



# Vegetation Survey and Mapping of the Crinolyn and Windella Ramsar sites 2023

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**NSW Department of Planning and Environment –  
Environment and Heritage Group**

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## Executive summary

This report documents tree demographic and full floristic plot vegetation surveys and desktop and in-field Plant Community Type (PCT) mapping in the Crinolyn and Windella Ramsar sites from 12 April to 16 April 2023.

Within Crinolyn, three PCTs were recorded, two of which (PCT 40 and 53) occur in two distinct forms and form the dominant vegetation communities within the site. A total of four PCTs were recorded within Windella, one of which (PCT 53) occurs in two distinct forms. Coolabah woodland (PCT 40a and 40b) occupied a considerable extent (33.02 ha combined) of Crinolyn and the presence of dead Coolabah throughout areas of PCT 53a, indicate a greater previous extent of Coolabah woodland within and surrounding the site. The extent of Coolabah woodland (PCT 40b) across Windella is less extensive, consisting mostly of patches featuring one mature tree and surrounding saplings and seedlings. PCT 182, characterised by dense stands of *Typha domingensis* (Narrow-leaved Cumbungi), dominates the central and southern portions of Windella. Following recent inundation, Narrow-leaved Cumbungi is widespread across the majority of the site, featuring as a measurable component of the remaining three other PCTs.

A total of two tree demographic / full floristic plots and four full floristic monitoring plots were established in both the Crinolyn and Windella Ramsar sites. A total of 70 flora species (comprising 50 native and 20 exotic species) were recorded within Crinolyn full floristic plots, whilst a total of 48 flora species (comprising 33 native and 15 exotic species) were recorded within Windella full floristic plots. Condition class schemas developed for flood-dependent PCTs were applied to Crinolyn and Windella full floristic plot data. Condition class results were consistent for PCTs across both Crinolyn and Windella, with PCT 40 plots (PCT 40a and 40b) assessed as either Intermediate/Poor or Intermediate, whilst PCT 53a plots ranged from Intermediate to Good or Excellent/Benchmark and PCT 182 plots were assessed as Intermediate.

A total of 45 trees were assessed within the two tree demographic plots (CRIN\_3 – PCT 40b and CRIN\_6 – PCT 40 a) established and surveyed within Crinolyn Coolabah woodland patches. Despite the two plots occurring in the two different forms of Coolabah woodland (PCT 40a and PCT 40b), major differences in tree condition between the two sites were not apparent. A total of 65 trees were assessed within the two tree demographic plots (WIND\_2 and WIND\_3 – both PCT 40 b) established and surveyed within Windella Coolabah woodland patches. Both plots recorded consistent results, reflective of the similar structure of the Coolabah woodland patches present within Windella.

Landscape features or structures present within and surrounding the Crinolyn and Windella Ramsar sites which may influence inundation and hydrological regimes were noted during the field survey, most evidently drainage channels that have been constructed within both sites. Both drainage channels influence the flow of water across both sites and in doing so, also influence the distribution and composition of vegetation within the sites. Away from site boundaries, and apart from *Phyla canescens* (Lippia) which was widespread across both sites, weed cover was generally low and no listed weed species for the region were recorded during field surveys (Local Land Services 2017). Evidence of two listed feral pest species, *Sus scrofa* (Feral Pig) and *Vulpes vulpes* (Red Fox) were recorded at Windella, with Red Fox also recorded at Crinolyn (Local Land Services 2018).

A diverse range of fauna species were opportunistically recorded during field surveys with a total of 32 native and two introduced species recorded at Crinolyn and a total of 46 native and three introduced species recorded at Windella. Across both sites *Aegotheles cristatus* (Australian Owlet-nightjar), *Eolophus roseicapilla* (Galah) and *Nymphicus hollandicus* (Cockatiel) were recorded utilising hollow-bearing trees and evidence of potential waterbird breeding in the form of eggs and a nest were also observed at Crinolyn.

Crinolyn and Windella Ramsar sites contain vegetation reflective of functioning wetland systems which vary in form and condition across their extent, and in addition to their individual ecological value, are an important part of the wider Gwydir Wetlands. At a broader scale, the separation of the sites from one another and surrounding wetlands is apparent, as is the influence of external factors such as the scale and intensity of surrounding land use.

The vegetation and conditions within both sites at the time of field surveys were typical of a recent 'wet' period and may contrast considerably with 'dry' period conditions. Given this, there may be value in assessing condition changes across both sites through remote sensing and a follow up 'dry period' field survey. It is also recommended that a revision of the boundaries of both Crinolyn and Windella Ramsar sites be undertaken in order to maximise the extent of remnant vegetation and overall ecological value of both sites.

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## Abbreviations

Abbreviation	Description
ADS40	Airborne Digital Sensor 40 cm
ARp	Amphibious fluctuation responder
ATe	Amphibious fluctuation tolerator – emergent
ATI	Amphibious fluctuation tolerator – low-growing
ATw	Amphibious fluctuation tolerator – woody
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
DPE-EHG	NSW Department of Planning and Environment – Environment and Heritage Group
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESR	Exotic Species Richness
GDA2020	Geocentric Datum of Australia 2020
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
NSR	Native Species Richness
NSW	New South Wales
PCT	Plant Community Type

Abbreviation	Description
PFC	Percent Foliage Cover
Se	Perennial
Tda	Terrestrial damp
Tdr	Terrestrial dry
TSR	Total Species Richness
WPFG	Water Plant Functional Group



## Introduction

### Location

The Gwydir Wetlands are located west of Moree, New South Wales (NSW) and to the west of the Great Dividing Range, within the northern Murray-Darling Basin. The Gwydir Wetlands are located on the lower floodplain of the Gwydir River, Gingham Watercourse and Mehi River, within the Darling Riverine Plains biogeographic region. Several nationally and internationally significant wetlands are located within the greater Gwydir Wetlands, including four wetland sites recognised and listed in 1999 under the Ramsar Convention on Wetlands of International Importance. These include the 88 hectare (ha) Crinolyn Ramsar site and 102 ha Windella Ramsar site, both located on freehold land within the lower Gingham Watercourse (Figure 1).

### Purpose

NSW Department of Planning and Environment – Environment and Heritage Group (DPE-EHG) is currently delivering the Gwydir Reconnecting Watercourse Country Program, which includes a range of actions and initiatives to support the Murray Darling Basin Plan. A key priority action of the program is to improve the efficiency and effectiveness of environmental water delivery to the Gwydir Wetlands.

Eco Logical Australia (ELA) was engaged to undertake Autumn surveys of the ecological assets of the Crinolyn and Windella Ramsar sites. These surveys were undertaken from 12 April to 16 April 2023, specifically the ground survey and mapping of vegetation within the sites. The purpose of this work is to help address gaps in ecological knowledge, as well as improve understanding as to potential constraints that may impact future environmental water deliveries. It is intended that the information contained within the report and accompanying datasets, will help support and inform the ongoing implementation of the Gwydir Reconnecting Watercourse Country Program in and around the Crinolyn and Windella Ramsar sites.



