Castlereagh Natural Heritage and Biodiversity Strategy



Valuing heritage and creating quality of life May 2009 **Conserving** remnant natural heritage

Re-instating local plant and animal communities

Restoring ecological services to provide quality air, water, soils

Integrating natural and cultural heritage

Managing natural assets

Improving understanding of ecological communities



Castlereagh Natural Heritage and Biodiversity



The Penrith Lakes Site – Its Natural Geography Geology and Vegetation

Located on the western margin of the extensive Cumberland Bordered by the Nepean River to the west and a sweeping riv to the south, the Penrith Lakes site covers 1935 hectares. Riv floodplain and the lower slopes of Cranebrook Escarpment to provide landform diversity.

Geology and soils vary:

Quaternary alluvium on the riverbank and floodplain – gravel silt, clay.

Tertiary fluvial sediments to the northeast – gravel, clay, irons outcrops.

Hawkesbury Sandstone - small outcrop at end of Smith Street

Wianamatta Shales to the south – Bringelly Shale, Minchinbu Sandstone, Ashfield Shale.

Formerly the various soil types supported a broad range of na plant communities and many wildlife habitats – wetlands, gras woodlands, tall trees, forests, open clearings, dense shrubby understorey, hollow logs, leaf litter.

Endangered Ecological Communities

Remnants of former Riverflat Forest Riparian Forest and Woodlands on the riverbank Alluvial Woodland on the floodplain

Freshwater swamps on the floodplain

Braided creeklines crossing the floodplain

Castlereagh Swamp Woodland

Shale Plain Woodlands on Cranebrook Escarpment

Shale Gravel Transition Forest

Shale Sandstone Transition Forest

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	Only about 13% of estimated original extent remains on the Cumberland Plain ¹
	On the Cumberland Plain
	Only 616 hectares remains
	About 7.7% of the estimated original extent remains
	Some 31.7% of estimated original extent remains
	Less than 23% of estimated original extent remains



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Before Castlereagh – Rich Aboriginal Heritage

The Castlereagh area provided abundant resources for the local Aboriginal people, the Darug. Water was plentiful and a wide range of both plant and animal foods were available from the Nepean River, floodplain swamps and higher dryland forests and woodlands.

Tench noted 'What we were able to learn from them was, that they depend but little on fish, as the river yields only mullets, and that their principal support is derived from small animals which they kill, and some roots (a species of wild yam chiefly) which they dig out of the earth.'²

Barrallier and Collins³ record the value of swamps in the inland country. In these they found eels, fish and various shellfish, which in April supplemented the basic diet of possums, squirrels and kangaroos. Grubs and lizards were also eaten. Barrallier noted 'the people of this area usually fed upon possums and squirrels, which are abundant in that country and also upon kangaroo rats and kangaroo, but they can only catch the last one with the greatest trouble, and they are obliged to unite in great numbers to hunt it.'⁴

Fish, eels, waterbirds, possums,'yams' and other edible roots, green leafy vegetables and plenty of different fruits throughout the year. The flowers of the native honeysuckles and paperbarks (*Banksia* and *Melaleuca* species) provided sweet nectar to drink and the paperbarks also yielded useful materials for wrapping and cooking food, carrying fire, and for many other purposes.



1. Tozer (2003); 2. Tench 1789 [1979]; 3. Collins 1798 [1975] 4. Barrallier 1802 [1975].

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Tools and Trade

Chert and basalt gravels and quartz and quartzite from within river sands of the Nepean River provided the raw material new making stone tools and other implements. The Castlereagh an an important tool production site. Many indications have been stone flakes and cores, pebble tools and scrapers, retouched and points. There is evidence also of trading from further afiel the closest source of silcrete found at Castlereagh is South C Eastern Creek. The tools that were manufactured were mainly blades and points and edge-ground hatchet heads.

Cox (1880) noted that eight stone axe heads had been turned the plough on the Nepean flats at Castlereagh. Edge-ground a and large stone artefacts were popular with collectors, with ma finds removed during the early 20th century. ⁵

Significant Aboriginal Cultural Heritage Sites

Nepean riverbank – a focus for economic and social activities The high ground and slopes south of Smith Street contain sev archaeological sites and possible camping areas.

