly or partially within SCA (%)
Patches > 50 ha	45,835	36.3
Patches > 20 ha	49,299	34.6

HABITAT CONNECTIVITY

Habitat connectivity was a key factor influencing the location of the SCA (see Chapter 8). In determining the SCA, priority was given to including areas in the Cumberland subregion that were adjacent to and connecting other patches of habitat (including existing reserves) and that could form broad habitat corridors across the landscape.

The SCA was also located to provide connectivity outside the Cumberland subregion. Figure 8-1 in Chapter 8 shows that the SCA provides connectivity to existing reserves in the Blue Mountains to the west of the subregion, and to existing reserves and protected water catchments to the south-east and south-west of the subregion.

As part of the commitment to secure a minimum of 5,325 hectares of native vegetation in the Cumberland subregion, the Plan commits to securing a reserve to protect the north-south Koala movement corridor along the Georges River (Commitment 10), as well as protect Koala corridors in the Cumberland subregion, including along the Nepean River, Georges River, Cataract River and Ousedale Creek (Commitment 12). These areas represent key areas of connectivity across the landscape and will benefit multiple other species and TECs.

The extent to which the SCA contains areas important for habitat connectivity was analysed based on BIO Map core and corridors in Section 41.5. These areas represent the most important area of habitat connectivity in the Cumberland subregion. The SCA contains a substantial percentage of BIO Map core area and corridors in the subregion, and is therefore likely to make a substantial contribution to supporting habitat connectivity across the landscape.

Furthermore, the urban capable land under the Plan has avoided substantial areas of BIO Map core areas and corridors and other areas of connectivity, such as local corridors (see Chapter 24). Much of this avoided land occurs outside the SCA, including large areas of native vegetation on the edge of Wilton and southern GMAC, and will make a significant additional contribution to protecting habitat connectivity across the landscape.

Key areas of habitat connectivity within the nominated areas that will be avoided are shown in Table 41-23.

Table 41-23: Key areas of habitat connectivity avoided in each nominated area

Habitat connectivity type	Area in nominated areas (not including excluded lands)	Percentage avoided (not including excluded lands)
BIO Map regional corridor and core area	3,134 ha	88%
Connected vegetation	1,636 ha	50%
Isolated vegetation	13 ha	1%
Local corridor	222 ha	70%

As described in Part 2 and Section 41.10, the avoided land and the SCA will be given protection from any future development proposed in those areas through development controls under the SEPP (Strategic Conservation Planning).

LANDSCAPE THREATS

The Plan recognises that the effective management of landscape scale threats is critical to the success of the conservation program under the Plan and in managing the impacts of climate change on biodiversity (see Section 41.10.1). The Plan includes a range of commitments to reduce threats to conservation lands secured within the SCA, including:

- Weed and pest control programs in strategic locations in the Cumberland subregion to reduce threats to land protected within the SCA (Commitment 15 and 16)
- Fire management to support the maintenance of biodiversity values in conservation lands (Commitment 17)
- Support programs to control key diseases affecting biodiversity in the Cumberland subregion (Commitment 18)

Actions under these commitments include to:

- Establish working groups to advise on threat management
- Develop more detailed implementation strategies in consultation with working groups and other key stakeholders, including delivery partners, to set out:
    - Priorities for management of the threat
    - Guidance on management approaches
    - Any research needs
    - Delivery arrangements, including the provision of funding under the Plan
- Enter into written agreements with delivery partners to implement the programs

The Plan identifies a range of delivery partners to support implementation of these commitments (see Part 2).

Trend analysis

The recognition under the Plan of the importance of managing landscape scape threats is supported by the results of the trend analysis (see Box 1 and Supporting Document D). The trend analysis examined the potential impacts of development and offsetting under various scenarios on PCT 849 in the Cumberland subregion.

Box 1: Trend analysis

Trend analysis for PCT 849

As part of the EPBC Act strategic assessment process for the nominated areas and major transport corridors, a trend analysis looking at the extent and condition of PCT 849 over the life of the Plan was undertaken by RMIT University (Gordon & Peterson, 2019). The trend analysis examined the potential impacts of development and offsetting under various scenarios on PCT 849 in the Cumberland subregion. It considered a summed score across the landscape for the PCT of extent and ecological condition (the latter being based on an approximation of the BAM vegetation integrity score).

The project involved two major components:

- A formal expert elicitation to gather quantitative knowledge regarding how the condition of PCT 849 will change over time under:
  - High or low intensity management
  - The case where the PCT is exposed to typical ongoing private land activities
- Quantitative modelling to simulate the urban development within the designated nominated areas and compensation via managing areas as biodiversity offsets in a strategically defined offset region and the ecological response of the PCT. The modelling included eight scenarios exploring different options for implementing biodiversity offsets which varied:
  - The timing of when offsets are implemented
  - The total area of offsets implemented
  - The type of management implemented for the offsets (low or high intensity)

The analysis found that:

- Existing landscape scale threats (e.g. weed invasion, grazing, rubbish dumping, disturbance from recreational activities) across the Cumberland subregion are significant and will result in an approximate 5.8 per cent decline in the extent and condition of the PCT over the life of the Plan unless additional areas are managed
- The proposed impacts of development under the Plan will lead to approximately the same magnitude of losses (~5.8 per cent) to the PCT that will result due to existing landscape threats
- High intensity management and early offsetting will provide the greatest benefits to the outcomes of the PCT over the life of the Plan
- Securing approximately 1,600 ha of offsets for the PCT:
  - Will compensate for the impacts of development where earlier offsetting and higher intensity management is preferential by improving the extent and condition of the PCT over the life of the Plan
  - Has the potential to also contribute significantly to addressing the declines across the subregion due to existing landscape scale threats

The commitments under the Plan to manage landscape scale threats reflect a broad and holistic approach to conservation and aim to address the current level of existing landscape scale threats across the Cumberland subregion.

RESTORATION

The Plan includes a commitment (Commitment 13) to deliver and support ecological restoration activities in conservation land, including ecological reconstruction of up to a maximum of 25% of the Plan's offset target for native vegetation (Commitment 8). This includes restoring up to a maximum of 1,330 ha for the following TECs (Commitment 13):

- Cooks River Castlereagh Ironbark Forest
- Cumberland Plain Woodland
- River-flat Eucalypt Forest
- Shale Gravel Transition Forest
- Swamp Oak Forest

The Plan includes a range of actions to ensure effective implementation of the restoration program, including:

- Establish a restoration working group to guide the implementation of restoration activities
- Develop a Restoration Implementation Strategy in consultation with the restoration working group and other key stakeholders, to:
    - Identify the range of restoration activities and what will be undertaken under the Plan
    - Identify considerations for restoration potential and constraints of land
    - Provide reference to guidelines for restoration, including the NSW BCT Guidelines for restoring native vegetation undertaken at a biodiversity stewardship site
    - Develop a seed-procurement approach
- Enter into written agreements with delivery partners, and engaging specialist providers where necessary, to implement the restoration strategy
- Incorporate adaptive management principles into restoration actions including pilot sites to trial and develop restoration methodologies and applying new research as appropriate

The recognition under the Plan of the importance of restoration is consistent with the Cumberland Plain Recovery Plan (DECCW, 2011), which highlights the importance of restoration in the context of the substantial degradation that has occurred in the Cumberland subregion due to agricultural and urban land uses.

Trend analysis

The emphasis on restoration under the Plan is also supported by the results of the trend analysis (see Box 1 and Supporting Document D). The expert elicitation process (involving experts on the management of Cumberland Plain Woodland) undertaken for the trend analysis indicates that high intensity management on conservation lands provides significant potential for providing restoration gains for PCT 849, even when starting from a low initial condition.

It is important to note that the trend analysis found that low intensity management has limited capacity to provide restoration gains for PCT 849 over time, especially when starting from a low initial condition.

41.6.3 CONCLUSION

The analysis suggests that the commitments broadly ensure biodiversity values and ecological function are improved in the long term as the SCA within which the land-based commitments are intended to be delivered:

- Includes many large patches > 50 ha that comprise approximately 93 per cent of the total native vegetation in the SCA and contains 36 per cent of the total area of patches > 50 ha in the Plan Area
- Contains substantial amounts of BIO Map core and corridors

Importantly the Plan has also committed to managing key landscape threats, including weeds, pest animals and fire, and restoring substantial areas of land in the SCA as part of the conservation program.

41.7 THEME 5: ARE THE COMMITMENTS ADDITIONAL TO EXISTING REQUIREMENTS?

41.7.1 CONTEXT AND METHOD

The strategic certification guidelines (DPIE, 2020) (Principle 5) requires that commitments are additional to existing conservation obligations. Existing conservation obligations are actions that are legally required to be carried out on land. Consistent with BC Regulation clause 5.1, existing obligations include actions required to be carried out:

- Because of the reservation of land under the NP&W Act
- Under existing conservation agreements or offset arrangements
- Under a condition of approval or consent under the EP&A Act

The strategic certification guidelines also state that existing conservation obligations include those under plans of management for 'community' land, and voluntary obligations are not considered to be existing conservation obligations

The Plan intends to secure all conservation land within the SCA through either:

- Creation of reserves through acquisition of land
- Establishment of Biodiversity Stewardship Agreements (BSAs) with landholders

The Plan ensures that commitments are additional to existing conservation obligations through:

- Accounting for existing conservation obligations in the process to identify the SCA
- Securing land in the SCA in accordance with the rules and processes under the BC Act and BAM, which account for existing conservation obligations

The analysis of Theme 5 involved explaining these processes.

41.7.2 ANALYSIS

STRATEGIC CONSERVATION AREA

The SCA was identified through a Conservation Priorities Method (see Chapter 8). The method combines detailed spatial information about biodiversity values with an analysis of constraints and opportunities to identify an optimal mix of potential conservation sites to offset the impacts of the development on biodiversity values.

The method to identify the SCA excluded land that was unlikely to be suitable as an offset, including because the land was already subject to existing conservation obligations or controls. This included the following land:

- Land reserved under the NP&W Act
- Existing BioBank and Biodiversity Stewardship Agreement sites
- Existing offsets for other development projects

The method ensures that land already subject to existing conservation obligations is not identified within the SCA.

PROCESS TO SECURE BIODIVERSITY STEWARDSHIP AGREEMENTS AND RESERVES

All BSAs under the Plan will be established in accordance with the requirements of the BC Act and BAM. These have rules and processes in place to ensure that the credits generated from establishing a BSA take into account existing conservation obligations. These include:

- Criteria under the BC Regulation (clause 5.1) that prevents several categories of land subject to existing conservation obligations from being eligible as a site for a BSA, including offset sites
- A process under the BAM (section 13.11) that ensures credits can only be created by management actions on a BSA site that are additional to existing conservation obligations. This includes a set of rules that reduce the credits generated according to either the tenure of the land (including land classed as 'community land' under the *Local Government Act 1993)* or the type of management action already required under existing obligations

This same rules and processes will be applied to land secured as reserves under the Plan, as the Plan intends that BSAs will be established prior to the acquisition of land by the Office of Strategic Lands. The land will then be transferred (along with the BSA, covenants on title and ongoing annual management payments) to a suitable long-term public land management authority such as National Parks and Wildlife Service or councils.