Figure 1: Location of Crinolyn and Windella Ramsar sites (inset shows location of sites within the broader region). Imagery captured August 2022

## Methods

### Plant Community Type Mapping

An accurate and comprehensive vegetation map is a key component of understanding the ecological assets contained within any site. The type and extent of Plant Community Types (PCTs) present within the Crinolyn and Windella Ramsar sites were mapped using desktop and field survey methodologies detailed in the sub-sections below.

#### Pre-field desktop assessment

Recent vegetation mapping of the Crinolyn and Windella Ramsar sites from the following two sources was assessed to provide information concerning the potential PCTs within and surrounding both sites:

- Vegetation extent and condition mapping of the Gwydir Wetlands and floodplains 2008 – 2015 (Bowen et al 2019)
- NSW State Vegetation Type Map (DPE 2022a).

Associated reports for both vegetation mapping sources were reviewed to provide an insight into the mapping methodology applied (Bowen et al 2019) and relevant qualitative data associated with the likely PCTs (Benson et al 2010).

The location and floristic composition of existing vegetation survey plots established and surveyed in 2008 (Bowen unpub.) and 2019 (ELA unpub.) was assessed. Only one survey plot, located within Crinolyn (CRIN\_1 V26, see Results section below), was deemed suitable for re-survey, as the other existing plots were located outside of the Ramsar boundary. The following data sources provided by DPE-EHG were also assessed to help determine target areas for the field survey and plot locations:

- Ramsar site boundaries
- Airborne Digital Sensor 40 cm (ADS40) aerial imagery captured August 2022
- 1m LiDAR Digital Elevation Model captured in 2009
- Gwydir Wetlands 10 year flood frequency map: 2012-2022 (DPE 2022b)
- NSW hydro line mapping.

#### Field survey

A total of 31 and 38 rapid vegetation assessment plots were completed across Crinolyn (Figure 2) and Windella (Figure 3) Ramsar sites respectively, with the following data collected using ESRI Field Maps digital data collection software at each site:

- Dominant overstorey, midstorey and ground stratum species
- Relevant soil and landscape features or positioning
- Initial field assigned PCT number
- Photograph (where relevant).

Utilising Field Maps, the spatial extent of vegetation community patches encountered in the field were mapped in real-time, via the use of GPS-enabled georeferenced polygons. This allowed for an initial in-field PCT map to be produced, which included the delineation of vegetation community boundaries based on vegetation and landscape conditions present at the time of survey. Whilst the majority of both sites were able to be surveyed on the ground, the south-west corner and central portion of

Windella (Figure 6) was not able to be accessed due to the presence of surface water and highly dense vegetation growth. These areas were surveyed from a distance using binoculars and aerial photograph interpretation in order to delineate PCT boundaries.

#### Post-field desktop mapping

Data collected from the field was downloaded directly into ESRI Arc Pro digital mapping software and Microsoft Excel formats for analysis and further refinement. In-field allocation of initial PCTs, along with rapid vegetation assessment and full floristic plot data, was quantitatively assessed against the PCT descriptions and species compositions detailed in the NSW BioNet Vegetation Information System (DPE 2023), along with previous mapping sources (Benson et al 2011 and Bowen pers. comm.). Attributes included Interim Biogeographic Regionalisation for Australia (IBRA) region and subregion, landscape position and features, soils, vegetation formation, vegetation class, dominant flora species in each stratum and their relative abundance. Once final PCT allocations were determined, a final PCT map was produced utilising ESRI Arc Pro with output files set to Geocentric Datum of Australia 2020 (GDA2020).

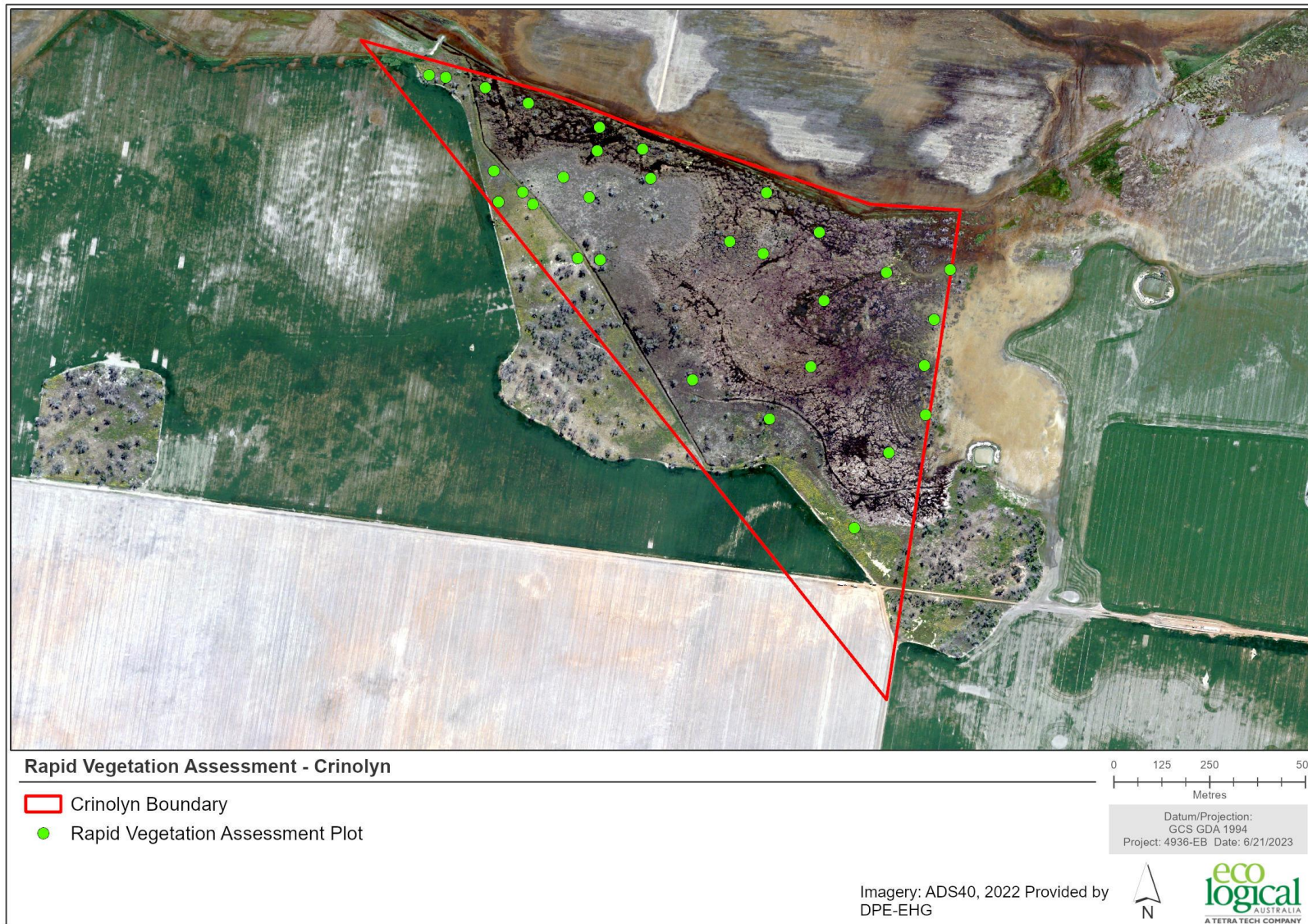


Figure 2: Crinolyn Ramsar site Rapid vegetation assessment plots. Imagery captured August 2022