Parts of Cranebrook Creek were important resource areas for food and raw materials.

Cranebrook Escarpment has several archaeological sites. Th scarred trees that represent another focus of Aboriginal activi

Many other Aboriginal sites are found within a few kilometres Castlereagh: rock shelters with deposits of artefacts, rock eng axe grinding grooves and scarred trees.



5. Quoted in ERMA (2001)

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n the eeded for area was n found – d blades eld as Creek or ly small d up by axes nany such	
s. veral r water, nere are ity. of gravings,	Local and regional Aboriginal communities value all of these sites and have concern for their protection and custodianship. The sites illustrate the lifestyle, values and experiences of ancestors, and provide examples of their creative and technical ability. They provide continuing links with the past and are of great social value.

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Kennedy grant (Smith Street): 160 acres; in the 1805-06 muster he had 5 acres of wheat, 130 acres of pasture, 25 acres fallow, 28 sheep and 120 goats.

Robert Smith grant (Landers Inn): 80 acres; rented to Stockfish; in 1805-06 had 4 ½ acres wheat, 2 ½ acres barley, 3 acres maize and 16 pigs.

James McCarthy grant (McCarthy's cemetery): 100 acres; by 1806 had 8 acres cultivated, remainder in pasture and had 1 horse, 2 oxen, 10 goats and 3 pigs.⁶ Finding good land suitable for farming was a priority for the first European settlers. By mid-1789 the country within 100km radius of Port Jackson (Sydney) had been traversed, the Hawkesbury and Nepean Rivers explored and the land along their banks deemed suitable for cultivation. The first European settlers moved to near present-day Windsor on the Hawkesbury in early 1794. By April 1794 the 22 settlers had cleared about 70 acres of land. The soil was rich and crops grew well.

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European Cultural Landscape – Timber-getting,

Agriculture, a Township and Quarrying.

James Meehan surveyed the Castlereagh area in 1803 and Governor King allocated the first land grants there. By 1804 about 24 people were establishing farms. Much of the land was open grassy woodland, so clearing of trees, although difficult, was probably not such a burdensome task as in other parts of the country. Crops grew readily on the fertile floodplain soils.

Three floods in 1806 and two in 1809 set back the development of farming but by 1810 James McCarthy was supplying meat to the government stores. Despite the flooding problem, farming continued on the floodplain because of the fertile soils and proximity of the river. Further floods occurred in 1816, 1817 and 1819 (February and June).



6. Liston (1998)

Timber getters seeking cedar and other useful timbers were p the first into the Castlereagh area. Cedar was discovered by Europeans on the Hawkesbury in 1794-95. In March 1795 per was given for the master of the *Experiment* to take a cargo of timber to India. Collins mentions that the *Experiment* sailed w large logs of cedar and some mahogany taken from the Haw Lieutenant Shortland informed Lord Sydney in October 1795 very valuable wood call'd the Cedar was discovered on those [of the Hawkesbury River] and is of very great service in this It is very fine wood, and light for Boat Building, good also and for House Building, and works up into beautiful furniture.'⁸

Bark and timber were also used for early shelters and later slab buildings. Shingles could be readily split from she-oaks (*Casuarina* spp.) for roofing. Ironbarks and blue barked gum (*Eucalyptus fibrosa* and *E. tereticornis* respectively) were use for houses and fencing. Paperbarks (*Melaleuca* spp.) provided linings and other useful products.

Following the early floods, Governor Macquarie established t township of Castlereagh on higher ground in 1810 to assist in overcoming the flood problem. By 1848 Wells in his *Gazettee Australian Colonies* describes the parish of Castlereagh as co 225 houses and 1205 inhabitants.

By the 1830s some mills were established and mixed grazing cropping were the main farming activities, and in the 1840s ta production commenced. Improved access to Sydney's agricu produce markets via the railway in the 1850s shifted the focu market gardening, poultry farming and orchards. Horse breed also important from the 1860s. During the 1880s land was su and dairying began by 1900.