ACCOUNTING FOR OFFSET TARGETS

The Plan includes an action under Commitment 25 to establish an accounting process to track progress of commitments and actions, including progress in meeting offset targets. Offset targets will be tracked in terms of hectares of land secured, as well as credits where appropriate.

41.7.3 CONCLUSION

The Plan ensures that commitments are additional to existing conservation obligations consistent with the strategic certification guidelines (DPIE, 2020) (Principle 5) through:

- Accounting for existing conservation obligations in the process to identify the SCA

- Securing land in the SCA in accordance with the rules and processes under the BC Act and BAM, which account for existing conservation obligations
- Establishing an accounting process to track progress in meeting commitments and actions, including offset targets.

41.8 THEME 6: DO DEVELOPMENT CONTROLS PROPOSED AS COMMITMENTS CONSERVE THE ENVIRONMENT?

41.8.1 CONTEXT AND METHOD

The strategic certification guidelines (DPIE, 2020) (Principle 7) requires that commitments involving the use of development controls that conserve or enhance the natural environment are new or represent a significant upgrade. Consideration of this principle is guided by the following:

- Land use zoning for the conservation or enhancement of the natural environment is implemented following the biodiversity certification application
- Land use zone objectives are consistent with conservation or enhancement of the natural environment
- Permissible uses are consistent with conservation or enhancement of the natural environment
- Specific local provisions are put in place to set out the development controls that will apply to protect native vegetation and any other habitat for native species on the land
- Minimum lot sizes and/or options for lot averaging and lot clustering aim to preserve the integrity of native vegetation and any other habitat for native species on the land
- Management actions are proposed to enhance the natural environment
- Security of biodiversity values is improved (i.e. development controls are new or represent a significant upgrade)

41.8.2 ANALYSIS

STATE ENVIRONMENTAL PLANNING POLICY

The Department is proposing a new State Environmental Planning Policy (SEPP) for strategic conservation planning to implement the Plan's strategic conservation planning requirements. The proposed SEPP is described in Chapter 9 and will apply development controls to avoided land and the SCA to limit the impact of future development and subdivisions under Part 4 of the EP&A Act and ensure biodiversity values are protected if development is proposed on these lands. The development controls identify key biodiversity values that are the focus of the Plan, such as TECs, threatened species and their habitats, Koala habitat and corridors, and MNES, and requires the consent authority to ensure any future development avoids and minimises impacts on these values.

The development controls in the SEPP (Strategic Conservation Planning):

- Require development consent to clear native vegetation
- Require development to avoid and minimise native vegetation and compensate through revegetation on the land for impacts that cannot be avoided
- Require the consent authority in granting consent to consider impacts to specific biodiversity values, including TECs and species and habitat connectivity
- Limit when the consent authority can grant consent. For example, the consent authority must be satisfied that the development avoids any adverse impacts to the specific biodiversity values described in the SEPP
- Limit when the consent authority can grant consent for subdivisions

The development controls are similar between avoided land and the SCA, with several differences to account for the different purposes of these lands in relation to the Plan.

The SEPP will further support the protection of avoided land and the SCA by:

- Identifying the location of urban capable land, avoided land, the SCA and land identified for acquisition on maps
- Requiring asset protection zones (APZ) for development on urban capable - certified land to be located within the certified land (and not within avoided land)
- Requiring infrastructure under Part 4 of the EP&A Act on avoided land to comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development

OTHER PLANNING MEASURES

In addition to the SEPP (Strategic Conservation Planning), the Department also proposes to introduce (see Chapter 9):

- Ministerial Direction under section 9.1 of the EP&A Act
- The Cumberland Plain Conservation Plan Guideline for Infrastructure Development which applies to infrastructure development, including activities under Part 5 of the EP&A Act and 'Essential infrastructure' under Part 4 of the EP&A Act, as defined in the Plan
- Amendment to the EP&A Regulation 2000

The Ministerial Direction will apply to planning proposals by planning authorities in avoided land and the SCA. The direction requires planning proposals to protect or enhance and/or minimise impacts to native vegetation, riparian corridors, TECs and species, Koala habitat and corridors, and habitat connectivity and several other biodiversity value. It also prevents planning authorities from rezoning land inconsistent with the objectives of avoided land or the SCA.

The Cumberland Plain Conservation Plan Guideline for Infrastructure Development ensures infrastructure development within avoided land, the SCA and urban capable land avoids and minimises impacts to biodiversity values and mitigates indirect impacts in accordance with the requirements of the Plan.

The amendment to the EP&A regulation introduces requirements for public authorities to notify the Department about activities under Part 5 of the EP&A Act proposed on avoided land. Public authorities must:

- Notify the Department of the proposed activity
- Include a statement of consistency of the proposed activity with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
- Consider any response from the Department about the activity

BIODIVERSITY VALUES MAP

EES has provided in-principle support for including the vegetation mapped in the SCA in the Biodiversity Values (BV) map (where the vegetation is not already identified on the BV map). This will provide additional protection for the SCA from future developments. The BV map is prepared by the Department under Part 7 of the BC Act. The map identifies land with high biodiversity value that is sensitive to impacts from development and clearing. The map is one of the triggers for determining whether the Biodiversity Offsets Scheme applies to a proposal for clearing or development.

The BV Map is relevant for:

- Local developments (development under Part 4 of the EP&A Act that is not state significant development or complying development)
- Clearing regulated by SEPP (Vegetation in Non-Rural Areas) 2017

The Biodiversity Offsets Scheme applies to a proposal for clearing or development within an area identified on the BV map where it clears native vegetation or causes a prescribed impact.

Including the SCA in the BV map ensures proposals for development in the SCA that involve clearing of native vegetation or would result in a prescribed impact are subject to assessment and approval under the BC Act, including requirements for avoidance and minimisation.

41.8.3 CONCLUSION

The planning mechanisms represent a significant upgrade to existing levels of protection in the avoided land and the SCA. The SEPP (Strategic Conservation Planning) is legally binding and requires the consent authority to be satisfied certain conditions relating to the avoidance and minimisation of impacts are met before granting consent. The Ministerial Direction restricts the ability of planning authorities to rezone avoided land, increase development or intensify land uses in the SCA. Including the SCA in the BV map provides additional protection for the SCA from future developments.

41.9 THEME 7: ARE PROPOSED NEW NATIONAL PARKS CONSISTENT WITH THE CAR RESERVE FRAMEWORK?

41.9.1 CONTEXT AND METHOD

The strategic certification guidelines (DPIE, 2020) (Principle 7) requires that any proposed new national parks are consistent with the CAR reserve system scientific framework.

Specifically, the national parks must be:

- Comprehensive: the national parks must include regional-scale ecosystems impacted by the biodiversity certification in each subregion or bioregion
- Adequate: the national parks must include sufficient levels of each ecosystem to provide ecological viability and maintain the integrity of populations, species, and communities
- Representative: the national parks must include the variability of habitat within ecosystems

The Department has identified initial locations for land that will be potentially reserved under the NP&W Act within the SCA. The Georges River Koala Reserve has been announced as a priority, with the first stage (Stage 1A) to be gazetted as a reserve under the NP&W Act by year two of the Plan's implementation. Two additional priority reserves are under investigation for feasibility:

- The Gulguer Reserve Investigation Area
- The Confluence Reserve Investigation Area

These reserve locations are not final and are likely to be refined. Other areas within the SCA have also been identified for further investigation as future reserves to provide greater landscape connectivity.

The analysis of Theme 7 involved analysing data on the initial locations of land that will be potentially reserved under the NP&W Act within the SCA based on PCTs (those impacted by the development), as follows:

- Comprehensiveness: the extent to which the potential reserve locations contain each impacted PCT
- Adequate: the extent to which the potential reserve locations contain large patches of native vegetation more likely to be viable in the long-term and more likely to support persistence of species and communities
- Representative: the extent to which the potential reserve locations contribute to the existing levels of protection of each impacted PCT in the Cumberland subregion

41.9.2 ANALYSIS

COMPREHENSIVE

Table 41-24 shows the extent to which the potential reserve locations within the SCA contain each impacted PCT.

The table shows that 7 of the 9 impacted PCTs are included in the potential reserve locations. For PCT 1800 the lack of available mapping for this PCT is likely to be driving this result.

Table 41-24: Extent to which potential reserves component of the SCA contains each impacted PCT

Impacted PCTs	Area of PCT available in potential reserves (ha)	Restoration potential in potential reserves (ha)
724	9.1	3.5
725	16.0	3.2
781	51.1	0.3
830	0.0	0.0
835	62.0	328.9
849	191.9	403.3
850	70.8	3.4

Impacted PCTs	Area of PCT available in potential reserves (ha)	Restoration potential in potential reserves (ha)
1395	1,345.0	454.0
1800	0.0	0.0
Total	**1,745.9**	**1,196.6**

ADEQUATE

Table 41-25 shows the number of large and moderate patches in the potential reserves.Table 41-26 shows the extent to which the potential SCA contains the large and moderate patches that occur within the Plan Area.

The tables show that:

- Approximately 98 per cent of the total area of native vegetation in the potential reserves comprises patches > 50 ha
- The potential reserve locations contain about 12 per cent of the total area of patches > 50 ha in the Plan Area

Table 41-25: Extent to which large patches make up the total amount of native vegetation contained within potential reserves

	Total area of patches in potential reserves (ha) > 50 ha or > 20 ha*	Per cent of total area of native vegetation in potential reserves comprising patches > 50 ha or > 20 ha (%)*
Patches > 50 ha	5,636.4	98%
Patches > 20 ha	5,642.4	98%

*Note these figures may include smaller patches that are linked by contiguous areas of native vegetation, such as riparian corridors

Table 41-26: Extent to which the potential reserves contain the largest patches within the Plan Area

	Total area of native vegetation patches in Plan Area (ha)	Per cent of total area of patches in Plan Area wholly or partially within potential reserves (%)
Patches > 50 ha	45,835	12.3
Patches > 20 ha	49,299	11.4

REPRESENTATIVE

Table 41-27 identifies:

- Total amount of each impacted PCT in the Plan Area
- Amount/per cent of total amount in the Plan Area already represented in existing reserves (this includes reserves under the NP&W Act, BioBank sites and Biodiversity Stewardship Agreement sites)
- Amount/per cent of total amount in the Plan Area within potential reserves
- Extent to which the potential reserves contribute to existing levels of representation in the Plan Area

The table indicates that the potential reserve locations contribute greater than 15 per cent to existing levels of representation for 4 of the 9 PCTs. Importantly, this includes substantial contributions to the protection levels for the following critically endangered NSW TECs (figures reflect the NSW definitions of the TECs):

- Over 151 per cent for Shale Sandstone Transition Forest (PCT 1395)
- Approximately 30 per cent for Cumberland Plain Woodland (PCTs 849 and 850)

Table 41-27: Contribution of potential reserve locations to existing levels of representation of impacted PCTs