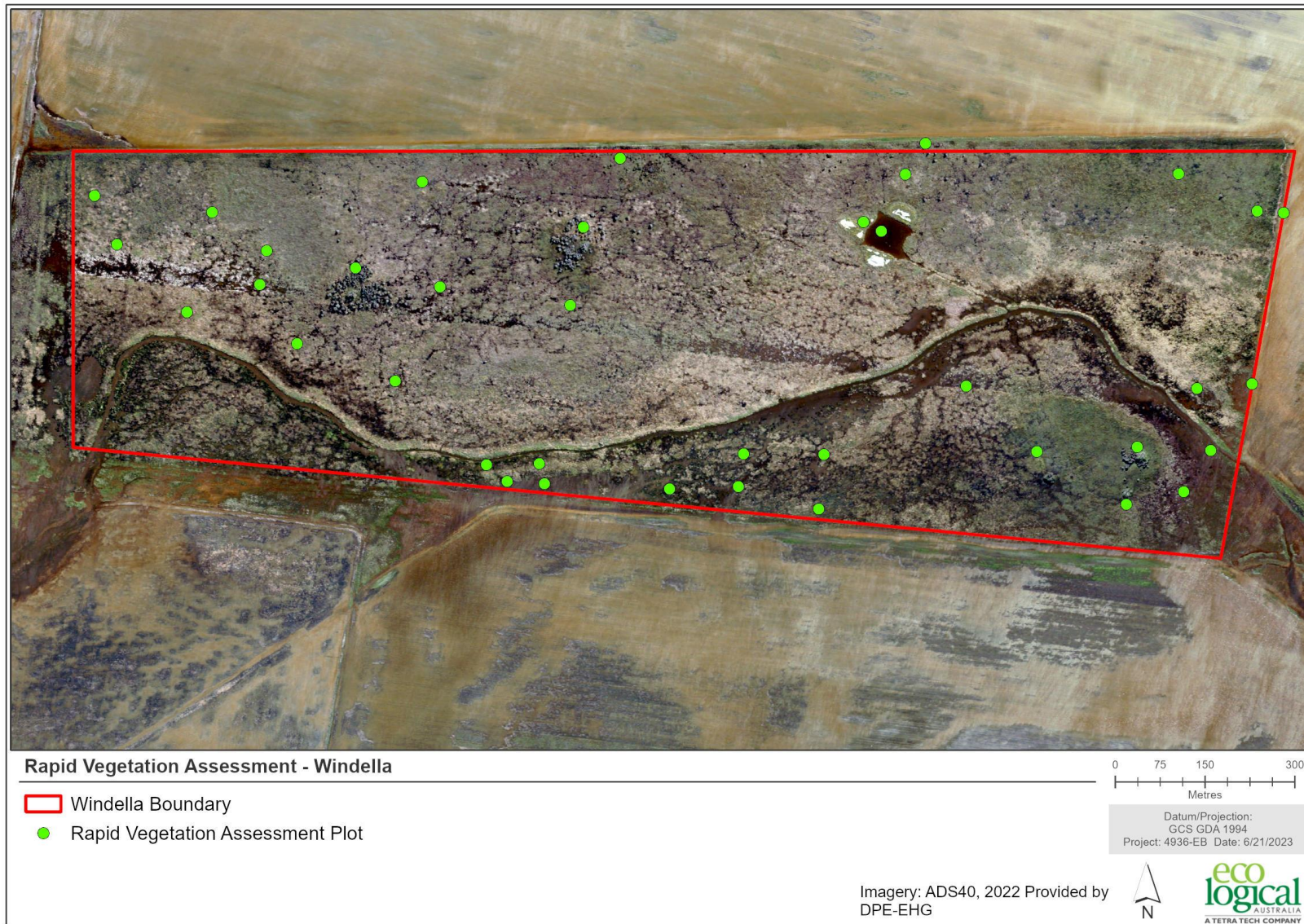


Figure 3: Windella Ramsar site Rapid vegetation assessment plots. Imagery captured August 2022

## Tree demographic and full floristic plot surveys

A total of two tree demographic plots and four full floristic monitoring plots were established in both the Crinolyn and Windella Ramsar sites (Table 1 and Figure 5 – 6). Plots were established and surveyed consistent with the methodology detailed in *Field method for the assessment of floodplain and wetland vegetation communities – DPEW Environmental Outcomes Monitoring Program* (Bowen 2022). This involved establishing 0.25 ha tree demographic plots, with 0.04 ha full floristic plots nestled within the north-east corner of the larger 0.25 ha tree demographic plot, in tree dominated vegetation communities (PCT 40), whilst 0.04 ha full floristic plots were established in non-woody vegetation communities (PCT 53 and PCT 182). All plots were marked with a white fibreglass pole in the NE corner of the plot.

The location of plots sought to ensure representation across the range of PCTs and hydrological regimes present and at the same time, provide adequate spatial coverage across the sites. Whilst plot CRIN\_4 was established partly within a tree dominated vegetation community (PCT 40b), there was an insufficient quantity of mature trees present to establish a tree demographic plot (Bowen 2022).

**Table 1: Crinolyn and Windella full floristic and tree demographic plots**

Site	Plot No.	PCT No.	Plot Type
Crinolyn	CRIN_1 V26	53a	Full floristic 20 m x 20 m (0.04 ha)
	CRIN_2	53a	Full floristic 20 m x 20 m (0.04 ha)
	CRIN_3	40b	Tree demographic 50 m x 50 m (0.25 ha) / Full floristic 20 m x 20 m (0.04 ha)
	CRIN_4	40b / 53a	Full floristic 20 m x 20 m (0.04 ha)
	CRIN_5	53a	Full floristic 20 m x 20 m (0.04 ha)
	CRIN_6	40a	Tree demographic 25 m x 100 m (0.25 ha) / Full floristic 20 m x 20 m (0.04 ha)
Windella	WIND_1	53a	Full floristic 20 m x 20 m (0.04 ha)
	WIND_2	40b	Tree demographic 50 m x 50 m (0.25 ha) / Full floristic 20 m x 20 m (0.04 ha)
	WIND_3	40b	Tree demographic 50 m x 50 m (0.25 ha) / Full floristic 20 m x 20 m (0.04 ha)
	WIND_4	182	Full floristic 20 m x 20 m (0.04 ha)
	WIND_5	53a / 182	Full floristic 20 m x 20 m (0.04 ha)
	WIND_6	40b	Full floristic 20 m x 20 m (0.04 ha)

Within tree demographic plots, all trees >10 cm diameter at breast height (DBH) were tagged using aluminium plant tags and the following data was collected for each tree:

- DBH of all stems >5cm
- Crown extent (m<sup>2</sup>) and Crown extent in plot (m<sup>2</sup>)
- Canopy density (Percent Foliage Cover (PFC) of the tree) and Dead canopy percent
- Total number of limbs and Dead limbs
- Insect damage (Heavy (H) >50% of leaves effected, Moderate (M) 25-50% leaves effected or Light (L) <25% leaves effected)
- Breeding status (presence of flowers (F) and/or or buds (B) and or / fruit (Fr))
- Number of nests and number of hollows.