Quarrying of sand and gravel was from the Nepean River be 1880 and 1950 but then shifted to focus on the adjacent floor



7. HRNSW; 8. Shortland in Cobley (1986); 9. Liston (1998)

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Early European Settlement Impacts – Changing the Landscape

The cumulative impacts of early European settlement were considerable and had the overall effect of permanently changing the landscape.

Forests were cleared and swamplands drained;

Soils were cultivated and exotic plants introduced as crops;

Grazing lands were developed with introduced grasses;

Native plant diversity was reduced and remnant vegetation stands fragmented;

Natural flooding was reduced;

River and floodplain gravels and sands were mined;

Roads, railways, bridges and other infrastructure developed.

From the earliest settlement times exotic plants were introduced. Crops and vegetables, such as wheat, maize, pumpkins, melons, potatoes, carrots, turnips, onions, and cabbages. Fruit trees such as oranges, lemons, peaches and figs. Grasses and clovers for grazing lands.

Prosperous farms – Hadley Park (established 1811-1812), and Nepean Park (1822-23) – had landscaped gardens, orchards and vineyards.

Native Kurrajong (*Brachychiton populneus*) and White Cedar and exotic Peppercorns (*Schinus molle*) and Chinese Windmill Palms (*Trachycarpus fortunei*) were often planted as ornamental trees. African Boxthorn as hedges and Buddleja, Roses and Camellias as shrubs.

The garden associated with The Poplars is extensive and diverse. It was begun in the 1930s on part of the original 1809 grant to Rosetta Marsh.¹⁰

Today a number of these exotic plants remain and could be conserved within the curtilage of the historic buildings. McCarthy's Cemetery, established in 1806, has the boundaries marked by Kurrajongs and Elm trees and some of the traditional grave plantings continue to thrive alongside the native plant species.

10. ERMA (2001)

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Natural Heritage Significance – A Platform to Achieve Sustainability

A diversity of water and landforms formerly existed at Castlere and a great variety of Cumberland Plain vegetation communiti habitats and ecosystems.

Unquarried lands are significant for their remaining geomorpho features, variety of soils and potential for Aboriginal archaeolog

Current remnant River-flat Eucalypt Forest is highly degraded can be conserved, re-instated and enhanced. Remnant Shale Woodlands, Shale Gravel and Shale Sandstone Transition For the Cranebrook Escarpment have been disturbed but are in re good condition and have high recovery potential.

Castlereagh is a significant place as it provided resources for Aboriginal inhabitants and European settlers alike.

Significance also lies in the potential to bring back the local na flora and fauna, to re-instate endangered ecological communit to protect and enhance remnant plant communities and to integrate them with the cultural heritage.

Flora

Over 600 native plant species could be represented. Remnant of River-flat Eucalypt Forest, Shale Plains Woodland, Shale G Transition Forest, Shale Sandstone Transition Forest are signi and are listed as Endangered Ecological Communities in the N Threatened Species Conservation (TSC) Act.

Vulnerable and endangered plant species listed in the NSW To occur within these communities:

Pimelea curviflora var curviflora

Dillwynia tenuiflora

Pultenaea parviflora

Acacia pubescens

Pimelea spicata

Maundia triglochinoides

Eucalyptus benthamii

Grevillea juniperina

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Some iconic species could feature at Castlereagh:

Red Cedar and *Eucalyptus benthamii* amongst the plants, Azure Kingfisher, Platypus and Koala amongst the animals.

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Many significant Western Sydney species have largely disappeared due to clearance of forest or woodland and drainage of swamplands:

27 aquatic and wetland species;54 herbs;

37 grasses;

8 climbers;

30 shrubs;

7 tree species.

Fauna

Recorded previously at Penrith Lakes

15 native mammals; 18 reptiles; 18 species of frogs;

over 100 species of birds.