PCT	Total amount in Plan Area (ha)	Amount in existing reserves* in Plan Area (ha)	Per cent in existing reserves* (%)	Amount in potential reserve locations** (ha)	Per cent in potential reserve (%)	Per cent in potential reserves or existing reserves* (%)	Per cent contribution of potential reserves to existing levels of representation (%)
724	2,154.5	303.6	14.1	12.7	0.4	14.5	4.2
725	1,084.8	422.1	38.9	0.4	1.5	40.4	0.1
781	430.2	53.4	12.4	51.5	11.9	24.3	96.4
830	1,361.9	130.8	9.6	0.0	0.0	9.6	0.0
835	6,965.9	522.9	7.5	390.8	0.9	8.4	74.7
849	11,585.8	1,361.0	11.7	572.0	1.7	13.4	42.0
850	8,782.0	747.1	8.5	74.2	0.8	9.3	9.9
1395	12,501.2	851.8	6.8	1291.6	10.7	17.5	151.6
1800	412.1	14.9	3.6	0.0	0.0	3.6	0.0

*This includes reserves under the NP&W Act, BioBank sites and Biodiversity Stewardship Agreement sites
**This includes vegetation and potential restoration within the Georges River Koala Reserve, Gulguer Reserve Investigation Area and Confluence Reserve Investigation Area

41.9.3 CONCLUSION

The analysis suggests that the potential reserves are broadly consistent with the CAR reserve system scientific framework as the reserves:

- Include the majority of PCTs impacted by the development (are comprehensive)
- Are almost completely comprised of very large patches (> 50 ha) (are likely to be adequate)
- Contribute greater than 15 per cent to existing levels of representation for several PCTs (are representative), including substantial contributions to protection levels for three critically endangered TECs

It is important to note that further consideration of the CAR reserve system scientific framework will be made in finalising the locations of the potential reserves during implementation of the Plan.

41.10 THEME 8: WILL THE PLAN BE EFFECTIVELY IMPLEMENTED AND WILL OUTCOMES BE CERTAIN?

41.10.1 CONTEXT AND METHOD

The strategic certification guidelines (DPIE, 2020) (Principle 9) and the ToR (Sections 4.6(2), 5.3 (2), 6.1(4), 6.2, and 7.1) require analysis of the extent to which the commitments are likely to be implemented effectively to achieve the outcomes.

The Plan establishes an implementation and assurance framework to ensure the efficient and effective delivery of the Plan. The framework covers governance arrangements, including the roles and responsibilities of key delivery partners, assurance mechanisms for delivery of the conservation program and offsets, and funding arrangements.

The Plan and sub-plans are high level documents which provide an overarching framework and assurance processes for implementing the Plan. It is appropriate for further details about how key elements of the Plan will be implemented to be developed during early implementation of the Plan. This allows proper consideration of more complex issues, seeking of expert advice through working groups, and comprehensive engagement with key stakeholders. The Plan includes actions to prepare more detailed implementation strategies for key elements of the Plan, including:

- Conservation program – the Conservation Lands Implementation Strategy
- Restoration – the Restoration Implementation Strategy
- Programs for managing landscape threats – the Weed Control Strategy, the Pest Animal Control Implementation Strategy, and Fire Management Strategy
- Community engagement and research programs – the Education and Engagement Implementation Strategy, Aboriginal Engagement Implementation Strategy, and Research Program Implementation Strategy
- Compliance program – the Compliance Strategy

These implementation strategies will set out further details about how each of these key elements of the Plan will be implemented, including criteria for decision-making, priorities for action, policy guidance for decision-making and implementation, procedures and protocols, and governance arrangements.

Effective implementation is particularly important with strategic assessments because of the size and complexity of the programs, the long timeframes over which they are implemented, the number of stakeholders and the diversity of their interests, the amount of money the programs cost, and the complexity of the legal frameworks they operate within.

Lessons learnt from other strategic assessments around Australia suggest that effective implementation requires:

- Clear and feasible outcomes that the Plan will deliver
- Clarity about the delivery framework and mechanisms to implement the Plan
- Appropriate flexibility within the Plan to ensure it remains relevant over time
- Clear governance arrangements, including certain funding
- Comprehensive processes to monitor and report on implementation, and adapt implementation as needed

Key risks associated with the effective implementation of the Plan, and the required measures considered necessary to address these risks, have been identified and are provided in Table 41-28.

The analysis of Theme 8 involved addressing each of these key risks in relation to the following questions:

- What is the risk and why may it affect implementation of the Plan?
- What is required to address the risk?
- How does the Plan address the risk and are these measures effective to ensure that Plan outcomes are still achieved?

Table 41-28: Key implementation risks and the required measures to address the risks

Key risks	Measures to address risk
Outcomes are not clear or feasible	Frame outcomes within a program logic
	Ensure outcomes are clear, measurable and achievable
A plan that does not allow for changing circumstances	Build processes into the Plan that enable changes to development locations in appropriate circumstances
	Include mechanisms under the Plan for changing how outcomes are delivered where appropriate
	Ensure appropriate flexibility around how the conservation program is delivered
Delivery framework is unclear or unsuitable	Clearly set out how the Plan is intended to be delivered
	Ensure the delivery framework is legally robust
	Ensure delivery partners act consistently with the Plan
	Enable action to be taken to ensure compliance

Key risks	Measures to address risk
	Establish assurance mechanisms for delivery of the conservation program to ensure the program keeps pace with impacts to biodiversity values
Poor governance arrangements and insufficient funding	Establish an organisational structure and define roles and responsibilities
	Ensure sufficient funding to deliver the conservation program
Ineffective monitoring, evaluation, reporting and adaptive management processes	Include a clear commitment to monitoring, evaluation, reporting and improvement through adaptive management (MERI) to ensure that: • Changes to the environment and legislation are accounted for in the implementation of the conservation program • Impacts to avoided land and unforeseen loss of biodiversity values can be identified and rectified • Failure of conservation measures (e.g. ecological restoration, fauna overpasses) can be evaluated and the measures updated • New scientific information which suggests alternative conservation actions are required is considered and implemented
	A MERI framework underpinned by a program logic
	Clarity on scope and timing of monitoring, reporting and evaluations
	Evaluation of outcomes not just delivery of actions
	Clarity on when and how adaptive management will be implemented

41.10.2 ANALYSIS

OUTCOMES ARE NOT CLEAR OR FEASIBLE

What is the risk and why may it affect implementation of the Plan?

Strategic assessments cover large spatial scales, long timeframes and involve a variety of development activities and conservation measures. Some previous strategic assessments undertaken in Australia have suffered from unclear and/or unfeasible outcomes resulting in abandonment of the process or poor implementation of the plan, program or policy. This has resulted in poor conservation outcomes and/or delays to development during implementation. Clear and achievable outcomes are critical for effective implementation to allow delivery partners to understand what they need to achieve, allow regulators and the public to understand what is intended to be delivered, and enable the Plan to be evaluated to determine if it is operating well, and ultimately if it has been a success.

What is required to address the risk?

To address this risk, the Plan needs to:

- Frame outcomes within a program logic
- Ensure outcomes are clear, measurable and achievable

How does the Plan address the risk and are these measures effective to ensure that Plan outcomes are still achieved?

Frame outcomes within a program logic

The outcomes under the Plan have been framed within a program logic that underpins the Plan.

The program logic describes broadly how the Plan will be implemented and the relationships between outcomes and commitments and actions (‘or ‘outputs’), and how the commitments and actions are expected to lead to the outcomes. Key elements of the program logic are:

- Overall vision and objective of the Plan
- Outcomes – Environmental, social and economic outcomes of the Plan
- Commitments – How the outcomes are going to be delivered

- Actions – What will be done to deliver the commitments

By framing the outcomes within a program logic, the Plan provides a clear picture of why and how it is intended to be delivered and a chain of reasoning between achieving the vision and taking actions. The increasing level of detail from vision to actions provides a suitable way of articulating what success looks like (i.e. the vision/objectives and outcomes that the Plan will deliver) as well as the way that will be achieved (i.e. the commitments and actions).

The vision and objective of the Plan have three elements to them:

- Environmental – conservation of biodiversity to support ecological function in the subregion
- Economic – facilitating urban development to support growth
- Social – improving liveability

The outcomes are considered to be consistent with the program logic, as they:

- Cover the three elements of the vision and objective
- Articulate what is needed to achieve the vision and objective
- Articulate the results of delivering the commitments

Importantly, the outcomes clearly reflect the level of performance or intended impact or value resulting from the delivery of commitment and actions. Appropriately, the outcomes are clearly distinct from the commitments, which reflect what is delivered as a result of the implementation of the actions.

Ensure outcomes are clear, measurable and achievable

The environmental outcomes of the Plan are:

- The extent and condition of native vegetation and TECs increases and improves in the SCA in the Cumberland subregion
- Populations of targeted threatened species persist and the condition of suitable habitat improves in the SCA in the Cumberland subregion
- Condition of important koala habitat is improved, connectivity between koala sub-populations is maintained, threats to koalas are managed and the koala population in South Western Sydney persists and thrives
- Areas of high biodiversity value in the nominated areas are protected and threats to species and ecological communities from increased urbanisation is managed

It is considered that these outcomes reflect best practice as they are:

- Specific in relation to scope – in the context of the commitments under the Plan, the area over which the outcome is intended to be achieved and the contribution of the Plan in achieving that outcome is clearly defined
- Measurable and able to be reported against – changes in extent and condition of native vegetation and persistence of species can be measured and reported against under the MER framework for the Plan
- Achievable – in the context of the commitments under the Plan, the outcomes are considered to be achievable

A PLAN THAT DOES NOT ALLOW FOR CHANGING CIRCUMSTANCES

What is the risk and why may it affect implementation of the Plan?

Given the spatial and temporal scale of the Plan, it is important that it retains sufficient flexibility to ensure that implementation can adapt to changing circumstances over time and still deliver the Plan outcomes. There are a number of circumstances that can change during the long timeframe of implementation, including:

- Development priorities change necessitating minor changes to development areas
- New knowledge on biodiversity values identifies new conservation opportunities or alternative actions
- Changes to technology mean there are better ways to achieve the outcomes than envisaged now
- Ecological processes change over time (e.g. due to climate change, bushfires, floods etc.) that require alternative conservation approaches to address new risks or changing circumstances

What is required to address the risk?

To address this risk, the Plan needs to:

- Include processes that enable changes to development locations in appropriate circumstances
- Include mechanisms for changing how outcomes are delivered where appropriate
- Ensure flexibility around how the conservation program is delivered

How does the Plan address the risk and are these measures effective to ensure that Plan outcomes are still achieved?

Build processes into the Plan that enable changes to development locations

The Plan includes an appropriate level of flexibility around development.

The Plan provides for a formal modification to the Plan's strategic biodiversity certification if required to adjust the boundaries of the urban capable land. This can be undertaken in certain circumstances and must meet certain conditions to ensure changes are consistent with the outcomes of the Plan (Commitment 1, Action 5).