A hemispherical photo was also captured within tree demographic plots to digitally record canopy cover and extent. The total length (m) of fallen timber >10 cm in diameter was recorded within the 0.21 ha portion of the 0.25 ha plot, along with the amount of target tree species young seedlings (<0.3 m tall), seedlings (0.3 – 2.0 m tall and <10 cm DBH) and saplings (>2 m tall and <10 cm DBH).

Within full floristic plots, the following data was recorded for all vascular species:

- Scientific Name
- PFC
- Species Abundance
- Growth Form (DPE-BCD 2023)
- Water Plant Functional Group (Casanova 2011)
- Average height (m)
- Strata type (Lower (L), Mid (M), Tallest (T))

Litter and bare soil percent cover was also recorded for the 0.04 ha plot, along with total length of fallen timber and the number of young seedlings, seedlings and saplings within the 0.04 ha plot.

Site flooding status (where applicable) at the time of survey was recorded, along with any evidence of disturbances including grazing, feral animals, fire, timber extraction and other general human disturbances e.g. vehicle tracks. Up to four site photographs were taken within each full floristic plot at the locations and bearing indicated in Figure 4 below.

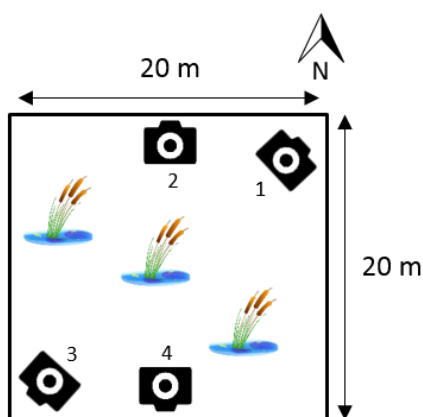


Figure 4: Full floristic plot photo points



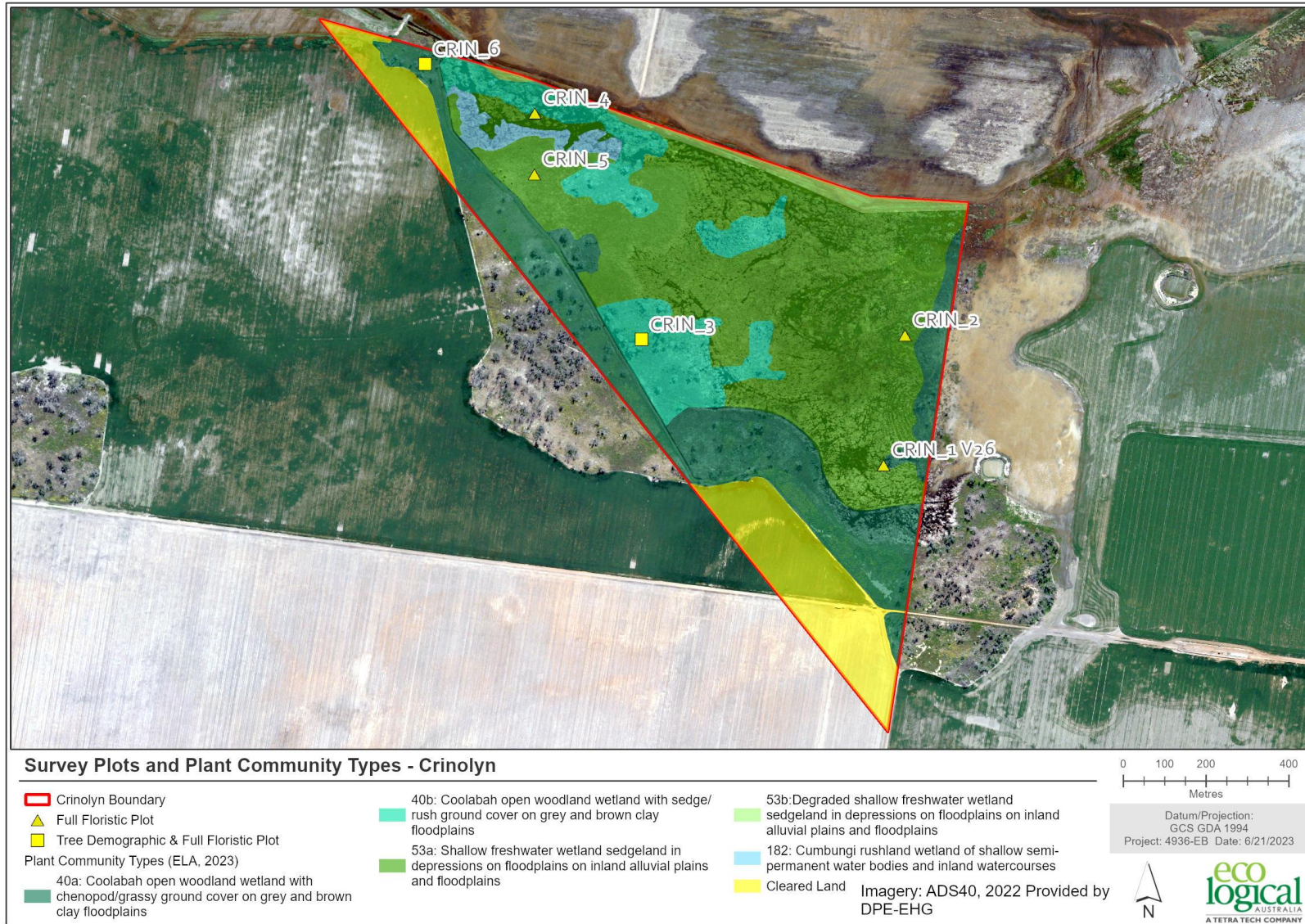


Figure 5: Crinolyn full floristic and tree demographic / full floristic plot locations. Imagery captured August 2022