Tree frogs, Ground Frogs, Dragons, Geckos, Skinks, Tree Snakes, Turtles, Snakes, Possums, Wallabies, Flying-Fox, Water Rat, Swamp Rat were all present.

Endangered and vulnerable native animals

There is potential to re-introduce populations of Green & Golden Bell Frog. Heath Monitors and various species of bats including the Grey-headed Flying Fox which may be encouraged to forage at Castlereagh.

Endangered Birds such as the Bush Stone-Curlew, Swift Parrot, Painted Snipe and Regent Honeyeater could be assisted to establish.

Vulnerable Birds such as the Blue-billed Duck, Freckled Duck, Australasian Bittern, Black Bittern, Glossy Black-cockatoo, Turquoise Parrot, Gang-gang Cockatoo, Powerful Owl, Masked Owl and Diamond Firetail may also be able to be re-introduced.

Natural significance means the importance of ecosystems, biodiversity and geodiversity for their existence value or for present or future generations, in terms of their scientific, social, aesthetic and life-support value.

Article 1.3 ANHC

The Vision – Re-instating and Conserving Natu

The Natural Heritage and Biodiversity Vision for Castlereagh seek to conserve and enhance remnant Cumberland Plain ve communities with their component plant and animal population

Penrith Lakes Development Corporation could establish foun plantings of Cumberland Plain wetland and dryland vegetation communities. These re-instated plantings on new landforms of be capable of progressive enhancement to ultimately reflect of vegetation types and habitats more closely.

Through time, the diversity of native plants and animals could expected to increase at Castlereagh and contribute to local a regional biodiversity conservation.

Local native plant species could be used to provide aesthetic pleasant environments at:

sporting grounds and other active recreational venues;

throughout the recreational parklands;

urban parks and gardens, streetscapes and residential lands

This will create a unique sense of place.

The cultural heritage sites could be integrated with the natural heritage areas.

The natural significance of the landscape, its vegetation, and animal communities could be interpreted to the publ



means all the processes and actions of looking after a to retain its natural significance and always includes maintenance and i

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Design features include:

 lake foreshore gradients that allow for the greatest plant diversity possible to be established

 a transition from aquatic to terrestrial communities around the lake that optimises the extent and diversity of ecotones

 reed beds unevenly scattered around the lake margins relating to different water depths and different substrates, and interspersed with open water areas, to provide a variety of micro-habitats

 dense patches of emergent vegetation on the lake and island margins to allow for bird roosting, feeding and breeding.

A New Lake for Wildlife

The northernmost part of the Castlereagh site is intended to include a Wildlife Lake. Specifically designed habitats will play a key role in local wildlife conservation and also provide interim habitat for visiting migratory birds such as those protected through the JAMBA, CAMBA and ROKAMBA bilateral agreements. The lake and surrounding terrain will contribute significantly to local and regional biodiversity by re-instating Cumberland Plain vegetation and many different habitats.

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A mosaic of plant communities on varied topography could border the lake providing dry land habitats to complement the aquatic areas. Dense ground cover and leaf litter, sparse and dense shrubby areas and many different tree species could provide food, shelter and other resources for fauna. Windbreaks and buffers to areas subject to disturbing influences should be present.

Public access to the wildlife lake should be limited. Many of the animal species that may be introduced or may establish there will be shy and intolerant of human disturbance. However, specific sites containing carefully hidden observation platforms and bird-hides would allow residents and visitors to observe the wildlife at the lake. Involvement in conservation management activities may also be possible.

The lake would also be expected play a vital role in water and flood management being linked by grass-covered weirs to adjacent areas and to the Nepean River.



A Restored Nepean Riverbank

The Nepean River bordering the Castlereagh site comprises interesting variety of landforms.

Flat, sandy terraces immediately above the Nepean River.

Historic fords with shallow waters flowing over gravel and bo bordered by gravelly flats.

A high levee bank with steep slopes.