The Plan also provides for flexibility in relation to infrastructure projects covered under the Plan where planning has not yet begun or that are only at concept stage, including:

- Detailed design of the major transport projects, which are at various stages of development
- Essential infrastructure to support the nominated areas, such as water and electricity utilities, which is at various stages of development and may need to be located within avoided land

The Plan includes commitments for the major transport corridors and essential infrastructure that allow for flexibility in relation to future strategic planning and detailed design, while also ensuring these projects avoid and minimise, mitigate and (where appropriate) offset the impacts of development consistent with the outcomes of the Plan.

The Plan also establishes governance arrangements to ensure the Department and regulators are provided oversight over these arrangements to ensure these projects proceed consistent with the requirements of the Plan (see below).

Mechanisms for changing how outcomes are delivered

The outcomes and commitments under the Plan are fixed and cannot be changed over time. This is appropriate as it ensures the Plan provides as much planning, development, and conservation certainty as possible.

The actions that will be implemented under the Plan to deliver the commitments are able to be changed over time. This allows an appropriate level of flexibility to change implementation approaches based on monitoring and evaluation of the effectiveness of these actions through the MERI framework and adaptive management approach (see below).

It is considered this ability to change actions based on an evaluation process and in response to changes in circumstances is essential to the successful delivery of the outcomes and commitments under the Plan.

Appropriate flexibility around how the conservation program is delivered

The Plan acknowledges that in some cases it may be challenging to meet some of the offset targets in the Plan. Rather than committing to reduced offset targets, the Plan allows for flexibility in reaching those targets through a set of conservation principles and 'conservation lands selection steps'.

The principles are broad and prioritise the protection of the best remaining large patches of vegetation, areas that provide ecological connectivity and landscape function, species adaptation needs under climate change, as well as the restoration of habitat corridors and areas that provide buffers to intact native vegetation.

The conservation lands selection steps will be used to identify and secure reserves or BSAs under the conservation program. The details of the steps are set out in Sub-Plan A. The selection steps:

- Set out priorities for securing offset targets in terms of locations within and outside the Cumberland subregion and the biodiversity values being targeted (TECs versus species)
- Identify the circumstances, including time periods, where offset targets can be substituted for alternative offsets for other biodiversity values or conservation measures in cases where those targets cannot be secured

The Biodiversity Conservation Trust will be required to follow these steps when implementing the BSA component of the conservation program, and the Department will be required to follow these steps for reserve proposals.

Box 4 of Sub-Plan A specifies separate priorities for TECs and species and sets out the circumstances, including time periods, where offset targets can be substituted for alternative offsets for other biodiversity values, or alternative conservation measures in cases where those targets cannot be secured.

The rules in Box 4 specify, for example, that where offsets for a target TEC cannot be secured within or outside the Cumberland subregion after taking appropriate steps (including securing of credits), preference should be to secure alternative PCTs of the same Class first, then of the same Formation to those of the target TEC.

The selection steps are considered to appropriately balance the need to provide certainty for achieving conservation outcomes in the Cumberland subregion while retaining enough flexibility to ensure successful delivery of the conservation program. In particular, the steps:

- Have been developed consistent with the offset rules under the BC Regulation 2016
- Prioritise securing of offsets within the SCA, which represent the areas in the Cumberland subregion that are considered most likely to be viable in the long-term and to maximise ecological function and connectivity
- Prioritise securing the most impacted TECs under the Plan first
- Ensure TECs and species are given higher priority where progress in securing offsets is not keeping pace with impacts of the development on those matters (through an offset reconciliation accounting process – see below)
- Cap the amount of offsets that can be secured outside the Cumberland subregion for TECs
- Specify clear timeframes over the life of the Plan after which species offset targets can be achieved outside the Cumberland subregion, with greater flexibility provided for higher conservation status species to minimise the time between the impact of the Plan and conservation benefit achieved by the Plan for these matters

Theme 6 (Section 41.8) further discusses delivery of the conservation program, focussing on how the development controls proposed as commitments ensure conservation of the environment.

DELIVERY FRAMEWORK IS UNCLEAR OR UNSUITABLE

What is the risk and why may it affect implementation of the Plan?

An appropriate framework to deliver the Plan is imperative to ensure that development and conservation actions are consistent with regulatory requirements. The Plan is a high-level framework that needs to be given effect through delivery mechanisms that turn the high-level requirements of the Plan into specifics. If the delivery framework is unclear or unsuitable, delivery partners and developers will not understand exactly what they need to do at a site or project level to meet the requirements of the Plan and implementation will be ineffective.

Assurance mechanisms are a key part of the delivery framework, to ensure that the outcomes achieved under the conservation program keep pace with the impacts of the development on biodiversity values.

What is required to address the risk?

To address this risk, the Plan needs to:

- Clearly set out how the Plan is intended to be delivered
- Ensure the delivery framework is legally robust
- Ensure delivery partners act consistently with the Plan
- Enable action to be taken to ensure compliance
- Establish assurance mechanisms for delivery of the conservation program to ensure the conservation program keeps pace with development and with impacts to MNES

How does the Plan address the risk and are these measures effective to ensure that Plan outcomes are still achieved?

Clearly set out how the Plan is intended to be delivered

The Plan sets out a clear delivery framework for implementation which will be supported by a range of planning mechanisms under the EP&A Act. The planning controls support the delivery of both the development and conservation

program under the Plan. The delivery framework for the nominated areas includes a series of strategic land-use plans (discussed in Chapter 9, Section 9.2) which include structure plans, precinct plans and neighbourhood plans. The Department will also introduce several planning mechanisms or amendments to the planning system to support the delivery framework and implementation of the Plan, these are:

- SEPP (Strategic Conservation Planning), made under the EP&A Act
- Ministerial Direction made under the EP&A Act
- Development Control Plan (DCP) template
- *Cumberland Plain Conservation Plan Guideline for Infrastructure Development* (infrastructure guideline), made under the EP&A Regulation 2000
- Amendment to the EP&A Regulation 2000

The ways in which these planning mechanisms support implementation of the Plan is described in Chapter 9 (Table 9-1). The key planning mechanism to support implementation of the Plan is a new Environmental Planning Instrument (EPI) made under the EP&A Act – the SEPP (Strategic Conservation Planning), which will provide certainty that the Plan's commitments and actions to protect, enhance, maintain, and restore biodiversity in Western Sydney will be met.

Ensure the delivery framework is legally robust

The Plan ensures the delivery framework is legally robust through utilising the NSW planning system as the primary delivery framework for the Plan (as discussed above and in Chapter 9).

Developing a SEPP to support delivery of the Plan will be the main mechanism that ensures delivery is legally robust. A SEPP is an EPI made under the EP&A Act and is a legally binding strategic plan. The SEPP will ensure development within the nominated areas is consistent with State and Commonwealth approvals for biodiversity. The SEPP will give statutory effect to relevant commitments and actions in the Plan and will:

- Identify the location of urban capable land, avoided land, the SCA and land identified for acquisition on maps
- Apply development controls to avoided land and the SCA to limit the impact of future development and subdivisions under Part 4 of the EP&A Act and ensure biodiversity values are protected if development is proposed
- Require asset protection zones (APZ) for development on urban capable land to be located within the certified land (and not within avoided land)
- Require infrastructure under Part 4 of the EP&A Act on avoided land to comply with the Cumberland Plain Conservation Plan Guidelines for Infrastructure Development
- Identify the authority with the power to acquire conservation lands within the SCA to be secured as offsets under the conservation program (if the land is needed to be acquired under the *Land Acquisition (Just Terms Compensation) Act 1991*)

Ensure delivery partners act consistently with the Plan

The Plan will ensure delivery partners act consistently with the Plan by establishing service level agreements or memorandums of understanding as part of the process of engaging delivery partners. These will set out:

- Roles and responsibilities
- Processes for delivery
- Funding arrangements
- Stakeholder consultation arrangements
- Any monitoring and reporting requirements

The Department has commenced consultation and collaboration with delivery partners in relation to the Plan.

Enable action to be taken to ensure compliance

The Plan includes a commitment to implement a surveillance and compliance program to ensure compliance with the Plan and conditions of approval, and includes several actions to deliver this commitment, including:

- Establishing a compliance working group comprising the Department and other key stakeholders
- Preparing a compliance strategy under guidance of the working group

The compliance strategy will address the key elements of an effective compliance program, including:

- Identifying relevant compliance mechanisms used to ensure compliance
- Setting out compliance monitoring/auditing priorities and processes
- Developing a clear decision-making for taking compliance action
- Setting out procedures and protocols for taking compliance action
- Identifying roles and responsibilities for compliance, including monitoring and taking action

Establish assurance mechanisms for delivery of the conservation program to ensure the program keeps pace with impacts

The Plan includes several processes to ensure offsets are secured in accordance with the Plan and in a timely manner consistent with the staging and impacts of the development. These are:

- A reconciliation accounting process to reconcile offsets secured through the Plan with development impacts
- Adaptive management steps to align the securing of offsets with development

The Plan includes an accounting process to track the impacts of the development on biodiversity values as clearing progresses and securing the offset targets proceeds. If progress in securing offsets is not keeping pace with impacts, the Plan sets out an adaptive management response that will triggered at a specific point to rectify the balance.

Offset targets will be tracked in terms of hectares of land secured, as well as credits where appropriate. This will be done by undertaking assessments using the BAM at each BSA and reserve to confirm the biodiversity values present, the credits generated at the site, and the contribution the site makes to the hectare targets (Commitment 8).

The impacts of the urban and industrial development will be tracked using housing data from the Department's existing Sydney Housing Monitor and the Greenfield Housing Monitor.

The impacts of the major transport corridors will be tracked by Transport for NSW as the projects are constructed and will be reported regularly to the Department (Commitment 3, Action 4 and Commitment 4, Action 2). The Department will adjust the predicted impacts and offset requirements associated with the corridors through the reconciliation accounting process and publish adjustments through the Plan's annual updates, mid-term reviews and five yearly reviews (see Part 2). This process ensures changes to impacts and offset requirements because of the future avoidance and minimisation processes for the major transport corridors is transparent and properly accounted for.

The offset liability of the Plan at any given point in time is determined using a ratio of 3.5:1 applied to the total area (ha) of native vegetation cleared in urban capable land. This ratio was determined based on the method for determining offset targets (see Part 2), which applied a higher ratio to impacted native vegetation of higher condition or threat status to determine the amount of offset target for each protected matter. The offset liability ratio is an average ratio to be applied across all the impacts of development in the urban capable land and would determine the liability in terms of total amount of native vegetation (ha) to be offset, rather than a specific amount of impacted TEC or species. This is considered to be a practical and feasible approach to determining the offset liability at any given point in time, and consistent with the flexibility built into the 'conservation lands selection steps' (see above).