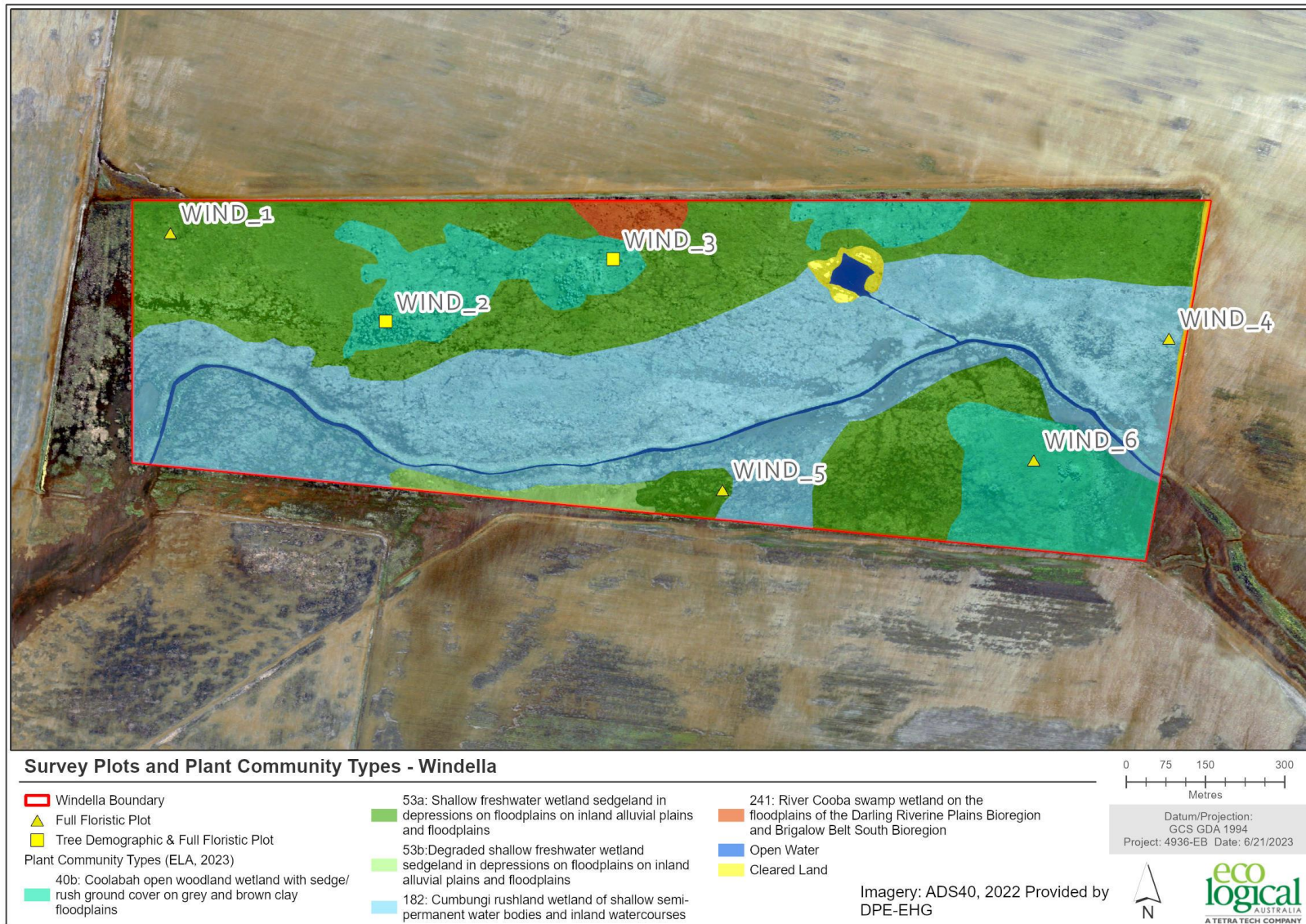


Figure 6: Windella full floristic and tree demographic / full floristic plot locations. Imagery captured August 2022

## Incidental observations

Incidental observations of relevant ecological assets and features were made across Crinolyn and Windella Ramsar sites throughout the field survey, including natural regeneration of target tree species, listed weeds and native and introduced fauna species including waterbirds and feral pests. Landscape features which may influence flooding and inundation into and across the Ramsar sites were also noted, along with any natural or human disturbances present. Where possible and deemed relevant, photographs and spatial locations / extents were recorded for incidental observations.

## Weather conditions and seasonal context

Field surveys were undertaken across Crinolyn and Windella Ramsar sites from 12 April to 16 April 2023. Weather conditions during the field surveys were fine and sunny with minimum temperatures ranging from 8.5°C – 19.4°C and maximum temperatures ranging from 25.2°C – 29.3°C (BOM 2023). No rainfall was recorded during the field survey with no rain recorded in the week preceding survey and only 2.0 mm of rain recorded in the fortnight preceding survey (BOM 2023). This relatively dry preceding period did, however, follow a prolonged period of above average rainfall across the Lower Gingham Watercourse, dating back to early 2020, with 2020, 2021 and 2022 all recording above average annual rainfall totals (BOM 2023). This prolonged ‘wet’ period included widespread flooding in the Lower Gingham Watercourse, including the Crinolyn and Windella Ramsar sites, during mid-late 2022. Sentinel satellite imagery from 29 October 2022 below (Figure 7) demonstrates the widespread flooding experienced in the Lower Gingham Watercourse, whilst Figure 8 shows imagery captured on 7 April 2023, shortly before the commencement of field surveys.