Riparian Forest formerly clothed the riverbank with stands of she-oak (*Casuarina cunninghamiana*) backed by Bangalay, E leaved Apple, Coastal Myall and White Sallow Wattle (*Eucaly botryoides, Angophora subvelutina, Acacia binervia, A. floribu* respectively) on the terraces. Many native shrubs and ground covers flourished below the tall trees. Today only a few old Eucalypts remain and some stands of regrowth Acacias. Exotic trees and weedy plants dominate.

As with the Wildlife Lake this area should have restricted pub access and be well-buffered from nearby recreational areas. A road for service vehicles should traverse areas of the high bank and the weir sites should be used for access to the lowe riverbank for management activities.



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A Reinstated Cranebrook Creek

James Meehan noted the creek in 1803 when surveying the land grants of McCarthy, Lees and Fredericks. It is believed that it was named by James McCarthy because of the abundant birdlife that it attracted.¹⁰ The southern parts of the creek were well-defined while further north there were lagoons, a narrow watercourse or just marshy ground.

The remnants of the watercourse are expected to be rejuvenated. It would link with a remnant *Angophora* stand and be extended to the north to enter the Wildlife Lake. The lower reaches of the creek could be designed specifically to meet the ecological needs of platypus and other selected species with waters lifted from the main lake providing the necessary environmental flows.

The margins of the current lagoon (near Nepean Park) and re-established watercourse to the north, would carry Alluvial Woodland species such as the Forest Red Gum, Cabbage Gum, Swamp Oak and Paperbarks (*Eucalyptus tereticornis, E. amplifolia, Casuarina glauca, Melaleuca styphelioides, M. linariifolia* respectively).



Re-instatement

nt means to introduce to a place one or more species or elements of habitat or geodiversity that are known to have existed there naturally at a previous time, but that can no longer be found at that place.

10. Liston (1998)

Article 1.25 ANHC

Connecting Wildlife Corridors – An Enhanced Cranebrook Escarpment

On the eastern margin of Castlereagh valley floor, wetlands a management lakes provide the opportunity for a variety of wil habitats and corridors. These corridor lands are important. The provide a wetland-dryland continuum to Cranebrook Escarpm will link the Cranebrook Escarpment to the Nepean River and natural areas further west. Links to conservation areas further and east outside of Castlereagh would also be possible.

Further south, parts of the attractive Cranebrook Lake could be bordered by natural wetlands, grasslands and groves of mixe *Casuarina* trees and Paperbarks (*Melaleuca* species).

On the slopes, plants typical of the Shale Plains Woodland, Shale Gravel and Shale Sandstone Transition Forests, all endangered ecological communities, could be planted and allowed to regenerate naturally.

The corridors should be shared by people and wildlife. Raised boardwalks and observational hides (for bird watching or observational hides (for bird watching or observational) could be provided in wetland areas and wall tracks through the enhanced woodlands and forests on the Cranebrook Escarpment.



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Presenting and Enjoying Castlereagh Natural Heritage

The natural heritage at Castlereagh can be interpreted to encourage greater enjoyment of it and enhanced understanding of its significance.

Informative signage along trails through remnant and restored vegetation on the riverbank and Cranebrook Escarpment can explain the nature of the Cumberland Plain vegetation, its diversity and beauty.

The value of replanting the relevant Cumberland Plain vegetation communities on the re-formed landscapes can be explained and the ways in which this was achieved could be documented.

The important role that the revegetated landscapes and the lakes can play in conserving local plants and animal populations could be interpreted and also the value for regional biodiversity of the potential dispersal corridors. These would link with conservation areas outside of the Castlereagh site.

The links between natural and cultural heritage could be explained at Aboriginal and historic sites, at the Muru Mittigar Cultural Centre, at the historic Lander's Inn and McCarthys cemetery, and through specific plantings along streets and in parks.

Aboriginal tool-making, camp sites and trading routes

Useful plants in Cumberland Plain vegetation communities

Great River Walk track – historic exploration

Historic fords on the Nepean River

Historic houses and farmlands reaching to the Nepean River

Viewing points

Potential for bird hides and boardwalks, observation platforms.

Presentation

means creating awareness and understanding of the natural significance of a place.