If progress in securing offsets is not keeping pace with the impacts of the development, the Plan specifies that:

- No action will generally be taken in the first 5 years of implementation to address any imbalance
- If the offsets secured are less than 80 per cent of the offset liability after Year 5, the executive implementation committee will consider a response. This will include, in order of priority:
    - Voluntary property acquisition
    - Compulsory property acquisition
    - Land use planning responses to development

The Office of Strategic Lands will prioritise voluntary acquisition of properties through several approaches, including market purchase, passive voluntary acquisition, or active and targeted voluntary acquisition. The Department will consider the use of compulsory acquisition only after voluntary options are not successful. The Department would consult with the community and key stakeholders before compulsory acquisition was undertaken.

The executive implementation committee may recommend land use planning responses if necessary to address the offset liability. These may include recommending development be temporarily constrained (a pause point). This advice would

be provided to the Minister for Planning, who may pause development through the planning system by delaying the release of additional precincts (if zoning has not yet occurred) or applying regulatory or statutory mechanisms to temporarily stop development applications from being assessed (if zoning has occurred).

The independent 5 yearly review may also make recommendations in relation to the progress of development delivery and the conservation program independent of the executive implementation committee.

POOR GOVERNANCE ARRANGEMENTS AND INSUFFICIENT FUNDING

What is the risk and why may it affect implementation of the Plan?

Governance can be considered as the systems and structures which are in place to ensure compliance, transparency and accountability during implementation of the Plan. Robust governance arrangements are necessary to ensure the Plan is delivered efficiently and effectively and complies with any conditions of approval. Sufficient funding is critical to ensure the conservation program can be delivered and the objective and outcomes of the Plan are met.

What is required to address the risk?

To address this risk, the Plan needs to:

- Establish an organisational structure and define roles and responsibilities
- Ensure sufficient funding to deliver the conservation program

How does the Plan address the risk and are these measures effective to ensure that Plan outcomes are still achieved?

Establish an organisational structure and define roles and responsibilities

The Plan establishes a clear organisational structure for implementation of the Plan and broadly sets out roles and responsibilities for each part of the structure, including delivery partners. The structure includes all relevant organisational levels needed to effectively implement the Plan, including:

- Oversight body and decision-making authority
- Coordinating and implementation body
- Delivery partners
- Technical working groups
- Stakeholder groups

The Plan identifies the Department as the responsible agency for delivering the Plan and meeting regulatory requirements. The Department's role under the Plan includes:

- Meeting statutory requirements
- Centrally coordinating the Plan
- Coordinating delivery partners, including setting implementation and reporting requirements
- Preparing regular Plan progress reports for publication
- Identifying breaches and notifying the appropriate regulatory authority

The Plan also establishes an executive implementation committee as a key oversight body to:

- Provide strategic direction and make key decisions in relation to implementation
- Ensure commitments and outcomes are monitored and reported on

The executive implementation committee includes executive level representatives from the Department, approval/regulators including DAWE and EES, and partner agencies including Transport for NSW. Working groups will be established where appropriate to advise the executive implementation committee on specific technical issues.

Roles and responsibilities of each body within the organisation structure will be defined in detail during early implementation of the Plan. The Department has commenced consultation with key delivery partners and will finalise and agree roles and responsibilities through service level agreements or memorandums of understanding.

Ensure sufficient funding to deliver the conservation program

The Plan includes a commitment (Commitment 24) to establish governance arrangements including funding, to ensure the efficient and effective implementation of the Plan.

The Department will be responsible for funding the Plan's implementation to 2056. Funding will be secured using a public-private funding model. The model involves upfront investment from the government and substantial cost-recovery through the Special Infrastructure Contributions (SIC) program or other contribution type.

The SIC program is a NSW Government initiative that seeks to recover some of the cost of infrastructure through developer contributions. Use of an existing program would ensure clarity regarding legal robustness and other factors important for successful administration of a levy, including how the levy is collected, when and over what land the levy is payable, whether the levy can be reviewed or challenged, and compliance mechanisms to ensure the levy is paid.

The Plan includes an additional level of accountability and transparency in relation to funding by:

- Establishing a Trust or other financial arrangement to administer funds on behalf of the Department
- Establishing arrangements to determine how funding decisions will be made, administered and reported

It is important to consider the need for some upfront government contributions to ensure funding is available early during implementation. Funding tied solely to a levy on development creates the following risks:

- Delays at the start of implementation before adequate funds from a levy become available
- Delays later during implementation due to downturns in development
- Priority biodiversity values are lost or degraded prior to being secured under the conservation program

As demonstrated by the trend analysis (see Box 1 and Supporting Document D), the existing level of landscape threats in the Cumberland subregion is significant. This creates a substantial risk that biodiversity values degrade before land is secured, which may reduce the effectiveness or increase the costs of the conservation program.

The NSW Government has recognised this risk and is committing substantial initial funding of $114 million over the first five years to deliver priority conservation actions. This includes a land purchase program to support the establishment of the Georges River Koala Reserve and to establish and expand other reserves, commencing with the restoration of koala habitat in priority areas including the Georges River Koala Reserve.

INEFFECTIVE MONITORING, EVALUATION, REPORTING AND ADAPTIVE MANAGEMENT PROCESSES

What is the risk and why may it affect implementation of the Plan?

Monitoring, evaluation, reporting and improvement through adaptive management (MERI) is crucial for ensuring implementation of the Plan is effective, transparent and accountable. MERI is essential for enabling new information over the life of the Plan to be integrated into implementation and to ensure that:

- Changes to the environment and legislation (including the status of TECs and species) are accounted for in the implementation of the conservation program
- Impacts to avoided land and unforeseen loss of avoided biodiversity vales can be rectified
- Failure of conservation measures (e.g. ecological restoration) can be evaluated and measures updated
- New information can be used to improve conservation actions

Without a robust MERI process, this information will not be effectively incorporated into the Plan, which may result in a failure to deliver the objective or outcomes of the Plan.

What is required to address the risk?

To address this risk, the Plan needs to include:

- A clear commitment to MERI
- A MERI framework underpinned by a program logic
- Clarity on scope and timing of monitoring, reporting and evaluations

- Evaluation of outcomes not just delivery of actions
- Clarity on when and how adaptive management will be implemented

How does the Plan address the risk and are these measures effective to ensure that Plan outcomes are still achieved?

A clear commitment to MERI

The Plan includes a commitment to implement an evaluation program consistent with an overall MERI framework described in Sub-Plan A (Commitment 25). This commitment is supported by several actions to ensure the MERI framework is implemented effectively. The MERI framework provides for:

- Monitoring of the delivery of actions and commitments and achievement of outcomes
- Evaluation of the Plan at annual and 2.5 yearly and 5-yearly intervals to inform adaptive management responses
- Public reporting on progress in delivering the Plan

To increase transparency and accountability in relation to the Plan's implementation, the NSW Government will commission a comprehensive, independent review on the status of implementation of the Plan and its outcomes every five years over the life of the Plan. The results of the independent review will be submitted in a report to the NSW Minister for Planning and Public Spaces and provided to the NSW Minister for the Environment and the Commonwealth Minister for the Environment for consideration.

A MERI framework underpinned by a program logic

The MERI framework has been developed based on the program logic underpinning the Plan (see Chapter 5). The program logic describes broadly how the Plan will be implemented and how the commitments and actions are expected to lead to the Plan's outcomes. Developing the MERI framework based on the program logic helps to:

- Clearly articulate assumptions underpinning the Plan (e.g. that action X leads to the delivery of commitment Y, which leads to the achievement of outcome Z)
- Determine robust Key Performance Indicators (for monitoring)
- Inform evaluations (as part of the evaluation program) and adaptive improvements to implementation of the Plan

Clarity on scope and timing of monitoring, reporting and evaluations

Sub-Plan A sets out the scope and timing of monitoring, reporting and evaluations (see also Chapter 9).

Monitoring will be undertaken regularly throughout implementation of the Plan to inform the evaluations. The Department will collect baseline data on biodiversity values through various methods, including vegetation plots, species surveys and rapid assessments. The baseline data will be compared with data collected on specific biodiversity values at specific locations throughout the implementation of the evaluation program to evaluate the effectiveness of the Plan over time and to ensure the Plan is delivering its commitments, actions, and outcomes.

Evaluations will be undertaken on an annual, 2.5 yearly and 5-yearly basis over the life of the Plan and not just at the end of implementation. This is important for effective MERI so there is scope for adaptive management of the Plan, if necessary, to ensure commitments and outcomes are met. The evaluations will aim to:

- Determine the effectiveness of commitments and actions to deliver outcomes
- Reconsider assumptions made as part of the program logic
- Determine the influence of external factors outside the control of the Plan
- Inform any necessary adaptive management decisions to the implementation of the Plan

Reporting will include:

- An annual update on the delivery of the commitments and actions, including program revenue and expenditure
- An internal mid-term review of the Plan's implementation at 2.5 years and then every 5 years in between each independent review
- A five-yearly independent review on the status of the Plan, its delivery and interim outcomes; based on evaluations

The annual updates, mid-term reviews and five-yearly independent reviews will be made publicly available on the Department's website.

Evaluation of outcomes not just delivery of actions

The purpose of an evaluation is to determine how well the Plan is being delivered and to provide a trigger point and basis for adaptive management of the Plan. An evaluation should include analysis of the achievement of outcomes, as well as the delivery of commitments and actions, because outcomes are what key stakeholders, including regulators and the public, are most interested in understanding. Evaluating outcomes also enables:

- Assumptions underpinning the program logic to be tested
- Effectiveness of the delivery of commitments and actions to be evaluated

An evaluation program will be developed within the first year of Plan implementation that will, consistent with best practice, evaluate outcomes as well as program implementation.

Clarity on when and how adaptive management will be implemented

Adaptive management is critical for effective implementation given the Plan is inherently subject to uncertainty and assumptions. Key elements of good adaptive management are:

- Clearly defining outcomes
- Undertaking regular data collection/monitoring to track progress
- Completing regular evaluations to investigate cause and effect, efficiency and effectiveness, and test assumptions
- Establishing programs of research to test and improve management interventions

The Plan includes each of these key elements to enable effective adaptive management.

Adaptive management under the Plan will use data from monitoring and the findings of program evaluations to determine whether actions need to be revised to more effectively achieve the commitments and outcomes.

Where an evaluation indicates a commitment or outcome is not being effectively and efficiently delivered or achieved, the Plan specifies that this will trigger a detailed review of implementation. This will be carried out by the relevant delivery agency for that particular project or program, in partnership with the Department.

The Plan specifies that adaptive responses may be triggered where:

- Offset targets are not being met
- External factors arise that affect the assumptions, logic or delivery of the Plan

The adaptive management steps to be taken where offset targets are not being met are described above.

Adaptive management arrangements are described further in Chapter 16.

41.10.3 CONCLUSION

The Plan includes the key elements important for effective implementation and to achieve its intended outcomes. In particular, the Plan provides:

- Clear and feasible outcomes
- Clarity about the delivery framework and mechanisms to implement the Plan
- Appropriate flexibility to ensure it remains relevant over time
- Clear governance arrangements, including certain funding
- Comprehensive processes to monitor and report on implementation, and adapt implementation as needed

It is important to note that the Plan and subplans are high level documents providing an overarching framework and assurance processes for implementing the Plan, and that successful implementation relies on considerable further work being done during the early stages of implementation to address specific details. This is appropriate because it allows detailed consideration of complex issues, seeking of expert advice, and comprehensive engagement with stakeholders.