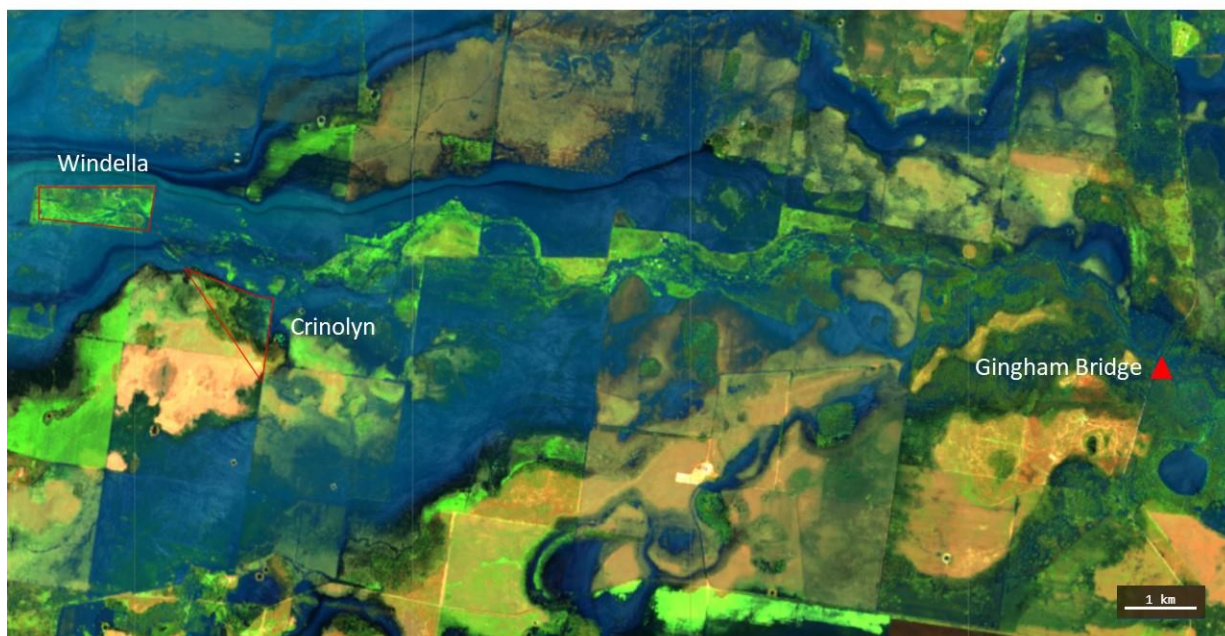


Figure 7: Sentinel-2 satellite imagery (surface reflectance in false colour) from 29 October 2022



Figure 8: Sentinel-2 satellite imagery (surface reflectance in false colour) from 7 April 2023 (the week preceding the surveys)

## Results

### PCT mapping

Given the close proximity of the Crinolyn and Windella Ramsar sites, combined with their similar landscape position and features, soils, hydrology and ultimately vegetation, many of the PCT mapping tasks were undertaken concurrently for both sites. Because of this, the PCT mapping results are presented collectively for both sites where appropriate, however, distinction is made in presenting PCT mapping results from the two sites where necessary, for example, in Table 4.

### Desktop assessment results

The outcome of the desktop assessment, including the review of existing vegetation mapping for the Crinolyn and Windella Ramsar sites (Bowen et al 2019 and DPE 2022a) and existing vegetation survey plots (Bowen unpub. and ELA unpub.), revealed a total of seven PCTs as potentially occurring within both sites (Table 2). This shortlist of potential PCTs was utilised to assist in-field initial PCT mapping and the completion of rapid vegetation assessment plots.

**Table 2: Potential PCTs identified through desktop assessment**

PCT No.	PCT Name	Vegetation Formation	Vegetation Class	Data Sources
39	Coolabah - River Cooba - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	Semi-arid Woodlands (Grassy sub-formation)	North-west Woodlands	(DPE 2022a)
40	Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	Semi-arid Woodlands (Grassy sub-formation)	North-west Woodlands	(Bowen et al 2019 and DPE 2022a). One plot from 2008 (Bowen unpub.) and two plots from 2019 (ELA unpub.)
53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	Freshwater Wetlands	Inland Swamps	(Bowen et al 2019)
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	Freshwater Wetlands	Inland Swamps	(Bowen et al 2019)
204	Water Couch marsh grassland wetland of frequently flooded inland watercourses	Freshwater Wetlands	Inland Swamps	(DPE 2022a). Three plots from 2008 (Bowen unpub.)
238	Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains	Freshwater Wetlands	Inland Swamps	(DPE 2022a)
241	River Cooba swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Freshwater Wetlands	Inland Shrublands	(Bowen et al 2019 and DPE 2022a)

### Plant Community Type selection justification

Data from in-field initial PCT mapping, rapid vegetation assessment plots and full floristic plots was quantitatively assessed against the PCT descriptions and species compositions detailed in the NSW BioNet Vegetation Information System (DPE 2023) to select the best fit PCT. Justification for PCT selections are provided in Table 3 below.

**Table 3: Potential PCTs and PCT selection justification**

PCT No.	PCT Name	Other PCT options	Justification for PCT selection
40a	Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains	<p>39 – removed from consideration due to the higher floodplain, relatively flat, non-channelised landscape position of Crinolyn and Windella and the overall absence of <i>Acacia stenophylla</i> (River Cooba) and relative scarcity of <i>Duma florulenta</i> (Tangled Lignum).</p> <p>87 – removed from consideration due to absence of <i>Eucalyptus populnea</i> (Poplar Box).</p>	<ol style="list-style-type: none"> <li>1. Filtered IBRA region to Darling Riverine Plains and IBRA Subregion to Castlereagh-Barwon</li> <li>2. Filtered vegetation formation to Semi-arid Woodlands (Grassy sub-formation) and vegetation class to North-west Floodplain Woodlands and Inland Floodplain Woodlands</li> <li>3. Filtered PCTs with overstorey dominated by <i>Eucalyptus coolabah</i> (Coolabah). This revealed three PCTs (39, 40, 87) for consideration. PCT 39 and 87 were removed for reasons listed adjacent and PCT 40 chosen as the best fit based on the following: <ul style="list-style-type: none"> <li>• PCT 40 occurs on grey and brown clay soils in higher floodplain positions, away from more channelised sections of the floodplain</li> <li>• A total of 18 PCT 40 characteristic flora species were recorded in Full floristic plots (Appendix B), along with an additional five species recorded in Rapid vegetation assessment plots.</li> </ul> </li> </ol>
40b	Coolabah open woodland wetland with sedge/rush ground cover on grey and brown clay floodplains	39 – as above.	As above for PCT 40a. PCT 40b occurs in a similar open woodland form to PCT 40a, however, with sedges and rushes dominating the ground cover rather than chenopods and grasses. PCT 40 is considered the best fit for this community as the current ground cover is likely reflective of recent inundation and relatively 'wet' conditions, with the ground cover naturally fluctuating between its present state and that of the chenopod/grass community above under 'dry' conditions. Additionally, a total of 11 PCT 40 characteristic ground stratum species were recorded within mapped sections of PCT 40b, including an abundance of <i>Eleocharis</i> spp. and <i>Marsilea drummondii</i> (Common Nardoo).
53a	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	<p>204 – removed from consideration due to only very minor presence of <i>Paspalum distichum</i> (Water Couch).</p> <p>205 – removed from consideration due to absence of</p>	<ol style="list-style-type: none"> <li>1. Filtered IBRA region to Darling Riverine Plains and IBRA Subregion to Castlereagh-Barwon</li> <li>2. Filtered vegetation formation to Freshwater Wetlands and vegetation class to Inland Floodplain Swamps</li> <li>3. Filtered PCTs with ground stratum dominated by <i>Eleocharis plana</i> (Flat Spike-sedge). This revealed four PCTs (53, 204, 205, 447) for consideration.</li> </ol>