Article 1.29 ANHC

should interpret to visitors and others the natural significance of the place and should encourage appreciation and respect. It should also encourage an appropriate level of awareness, understanding and support for the heritage values and conservation objectives of a conservation program or activity.

Article 28 ANHC

Applying Ecological Principles

Ecological principles should be applied at a landscape scale property level. They should also be maintained during and a development of Castlereagh.

Plants

Local provenance plant species should be used to establish 'mimic', as far as possible, the former natural vegetation con

Naturally occurring community composition should be reflect new plantings and the plant species distributed on the basis ecological preferences. Greater species diversity and full strucomplexity, integrity and functionality should be encouraged

Animals

Animal populations would colonise, establish and thrive only there is adequate living space provided for them. Habitat div needs to be created and sustained.

Various habitat components should be provided or encourage to develop naturally. Food and life-cycle resources should be available, and corridors to allow movement and dispersal. Refugia would be needed also.

Resilience

For long-term sustainability of vegetation and viable animal populations it is essential that resilience is developed. This means that there should be:

Effectively functioning and viable soil ecosystems;

Full structural complexity and also floristic diversity in the veg

Plant-animal interactions occurring;

Vegetation and habitats connected across the landscape.

Sustainability would reduce the need to manage threats to n heritage and biodiversity assets and hence would reduce ma costs for the site as a whole.

is the ability to withstand and/or recover from d

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Key Management Principles

A number of key management principles are also important. Building upon the Ecological Principles and in meeting its commitments, PLDC would also seek to apply the following management principles.

1. Assess and understand natural heritage significance

Identification of natural heritage values which would inform and direct management decisions.

2. Protect and actively manage remnant native vegetation Requirements for management of weeds, control of feral animals and other pests, minimising soil erosion, and impact of high nutrient run-off will be specified and activities planned in advance.

3. Enhance and link remnant vegetation patches Native vegetation remnants should be extended and linked by corridors to nearby patches. Regeneration of native plants will be encouraged and supplementary planting undertaken.

4. Plant and manage new landforms using best-practice Soils would be improved by introducing organic matter. Foundation plantings could use natural colonising and soil-stabilising species. Erosion, sedimentation, water pollution, and damage from high winds or drought should be minimised and weeds and pests managed

5. Enhance plant diversity in recently planted areas Planting losses should be replaced and additional species added where and when appropriate to increase diversity levels.

6. Retain, enhance and manage animal habitats Potential refuge areas should be identified and habitat quality assessed. Where necessary habitat components and food and life-cycle resources would be introduced and managed.

7. Integrate natural and cultural heritage aspects Areas of Aboriginal cultural significance should be protected within Cumberland Plain vegetation communities. Historic plantings should be conserved within heritage sites and intergraded with appropriate native species.

8. Monitor and adaptively manage site development A monitoring program would cost-effectively measure performance, track sustainability and enable regular review and improvement.

9. Provide adequate resources for natural heritage Resources and skills should be provided to ensure conservation, management and interpretation of the natural heritage resource.

10. Involve the communities at Castlereagh

Opportunities for involvement by all community sectors should be available so that the values of the site are recognised and future enjoyment and care of the site continued.

Natural Heritage Objectives

In applying the previously outlined principles, the overall longobjectives for natural heritage for the Penrith Lakes site should

Design, construct and maintain resilient aquatic and terrestrial ecosystems at minimum capital, operating and maintenance c

Conserve and enhance natural areas and those associated wi cultural heritage conservation areas within and adjacent to the Lakes Scheme landscape;

Achieve appropriate and effective communication between all holders, interested communities and individuals.

General Strategies

The general strategies that could be employed in order to achieve the objectives are to:

Design, construct and maintain resilient terrestrial ecosystems revegetating landforms with local provenance native species to develop grasslands and woodlands appropriate to end uses;

Design, construct and maintain resilient aquatic ecosystems a minimum capital and operating and maintenance costs;

Increase the biological diversity of the Penrith Lakes Scheme by creating new areas of habitat and re-introducing lo native plants and animals.