The Plan provides a clear framework for this future implementation work by identifying a set of actions that will be undertaken to deliver each commitment within a program logic framework.

41.11 THEME 9: DOES THE PLAN FACILITATE ADAPTATION TO CLIMATE CHANGE?

41.11.1 CONTEXT AND METHOD

The ToR (Section 4.6(5) and 5.3(1)) requires analysis of the extent to which the Plan considers, and the commitments under the Plan facilitate, adaptation of biodiversity to climate change.

The extent and nature of the impacts of climate change on specific biodiversity values is difficult to predict. There is a lack of information about how specific matters are likely to respond to climate change, and there is debate and uncertainty over how to best facilitate adaptation. Given this, the evaluation was undertaken in two main ways:

- A qualitative evaluation using a set of broad principles derived from the scientific literature on how to best manage the impacts and facilitate adaptation of biodiversity to climate change
- A quantitative evaluation using a study by Macquarie University that modelled changes to future habitat suitability on the Cumberland Plain for some Commonwealth listed species under several climate change scenarios

The qualitative evaluation was done to complement the quantitative evaluation because quantitative data is not available for all Commonwealth listed TECs and species and there are limitations associated with this data.

MACQUARIE UNIVERSITY STUDY

Scope of the study

The quantitative evaluation was based on a study by Macquarie University (Macquarie University, 2019) that modelled how climate change will affect the suitability of habitat for 92 Cumberland subregion species, including 23 Commonwealth listed Category 1 matters, under several different climate change scenarios. The study:

- Assessed the change in extent and location (losses and gains) of currently suitable habitat for each species under future climate changes. This helps to:
    - Understand how the availability of suitable habitat for a species may change in the future
    - Identify the species particularly vulnerable to climate change in terms of loss of habitat
- Determined the extent to which currently suitable habitat will remain suitable under future climate changes for each species. These areas represent climate refugia for those species
- Identified localities that are likely to remain suitable for multiple species under future climate changes. These areas represent climate refugia likely to be most robust to climate change for multiple species

Species Distribution Models (SDMs) were used to predict habitat suitability for species. The SDMs were developed specifically for the Macquarie University Study and are different to the SDMs used in the species impact assessments in this Assessment Report. The SDMs were developed based on seven climate and environmental variables relating primarily to temperature and precipitation. For some species, additional environmental variables were used relating to soils, weathering and topography.

Changes to suitable habitat are discussed in the study in terms of total and local suitable habitat:

- Local suitable habitat is the area of suitable habitat within an IBRA subregion that contains records for the species. This reflects an assumption that the ability for a species to disperse into areas of future suitable habitat is limited to within IBRA subregions that are already populated by the species
- Total suitable habitat is the total area of suitable habitat for a species (ignoring current records). This reflects an assumption that the ability for species to disperse into areas of future suitable habitat is unlimited

Climate scenarios modelled

The study was based on four NARCliM climate scenarios that were modelled on an assumed emissions scenario (SRES A2) (see Table 41-29). The project modelled climate scenarios over three time periods:

- Baseline climate (1990–2009)

- Near-future (2020–2039)
- Distant future (2060–2079)

Table 41-29: Climate scenarios projected by four Global Climate Models

Scenario	Global Climate Model	Summary of future climate
Warmer/Wetter	MIROC3.2 (medres)	Warmer and wetter than present, particularly in north eastern NSW, although alpine regions are projected to become drier
Hotter/Little Change	ECHAM5/MPI-OM	Has the greatest increase in temperature of the four scenarios. Precipitation trend varies across the state (slightly wetter in the north eastern and coastal regions, slightly drier elsewhere)
Hotter/Wetter	CCCMA CGCM3.1(T47)	Warmer than MIROC, and wetter across most of the state, although areas in the northwest and southeast of the state may be slightly drier
Warmer/Drier	CSIRO-Mk3.0	Warmer than present, and the driest of the four models

Key limitations of the study

The study is subject to several limitations. A key limitation is that the SDMs were not informed by the current extent of native vegetation and habitat in the Cumberland subregion. This means they may predict that suitable habitat occurs in areas that no longer contain native vegetation or habitat because of land clearing or urban development.

The study is useful in providing a broad indication of the adequacy of the Plan in facilitating adaptation to climate change. However, the results, particularly in relation to predicting areas in the Cumberland subregion likely to remain suitable for species under future climate changes, must be considered in the context of actual on-ground circumstances.

41.11.2 ANALYSIS

QUALITATIVE ANALYSIS

This section outlines a general set of key principles drawn from the scientific literature on how to best facilitate adaptation of biodiversity to climate change and analyses the Plan against these principles to help evaluate the extent to which the Plan is likely to facilitate adaptation of biodiversity to climate change.

Principles for managing biodiversity under climate change

The goal of adaptation can be defined as reducing the risk of adverse impacts by enhancing the 'resilience' or 'resistance' of ecosystems to change. Resilience strategies attempt to enhance a systems ability to recover from change, while resistance strategies attempt to enhance a systems ability to resist change (Heller & Zavaleta, 2009).

Scientists and practitioners have proposed a wide range of principles or strategies to manage the impacts of climate change on biodiversity (Heller & Zavaleta, 2009). A set of commonly recommended key principles can be derived from the literature. These principles are:

- Ensure representativeness and replication
- Protect the largest and most viable patches
- Maintain and improve habitat connectivity
- Reduce the impacts of other threats
- Manage uncertainty through adaptive management

Most of these principles are consistent with general conservation planning principles, and scientists often argue that many conservation planning principles remain robust under a changing climate (e.g. see Hodgson, Thomas, Wintle and Moilanen, 2009). Despite this, in identifying this set of key principles, it is recognised that:

- There is considerable uncertainty about the how climate change will impact biodiversity and the best ways to facilitate adaptation of biodiversity to climate change
- Measures to facilitate adaptation of biodiversity to climate change are likely to be regional and species-specific
- There may not be scientific consensus on all of these key principles and the relative importance of each
- There is much uncertainty about how each of the key principles should be applied in practice

Ensure representativeness and replication

Representativeness and replication are well established principles of conservation planning. Representation refers to the need to protect the full range of biodiversity (e.g. vegetation types). Replication refers to the need to protect multiple examples of each unit of biodiversity to order to spread risk (Margules & Pressey, 2000).

These two principles will continue to be important in facilitating adaptation of biodiversity to climate change (Dunlop & Brown, 2008; Heller & Zavaleta, 2009). Dunlop and Brown argue:

> *By sampling a diversity of communities…[we] are also sampling the underlying geographic diversity of the landscape…Thus, a set of areas that samples a high diversity of communities now will probably also capture a high diversity of communities under future climates, even if the composition of the communities is different in the future*

The extent to which the SCA includes a representative sample of each PCT in the Plan Area and contribute to total representativeness within protected lands in the Plan Area, is assessed in Section 41.5. The analysis indicates that the SCA has the potential to make a substantial contribution to existing levels of representation of PCTs in the Plan Area, including to many PCTs that are currently under-represented in existing reserves.

Protect the largest and most viable patches

Another well-established principle of conservation planning is to focus conservation efforts on protecting and restoring large patches. There are well established relationships between the size of a patch of native vegetation and the size and persistence of populations, species richness, species dispersal, genetic diversity, persistence of large vertebrates, maintenance of near-natural disturbance regimes, and other important ecological functions (Hodgson, Thomas et al., 2009; Lindenmayer, Hobbs et al., 2007).

Scientists argue this principle will continue to be important in facilitating adaptation of biodiversity to climate change. Because habitat loss remains the key threat to biodiversity and relationships between patch size and biodiversity value is well-established, protecting areas of high quality native vegetation and habitats should remain the primary focus of conservation efforts under climate change (Heller & Zavaleta, 2009; Hodgson, Thomas et al., 2009).

The extent to which the SCA includes large (> 50 ha) and moderate (> 20 ha) patches is assessed in Section 41.6. The analysis indicates the SCA includes many large patches > 50 ha that comprise approximately 93 per cent of the total native vegetation in the SCA and contains 36 per cent of the total area of patches > 50 ha in the Plan Area.

Habitat connectivity

Maintaining and improving habitat connectivity is often considered the most important strategy to manage the impacts of climate change on biodiversity (Dunlop & Brown, 2008; Heller & Zavaleta, 2009). Despite this, there is much uncertainty about the importance of habitat connectivity in managing the impacts of climate change. Some scientists argue that other, more certain strategies, such as protecting the largest patches of high quality native vegetation, should be prioritised over habitat connectivity (Hodgson, Thomas et al., 2009):

> *As uncertainties about connectivity tend to be high, and increases in habitat quantity and quality coincidentally improve connectivity, we conclude one should generally provide higher weight in decision-making to actions that increase area and quality [of habitat] Theoretically, we know that populations will sometimes benefit more from a small, well-connected piece of habitat than a larger, more isolated one, but the relative uncertainties and the probability of worse-than-expected outcomes [from improving habitat connectivity] should also affect our decision making…*

The extent to which the SCA includes the most important areas of habitat connectivity in the Cumberland subregion (BIO Map core areas and BIO Map corridors – see Section 41.6) is assessed in Section 41.5 and Section 41.6. The analysis indicates that the SCA protects substantial areas of BIO Map core areas and corridors.

The SCA is therefore likely to make a substantial contribution to supporting habitat connectivity across the subregion.

It is also important to note that habitat connectivity was a key factor influencing the location of the SCA (see Chapter 8). Priority was given to including areas that were adjacent to and connecting other patches of habitat, including existing reserves, and that could form broad habitat corridors across the landscape.

The SCA was also located to provide connectivity outside the Cumberland subregion, including to existing reserves in the Blue Mountains to the west of the subregion, and existing reserves and protected water catchments to the south-east and south-west (see Chapter 8). This potentially enables more mobile species to shift to higher elevations (e.g. the Blue Mountains) or south to cooler climates in response to climate change.

Reduce the impacts of other threats

Some scientists argue that given the uncertainty about the impacts of climate change on biodiversity and how best to facilitate adaptation, focusing on reducing key existing threats to biodiversity provides a robust strategy to address climate change. For example, Steffen et al (Steffen, Burbidge et al., 2009) state:

> *A central strategy is giving ecosystems the best possible chance to adapt by enhancing their resilience. Approaches to building resilience include managing appropriate connectivity of fragmented ecosystems…* [and] *implementing more effective control of invasive species, and developing appropriate fire and other disturbance management regimes*

The Plan recognises that the effective management of landscape scale threats is critical to the success of the conservation program under the Plan and in managing the impacts of climate change on biodiversity. The Plan includes a range of commitments to reduce threats to conservation lands secured within the SCA. These are discussed in Section 41.6.

Address uncertainty through adaptive management

Adaptive management is an iterative process that seeks to improve management over time by testing hypotheses and learning from the results, and then incorporating lessons learnt into future management actions.