PCT No.	PCT Name	Other PCT options	Justification for PCT selection
		<p>Bolboschoenus fluviatilis (Marsh Club-rush).</p> <p>447 – removed from consideration due to plot species only sharing three characteristics species with this PCT. It is noted that PCT 53b shares similarities with this PCT (see below).</p>	<p>PCT 204, 205 and 447 were removed for reasons listed adjacent and PCT 53 chosen as the best fit based on the following:</p> <ul style="list-style-type: none"> <li>PCT 53 occurs on grey and brown clay soils on low lying flats and depressions on floodplains including gilgai's</li> <li>A total of 20 PCT 53 characteristic flora species were recorded in Full floristic plots (Appendix B) including an abundance of Flat Spike-sedge, <i>Juncus aridicola</i> and Common Nardoo, along with an additional three species recorded in Rapid vegetation assessment plots.</li> </ul>
53b	Degraded shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	<p>447 – shares similarities with PCT 53b in that both communities occupy similar landscape positions and are both degraded. However, given PCT 53 represents the natural occurrence of the vegetation community, it is considered the best fit PCT.</p>	<p>As above for PCT 53a. PCT 53b represents a degraded form of the PCT, occurring on the boundaries of both Crinolyn and Windella that are subject to edge effects from adjacent agricultural land use. Whilst the floristic structure and composition of the PCT remains present within PCT 53b (i.e. abundant Flat Spike-sedge and <i>Juncus aridicola</i>), large areas of bare soil are present, along with both invasive exotic species (e.g. <i>Phyla canescens</i> (Lippia), <i>Xanthium</i> spp.) and invasive native species (e.g. <i>Sclerolaena muricata</i> (Black Roly-poly) and <i>Sesbania cannabina</i> (Sesbania Pea).</p>
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	<p>181 - removed from consideration due to absence of <i>Phragmites australis</i> (Common Reed)</p> <p>204 – removed from consideration due to only very minor presence of <i>Paspalum distichum</i> (Water Couch).</p> <p>It is noted that the boundaries and extent of PCT 182 and 53 is likely to vary across both Crinolyn and Windella sites in response to changing 'wet' and 'dry' conditions.</p>	<ol style="list-style-type: none"> <li>Filtered IBRA region to Darling Riverine Plains and IBRA Subregion to Castlereagh-Barwon</li> <li>Filtered vegetation formation to Freshwater Wetlands and vegetation class to Inland Floodplain Swamps</li> <li>Filtered PCTs with mid stratum dominated by <i>Typha domingensis</i> (Narrow-leaved Cumbungi). This revealed three PCTs (181, 182 and 204) for consideration. PCT 181 and 204 were removed for reasons listed adjacent and PCT 182 chosen as the best fit based on the following: <ul style="list-style-type: none"> <li>PCT 182 occurs on grey and brown clay soils on low lying depressions of floodplains as well as in and adjacent to semi-permanent water bodies</li> <li>A total of 12 PCT 182 characteristic flora species were recorded in Full floristic plots (Appendix B) including an abundance of Narrow-leaved Cumbungi and Common Nardoo, along with an additional two species recorded in Rapid vegetation assessment plots.</li> </ul> </li> </ol>
241	River Cooba swamp wetland on the floodplains of the Darling Riverine	<p>39 - removed from consideration due to</p>	<ol style="list-style-type: none"> <li>Filtered IBRA region to Darling Riverine Plains and IBRA Subregion to Castlereagh-Barwon</li> </ol>

PCT No.	PCT Name	Other PCT options	Justification for PCT selection
	Plains Bioregion and Brigalow Belt South Bioregion	absence of Coolabah	<p>2. Filtered vegetation formation to Freshwater Wetlands and vegetation class to Inland Floodplain Shrublands and North-west Floodplain Woodlands</p> <p>3. Filtered PCTs with mid stratum dominated by <i>Acacia stenophylla</i> (River Cooba). This revealed two PCTs (39 and 241) for consideration. PCT 39 was removed for reasons listed adjacent and PCT 241 chosen as the best fit based on the following:</p> <ul style="list-style-type: none"> <li>• PCT 241 occurs on alluvial clay soils in depressions of floodplains in patches of limited extent</li> <li>• A total of 12 PCT 241 characteristic flora species were recorded, including an abundance of River Cooba, Flat Spike-sedge, Common Nardoo and Lignum.</li> </ul>

Table 4 below details the areas occupied by each PCT (along with other areas not conforming to a PCT) within both Crinolyn and Windella Ramsar sites, along with the proportion each PCT occupies as a percent of the total area of each site.

**Table 4: PCT areas and proportions of Crinolyn and Windella Ramsar sites**

PCT No.	PCT Name	Crinolyn Area (ha) and proportion (%)	Windella Area (ha) and proportion (%)
40a	Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains*^	21.13 (24%)	-
40b	Coolabah open woodland wetland with sedge/rush ground cover on grey and brown clay floodplains*^	11.89 (13.5%)	15.98 (16%)
53a	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	39.61 (45%)	35.71 (35%)
53b	Degraded shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	2.18 (2.5%)	1.32 (1.5%)
182	Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses	1.83 (2%)	45.21 (44%)
241	River Cooba swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	-	1.16 (1%)
N/A	Open Water and Dams	-	1.48 (1.5%)
N/A	Cleared land	11.48 (13%)	0.80 (1%)

\*Listed as Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain and Mulga Lands Bioregions Endangered Ecological Community (EEC) under the NSW *Biodiversity Conservation Act 2016* (BC Act); ^Listed as Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions EEC under the Commonwealth *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act)

Photographic profiles including key descriptive features for each PCT recorded within the Crinolyn and Windella Ramsar sites are provided below in Tables 5 – 10.



Table 5: PCT 40a photographic profile

PCT 40a: Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains



Mature Coolabah trees in **Crinolyn** demonstrating signs of stress through canopy dieback and epicormic growth. Ground stratum dominated by native chenopods and grass species, typical of PCT 40a.

Coolabah seedlings amongst mature Coolabah and *Casuarina cristata* (Belah) in the north-western corner of **Crinolyn**, with photo taken towards the south.



The drainage channel which runs through **Crinolyn** bisects a large patch of Coolabah on the western boundary of the site and impacts upon the flooding regime of this patch, with Coolabah north of the drainage channel (left of photo) having a sedge/rush ground stratum (PCT 40b), whilst Coolabah south of the drainage channel (right of photo) has a chenopod/grass ground stratum (PCT 40a).

Coolabah tree located along the north-west boundary of **Crinolyn** containing several hollows, of which *Nymphicus hollandicus* (Cockatiel) were observed utilising during the field survey. Mature Coolabah trees across both **Crinolyn** and **Windella** frequently contained hollows.

Table 6: PCT 40b photographic profile

PCT 40b: Coolabah open woodland wetland with sedge/rush ground cover on grey and brown clay floodplains



An open patch of Coolabah woodland towards the centre of **Crinolyn** with scattered mature Coolabah. The ground cover stratum beneath mature Coolabah trees was typically quite bare and dominated by exotic species, contrasting with the surrounding dense ground cover of native sedges and rushes.

The three remaining patches of PCT 40b within **Windella** had a consistent structure featuring one mature Coolabah surrounded by a dense band of saplings and scattered seedlings.