Specific Strategies

More specific strategies relating to re-instatement, protection, monitoring and management, communication, recording and reshould be implemented in order to progress towards achieving longer-term objectives.

Re-instatement

Ensure floodplain wetlands (including lakes and detention basis are rehabilitated and managed to provide a variety of habitats migratory and other wetland birds, and other fauna including fr reptiles and invertebrates.

Design and construct a wildlife lake and landforms to provide a of habitats for migratory and other wetland birds, and other fau including frogs, reptiles and invertebrates.

Identify and develop terrestrial and wetland vegetation corridor the Scheme with links to external catchment vegetation.

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Protection

Protect, rehabilitate and maintain natural areas on the riverbank and ensure works in the vicinity of the Nepean River have minimal adverse impact on riverbank stability and biodiversity.

Protect, rehabilitate and maintain remnant stands of trees and other natural areas on the floodplain.

Conserve and enhance the natural habitats of the Cranebrook Escarpment.

Monitoring and Management

Develop and implement an Integrated Monitoring Program to track progress in development of soils, establishment of vegetation cover, habitats and animal communities and to inform adaptive management processes.

Maintain water quality and other environmental monitoring to inform management decisions, and enhance monitoring where necessary to track progress towards fully functioning ecosystems in newly formed lakes.

Develop and implement a Landscape Operational Plan to ensure on-going conservation, monitoring and management of terrestrial and aquatic habitats and associated corridors across the landscape.

Continue to use the Water Operations Manual which guides the interim operation of the lakes and enhance progressively to cover water operations across the whole Penrith Lakes site.

Communication and Records

Continue to liaise with State Agencies and Council to ensure that planning, operational obligations and all statutory requirements continue to be met.

Develop a Record and Reporting System to ensure maintenance and lodgement of records on planning and progress of development, land rehabilitation and the management of water, vegetation and cultural heritage.

Prepare and implement a community awareness and education plan to raise community understanding and appreciation of the natural and cultural heritage values at Castlereagh and develop a stewardship ethos that enables and sustains participatory management of the area.

Planning for Natural Heritage and Biodiversity

Master Plan

A Natural Heritage and Biodiversity Master Plan is being devel adaptively apply the Ecological and Management Principles. It on the earlier flora and fauna studies.

The Master Plan outlines the theoretical base for the developm of sustainable Cumberland Plain plant and animal communities at Castlereagh.

Policy and strategic direction is provided for:

Rehabilitation of the soils;

Establishment of a stable native ground cover;

Re-establishment of relevant vegetation communities;

Re-introduction of appropriate native animal populations;

Conservation and enhancement of the unguarried lands.

Natural Heritage Benchmarks

In accordance with current scientific research, the benchmarks below are being used within the Master Plan to develop draft ta These criteria should help achieve sustainability in grassy woo communities (such as at Castlereagh):

At least 30% of the land area could be in woodland;

At least 10% (and preferably 20%) of the land area could be set aside as 'core conservation';

Core conservation areas could be 30-50 hectares in size;

Patches of vegetation across the landscape could be 20-25 hectares in size:

Links or 'stepping stones' between patches could be less than kilometers apart and be 5-10 hectares in size:

Core conservation and corridor areas could be connected to others on the site and within the district;

Intensive land use could be no more than 30%.

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Adaptive Implementation

An adaptive management approach which integrates monitoring within the management cycle of Plan-Act-Monitor-Evaluate could be pursued. This would be consistent with current best practice and Penrith Lakes Development Corporation's long standing policies.

Using a variety of different methods, the monitoring could costeffectively measure performance, guide assessment of progress towards sustainability and provide a basis for evaluating decisions and adjusting management to ensure progressive improvement over the longer term.

The community could be involved in monitoring, assessment, and recording progress.

Reports could go to residents, the public and relevant Government agencies and authorities.





Monitoring,

which allows review of the effectiveness of conservation programs and re- examination of the appropriateness of decisions, is fundamental to improving conservation practice. It requires keeping adequate records.

Article 30 ANHC

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