Many scientists argue that given the uncertainty about the impacts of climate change on biodiversity and how best to facilitate adaptation, management within an adaptive framework will be critical to facilitating adaption.

The Plan will be implemented adaptively to ensure the commitments and actions are delivered and the outcomes are achieved efficiently and effectively. Adaptive management will be triggered on the basis of the findings of the evaluations undertaken as part of the monitoring, evaluation and reporting program under the Plan.

The approach to adaptive management under the Plan is described in Chapter 9 and evaluated in Section 41.10.

QUANTITATIVE ANALYSIS

The quantitative analysis, based on the Macquarie University study (Macquarie University, 2019), was used to identify the Commonwealth listed species most vulnerable to climate change, as well as determine the extent to which the SCA contains suitable habitat for these species and refugia for multiple species under future climate changes.

Species most vulnerable to climate change

The Macquarie University study modelled the change in the area of 'currently occupied' suitable habitat across the Cumberland subregion and NSW under the different climate scenarios. 'Occupied habitat' means the proportion of the climatically suitable habitat that is also found within a subregion for which there are records.

Table 41-30 shows the results of the study for 23 of the Commonwealth-listed Category 1 species that were modelled. The table shows the area of 'occupied' suitable habitat remaining at 2030 and 2070 that is predicted to remain suitable under all climate scenarios (i.e. there is consensus across all climate scenarios that the area remains suitable).

The table also indicates that climate change may have substantial impacts on suitable habitat for the vast majority of Commonwealth-listed Category 1 species. Of the 23 Category 1 species that were modelled:

- The majority are predicted to have no suitable habitat remaining in the Cumberland subregion at 2070
- The vast majority are predicted to be subject to substantial declines of greater than 50 per cent in suitable habitat within NSW by 2030 and by 2070

The species likely to be most vulnerable to climate change were defined for this assessment as species with less than 100 km² of 'occupied' suitable habitat remaining at 2030 across NSW. These species are highlighted in blue and are:

- *Eucalyptus benthamii*
- *Leucopogon exolasius*
- *Micromyrtus minutiflora*
- *Persoonia bargoensis*
- *Persoonia nutans*
- *Pomaderris brunnea*
- *Pultenaea parviflora*

Table 41-31 identifies the risk of impacts of the Plan on these seven species and the commitments under the Plan relevant to each species, drawing on the assessments in this Assessment Report (see Chapter 29). The table shows that the risk of impacts of the Plan for most of these species is low or very low or no risk.

The Plan includes commitments to secure offset locations for *Persoonia nutans* and *Pultenaea parviflora.* Furthermore, substantial areas of potential habitat for each of these seven species will also be secured through meeting offset targets for NSW TECs– see Section 41.4) in conservation lands within the SCA.

Given the low risk of impacts to most of these species, the specific offsets being provided for the two higher risk species, and the consistency of the SCA with adaptation principles (see above), it is considered overall that the commitments in the Plan are adequate to facilitate adaptation to climate change for these species.

Table 41-30: Predicted impacts of climate change on currently 'occupied' habitat at 2030 and 2070 under all climate scenarios

		Habitat in Cumberland subregion		Habitat within NSW				
Species	**Status**	**Current habitat (km²)**	**Predicted habitat at 2070 (km²)**	**Current habitat (km²)**	**Predicted habitat at 2030 (km²)**	**Predicted % habitat remaining at 2030**	**Predicted habitat at 2070 (km²)**	**Predicted % habitat remaining at 2070**
Acacia bynoeana	EN	17.9	9.6	10,379	5,916	57%	3,529	34%
Acacia pubescens	V	16.8	1.8	3,828	842	22%	421	11%
Anthochaera phrygia	CE	21.0	0.0	198,185	126,838	64%	120,893	61%
Botaurus poiciloptilus	EN	14.9	0.0	217,443	36,965	17%	32,616	15%
Commersonia prostrata	EN	10.1	0.0	5,858	351	6%	176	3%
Dasyurus maculatus	V	8.8	0.0	135,878	74,733	55%	40,763	30%
Eucalyptus benthamii	V	7.7	0.0	1,244	0	0%	0	0%
Genoplesium baueri	EN	0.9	0.8	2,217	1,751	79%	1,751	79%
Heleioporus australiacus	V	4.4	0.1	22,399	5,152	23%	3,584	16%
Lathamus discolor	EN	0.7	0.0	39,770	15,510	39%	12,329	31%
Leucopogon exolasius	V	5.5	0.0	1,972	0	0%	0	0%
Litoria aurea	EN	20.3	0.0	21,568	2,157	10%	647	3%
Melaleuca deanei	V	8.3	1.1	6,793	2,174	32%	1,087	16%

		Habitat in Cumberland subregion		Habitat within NSW				
Species	**Status**	**Current habitat (km²)**	**Predicted habitat at 2070 (km²)**	**Current habitat (km²)**	**Predicted habitat at 2030 (km²)**	**Predicted % habitat remaining at 2030**	**Predicted habitat at 2070 (km²)**	**Predicted % habitat remaining at 2070**
Micromyrtus minutiflora	EN	3.4	0.0	349	0	0%	0	0%
Persoonia bargoensis	EN	2.4	0.0	342	0	0%	0	0%
Persoonia glaucescens	EN	1.1	0.0	1,214	304	25%	0	0%
Persoonia hirsuta	EN	19.7	0.1	8,659	1,126	13%	433	5%
Persoonia nutans	EN	8.0	0.0	844	0	0%	0	0%
Pimelea curviflora var. *curviflora*	V	6.5	0.6	3,376	675	20%	473	14%
Pimelea spicata	EN	19.2	0.0	2,012	262	13%	40	2%
Pomaderris brunnea	EN	19.8	0.0	6,943	0	0%	0	0%
Pteropus poliocephalus	V	26.9	24.7	59,602	46,490	78%	46,490	78%
Pultenaea parviflora	EN	7.0	0.0	728	80	11%	0	0%

Table 41-31: Impacts of Plan and relevant commitments for species predicted to be most vulnerable to climate change

Species	Risk of impacts	Relevant commitments under the Plan	Potential habitat secured through NSW TEC offset targets in SCA (ha)
Eucalyptus benthamii	Low risk	No specific offset target	2,655 ha
Leucopogon exolasius	No risk	No specific offset target	0 ha
Micromyrtus minutiflora	Very low risk	No specific offset target	400 ha
Persoonia bargoensis	Low risk	No specific offset target	3,605 ha
Persoonia nutans	Medium risk	2 offset locations	1,855 ha
Pomaderris brunnea	Low risk	No specific offset target	2,030 ha
Pultenaea parviflora	High risk	2 offset locations	400 ha

Suitable habitat for species in Cumberland subregion

Table 41-32 shows the predicted area of 'occupied' suitable habitat within the SCA at 2070 under all climate scenarios for the 23 Commonwealth-listed Category 1 species that were modelled. The species likely to be most vulnerable to climate change (as defined above) are highlighted in blue in the table. The table shows that:

- The majority of species are predicted to not have any suitable habitat remaining in Cumberland subregion at 2070
- The SCA is predicted to contain suitable habitat for four of the 23 Commonwealth listed Category 1 matters at 2070
- The SCA does not contain any suitable habitat for the species most vulnerable to climate change (highlighted in blue). However, none of these species are predicted to have any suitable habitat remaining in the subregion at 2070

Table 41-32: Predicted area of 'occupied' suitable habitat within the SCA at 2070 under all climate scenarios

Species	Status	Predicted habitat at 2070 in Cumberland subregion (ha)	Predicted habitat at 2070 in the SCA (ha)
Acacia bynoeana	EN	96,300	2,400
Acacia pubescens	V	18,000	0
Anthochaera phrygia	CE	0	0
Botaurus poiciloptilus	EN	100	0
Commersonia prostrata	EN	0	0
Dasyurus maculatus	V	0	0
Eucalyptus benthamii	V	0	0
Genoplesium baueri	EN	8,100	0
Heleioporus australiacus	V	800	0
Lathamus discolor	EN	0	0
Leucopogon exolasius	V	0	0
Litoria aurea	EN	300	0

Species	Status	Predicted habitat at 2070 in Cumberland subregion (ha)	Predicted habitat at 2070 in the SCA (ha)
Melaleuca deanei	V	10,600	2,000
Micromyrtus minutiflora	EN	0	0
Persoonia bargoensis	EN	0	0
Persoonia glaucescens	EN	0	0
Persoonia hirsuta	EN	700	300
Persoonia nutans	EN	0	0
Pimelea curviflora var. *curviflora*	V	5,700	0
Pimelea spicata	EN	0	0
Pomaderris brunnea	EN	0	0
Pteropus poliocephalus	V	246,600	18,200
Pultenaea parviflora	EN	0	0

Refugia for multiple species in the Strategic Conservation Area

The study identified the localities in the Cumberland subregion that are likely to continue to have suitable climates for multiple threatened species under all climate scenarios. These are called 'high value' refugia and are particularly valuable for conservation as they represent the areas that are most likely to be robust to climate change.

High value refugia were identified in the study by combining maps for each species of 'occupied' suitable habitat that remains suitable under all climate scenarios, and calculating the number of species for which each map cell was suitable.

Table 41-33 show the extent to which the SCA contains potentially suitable habitat for multiple species (of the 92 species modelled in the study) under all climate scenarios ('high value refugia'). The figures shown in the table are not additive (e.g. row 1 means that there is a total of 4,300 ha of habitat in the SCA that is suitable for all 9 species).

The table shows:

- Some localities in the Cumberland subregion retain potentially suitable habitat (a total 100 ha) under all climate scenarios for up to a maximum of 22 of the 92 modelled species
- The SCA includes localities that retain considerable areas of potentially suitable habitat (a total of 4,300 ha) under all climate scenarios for multiple species (a maximum of 9 species)

Table 41-33: Extent to which the SCA contains habitat for multiple species under all climate scenarios

Number of species	Area of habitat in Cumberland subregion suitable for that number of species (ha)	Area of habitat in the SCA suitable for that number of species (ha)	Percentage of total habitat in Cumberland subregion included in the SCA (%)
9	34,800	4,300	12%
15	18,300	500	3%
22	100	0	0%

41.11.3 CONCLUSION

The extent and nature of the impacts of climate change on specific biodiversity values is difficult to predict. There is a lack of information about how specific matters are likely to respond to climate change, and there is debate and uncertainty over how to best facilitate adaptation of biodiversity to climate change.

In the context of this uncertainty, the Plan has taken adequate steps to consider climate change. In particular, the SCA has been designed consistent with key principles commonly recommended by scientists and practitioners to facilitate adaptation of biodiversity to climate change, including:

- Ensure representativeness and replication
- Protect the largest and most viable patches
- Maintain and improve habitat connectivity
- Reduce the impacts of other threats
- Manage uncertainty through adaptive management

41.12 HOW PLAN MEETS THE COMMONWEALTH ENDORSEMENT CRITERIA

The ToR (section 5.2(4)) also requires the Assessment Report to evaluate the extent to which the Plan meets the endorsement criteria under clause 8 of the Agreement. The endorsement criteria specifies that, in determining whether the Assessment Report adequately addresses the impacts of the Plan, the Commonwealth Environment Minister must have regard to the extent to which the Plan meets the objectives of the EPBC Act, including how the Plan:

- Protects the environment, particularly protected matters (under Part 3 of the EPBC Act)
- Promotes ESD through the conservation and ecologically sustainable use of natural resources
- Promotes the conservation of biodiversity
- Provides for the protection and conservation of heritage
- Promotes a co-operative approach to the protection and management of the environment
- Assists in the co-operative implementation of Australia's international environmental responsibilities

Table 41-34 summarises how the Plan meets each of these criteria, and where further information relevant to each criterion can be found in the Assessment Report.

Table 41-34: Summary of the how the Plan meets the endorsement criteria

Endorsement criteria	Summary of how the Plan meets the criteria
Protects the environment, particularly protected matters	The Plan protects the environment, particularly protected matters, through: • Avoiding and minimising impacts to biodiversity values, including protected matters. The Plan achieves substantial avoidance outcomes for protected matters and includes commitments to ensure the avoidance to be achieved is certain and protection of avoided lands is strengthened through development controls. The avoidance outcomes of the Plan are discussed in Chapter 14 • Implementing mitigation measures to ensure indirect impacts of the development are adequately mitigated. The Plan includes commitments to ensure indirect impacts are mitigated and identifies specific mitigation measures to address protected matters identified at risk of impacts. Mitigation measures are discussed in Chapter 15 • Establishing offsets to ensure the direct impacts of the development are adequately compensated. Offsets will be established for each impacted Commonwealth-listed TEC, as well as each Commonwealth-listed species identified as being at high or medium risk of residual direct impacts. The method to determine offsets is described in Part 2. The adequacy of the offsets are evaluated in Section 41.4 and discussed for each TEC and species in Chapters 29 to 31 • Establishing governance arrangements and implementing an evaluation program to ensure actions to protect the environment are delivered and adjustments are made to protection measures if necessary to ensure the Plan's outcomes are achieved. These are described in Chapter 9 and evaluated in Section 41.10

Endorsement criteria	Summary of how the Plan meets the criteria
Promotes ESD through the conservation and ecologically sustainable use of natural resources	The principles of ESD have been promoted and considered in the development of the Plan, both in guiding the Plan's development and informing the commitments under the Plan. Chapter 40 details how the Plan is consistent with each of the principles of ESD. The adaptive management and assurance frameworks (described in Chapters 9 and 16) will ensure that ESD is promoted throughout the life of the Plan
Promotes the conservation of biodiversity	The Plan promotes the conservation of biodiversity by establishing a conservation program which details the: • Avoidance and minimisation of impacts • Mitigation of indirect impacts • Conservation of flora, fauna and habitat (including offsets) • Management of landscape threats • Building of knowledge and capacity The main aim of the conservation program is to conserve flora, fauna and habitat by securing priority conservation areas in the Cumberland subregion to offset the impacts of the development under the Plan on biodiversity values and maximise ecological function and resilience at the landscape scale. The conservation program is described in Chapter 8
Provides for the protection and conservation of heritage	The Plan provides for the protection and conservation of heritage. Chapter 34 discusses impacts to both World and National heritage as required under the EPBC Act. It has been determined that the direct and indirect impacts to these sites from the Plan are negligible. Additional heritage sites that are not considered MNES, such as archaeological, built, and Aboriginal cultural heritage, are regulated in NSW under other legislation and are subject to separate assessment and approval processes that are not part of the Plan (see Chapter 1). These heritage sites will be assessed during implementation via state development approvals and planning mechanisms. The Plan ensures a clear delivery framework for implementation which will be supported by a range of planning mechanisms under the EP&A Act (discussed in Chapter 9)
Promotes a co-operative approach to the protection and management of the environment	A co-operative approach to the protection and management of the environment has been maintained throughout the development of the plan via ongoing stakeholder engagement with councils, landholders, industry groups, environmental groups, Local Aboriginal Land Councils (LALCs), Aboriginal groups and members of the community. This process is detailed in Chapter 5 Ongoing engaging with stakeholders has enabled a co-operative approach to development of the Plan and will promote community engagement with ongoing management under the Plan The Plan has also developed a series of commitments that aim to increase the capacity of the community to participate in biodiversity conservation and support research to improve understanding of threats and land management issues. These commitments will promote a co-operative approach to the protection and management of the environment during implementation of the Plan and include: • Commitment 20 – to 'Provide opportunities for the residents of Western Sydney to learn about and actively participate in biodiversity conservation including koala conservation'. As part of this commitment, the Department will develop an Education and Engagement Implementation Strategy to guide implementation of an education and engagement program. This aims to help the Plan achieve its conservation objectives by increasing communities understanding of the environment and biodiversity. The Department will partner with environment groups, education facilities and councils to deliver this program. The Department will also establish an engagement program to educate landholders within the SCA and promote the opportunities and benefits of BSAs • Commitment 21 – to 'Partner with Aboriginal communities in Western Sydney to deliver biodiversity conservation and support economic opportunities arising from the delivery of the Plan'. As part of this commitment, the Department will co-

Endorsement criteria	Summary of how the Plan meets the criteria
	design a 10-year Aboriginal Engagement and Implementation Strategy and will seek to establish partnerships with NSW Aboriginal Land Council and Local Aboriginal Land Councils, an advisory group, and Aboriginal networks to implement the strategy. This aims to ensure Aboriginal people are at the forefront of implementing the Plan and can benefit from the economic opportunities arising from the Plan's implementation • Commitment 22 – to 'Invest in research priorities that will support the implementation of the Plan and help to deliver the Plan's outcomes'. As part of this commitment, the Department will develop a Research Program Implementation Strategy to guide long term research funding that will help achieve the Plan's biodiversity outcomes, including the identification of research partners, the potential establishment of a small-scale competitive grant program, and development of decision-making criteria for funding research programs under the Plan. Key outcomes of the strategy include: o Research into changing community attitudes and behaviour to biodiversity and conservation values o Research into the connections between biodiversity and Aboriginal culture and practices in Western Sydney • Commitment 23 – to 'Support rehabilitation measures to help maintain koala health and welfare'. As part of this commitment, the Department will invest in the *NSW Koala Strategy* and other potential partners to implement the koala health and welfare program in South Western Sydney. This program includes a range of deliverables including provision of grants for community wildlife organisations for resources and carer recruitment and training
Assists in the co-operative implementation of Australia's international environmental responsibilities	Australia's international environmental responsibilities and agreements have been considered in the development of the Plan. This includes the following agreements and obligations: • The Ramsar Convention on Wetlands • The Convention on the Conservation of Migratory Species of Wild Animals (Bonn) • The Japan - Australia Migratory Bird Agreement (JAMBA) • The China - Australia Migratory Bird Agreement (CAMBA) • The Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA) • The voluntary East Asian - Australasian Flyway Partnership (EAAFP) Implementation of avoidance, mitigation and conservation measures under the Plan will ensure that there are unlikely to be significant residual impacts to protected matters under these international agreements and obligations as result of development under the Plan Additionally, Australia's international obligations under the World Heritage Convention have also been considered. As discussed in Chapter 34, the potential impacts to World Heritage properties from the Plan are acceptable, and the Plan is not inconsistent with these obligations

41.13 CONCLUSION

The Plan will deliver substantial conservation outcomes for the Cumberland subregion and adequately addresses the likely impacts of the urban and industrial development, infrastructure, intensive plant agriculture and major transport corridors on biodiversity values and other protected matters under the BC Act and EPBC Act.

The Plan is considered to be consistent with strategic certification guidelines (DPIE, 2020) and the requirements in the Commonwealth ToR relating to evaluating the commitments. In particular, the Plan:

- Is broadly consistent with the principles of ESD
- Has achieved substantial avoidance outcomes for biodiversity values

- Includes commitments that:
  - Adequately address the biodiversity values being impacted
  - Prioritise the most important biodiversity values, particularly the most threatened matters
  - Are considered likely to improve biodiversity values and landscape function in the long-term
  - Are additional to existing conservation obligations
  - Establish development controls that conserve the environment and represent a new or significant upgrade
  - Will deliver new reserves generally consistent with the CAR reserve framework
  - Are likely to be effectively implemented and lead to timely and certain outcomes
  - Are consistent with key principles for facilitating adaptation of biodiversity to climate change
  - Meet the Commonwealth's endorsement criteria

In concluding that the Plan adequately addresses the impacts of the development, it is important to note that the Plan's commitments are not driven solely by meeting the biodiversity credit requirements of the BAM, which is a key part of the definition of 'no net loss' under the BAM. This is consistent with the BC Act. For strategic biodiversity certifications such as the Plan, the Act does not require the value of commitments be calculated in terms of credits. This recognises that strategic biodiversity certification provides significant opportunities to maximise benefits to biodiversity and address landscape scale conservation challenges that are not provided by site-by-site assessment processes.

The key commitments under the Plan have been developed in recognition of these potential benefits, including:

- Focusing the conservation program, including offsets, on the areas of the landscape considered most likely to be viable in the long-term and maximise ecological function and connectivity across the landscape
- Addressing ecological function and landscape-scale ecological processes through improving habitat connectivity and undertaking ecological restoration in priority parts of the landscape
- Implementing programs to manage threats at a landscape scale that can benefit multiple species and TECs
- Consolidating offsets into larger patches that are likely to be more viable in the long term

Furthermore, modelling work undertaken as part of the Assessment Report that looked at trends in native vegetation extent and condition in the subregion (see Supporting Document D) demonstrated that the existing level of landscape threats is significant and is likely to lead to substantial declines in native vegetation over time unless action is taken.

The trend analysis indicated the Plan's commitments will contribute to addressing this ongoing decline by securing and managing large parts of the landscape in perpetuity. The Plan also includes commitments to deliver programs that are expected to lead to improved management of landscape scale threats, including weeds, pests, fire and disease.

A key implication of the high level of existing landscape threats in the Cumberland subregion is that there is a substantial risk that biodiversity values will degrade before land is secured under the conservation program, which may reduce the effectiveness or increase the costs of the conservation program.

The NSW Government has recognised this risk and is committing substantial initial funding of $114 million over the first five years to deliver priority conservation actions. This includes a land purchase program to support the establishment of the Georges River Koala Reserve and to establish and expand other reserves, commencing with the restoration of koala habitat in priority areas including the Georges River Koala Reserve. Importantly, the upfront funding will also enable:

- Commencement of Koala habitat restoration, including installation of Koala crossings and predator exclusion fences
- Support for the *NSW Koala Strategy* including the commencement of annual monitoring in the region
- Establishment of partnerships including with the Biodiversity Conservation Trust to facilitate formation of BSAs primarily in the Razorback Area which is dominated by Cumberland Plain Woodland
- Establishment of partnerships with the NSW Aboriginal Land Council to establish a grant program for Western Sydney Local Aboriginal Land Councils to deliver cultural and conservation opportunities

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