Across **Crinolyn**, the ground stratum of PCT 40b was more commonly dominated by Flat Spike-sedge, in combination with *Juncus aridicola* and in more open patches such as this at plot CRIN\_3, the native aquatic fern Common Nardoo was also prevalent.

Narrow-leaved Cumbungi was widespread and abundant across **Windella** with this patch of PCT 40b towards the west of **Windella** demonstrating a ground stratum co-dominated by the upright Narrow-leaved Cumbungi and more prostrate Flat Spike-sedge.

**Table 7: PCT 53a photographic profile**

**PCT 53a: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains**



PCT 53a towards the eastern boundary of **Crinolyn** with a ground stratum dominated by highly dense Flat Spike-sedge, with scattered Narrow-leaved Cumbungi and *Juncus aridicola* tussocks also present. Dead Coolabah stags (visible in the background) were scattered across the eastern portion of **Crinolyn**.

PCT 53a, towards the western boundary of **Windella** on flat sections of the floodplain, the ground stratum was dominated by *Juncus aridicola*, with native grasses *Panicum decompositum* (Native Millet) and *Paspalidium jubiflorum* (Warrego Grass) also occurring.



Towards the north-west corner of **Crinolyn**, PCT 53a occurred in lower lying areas of the floodplain which included micro-depressions and gilgai formations. Inundation appears to concentrate in these areas with relatively high moisture retention also evident in the green flush present in Flat Spike-sedge and the diversity of both native and exotic forbs, ferns and chenopods.

PCT 53a occupied a similar landscape position along the southern boundary of **Windella**, such as here at plot WIND\_5, with Narrow-leaved Cumbungi patches occurring on micro-rises and a diverse range of native and exotic species occurring in micro-depressions, including the invasive Lippia.

**Table 8: PCT 53b photographic profile**

**PCT 53b: Degraded Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains**



PCT 53b on the southern boundary of **Windella** with a ground stratum dominated by *Lippia*, yet still containing characteristic native species *Cyperus* spp. A lower-mid stratum containing invasive / colonial native (*Sesbania* Pea) and exotic (*Xanthium occidentale* (Noogoora Burr)) species is also visible.

This patch of PCT 53b on the northern boundary of **Crinolyn** and adjacent to cropped paddocks is dominated by Noogoora Burr and is demonstrating the likely impacts of edge effects.

**Table 9: PCT 182 photographic profile**

**PCT 182: Cumbungi rushland wetland of shallow semi-permanent water bodies and inland watercourses**



Amongst a dense patch of PCT 182 towards the eastern boundary of **Windella**, Narrow-leaved Cumbungi grows well above 2 m in height.

Looking south-east across **Windella**, showing the vast extent of Narrow-leaved Cumbungi across the site.

**Table 10: PCT 241 photographic profile**

**PCT 241: River Cooba swamp wetland on the floodplains of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion**



PCT 241 occurs in a small patch on the northern boundary of **Windella** where an upper-mid stratum of River Cooba is present above a ground stratum featuring Common Nardoo, Flat Spike-sedge and Narrow-leaved Cumbungi.

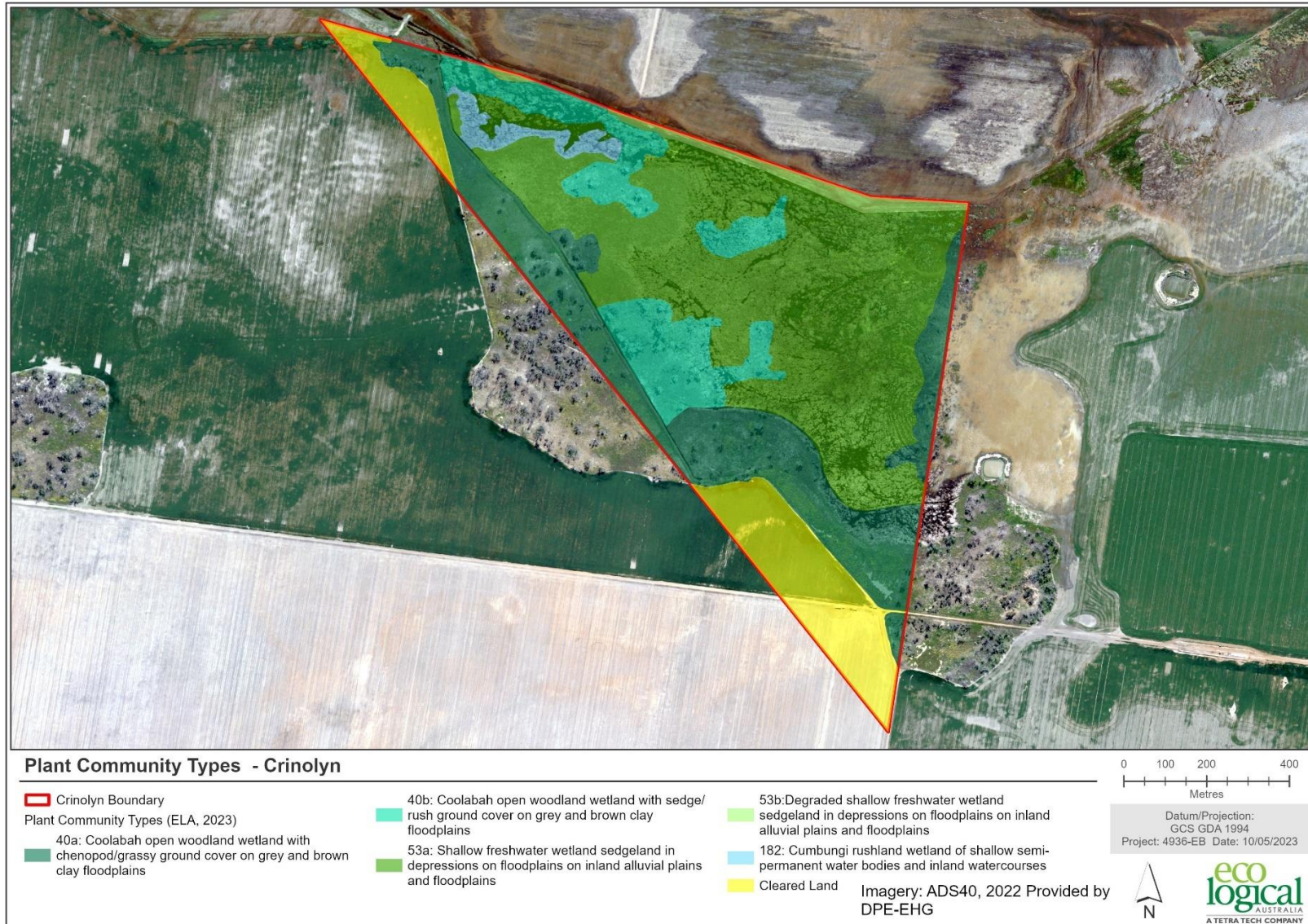


Figure 9: PCT mapping of Crinolyn Ramsar site. Imagery captured August 2022

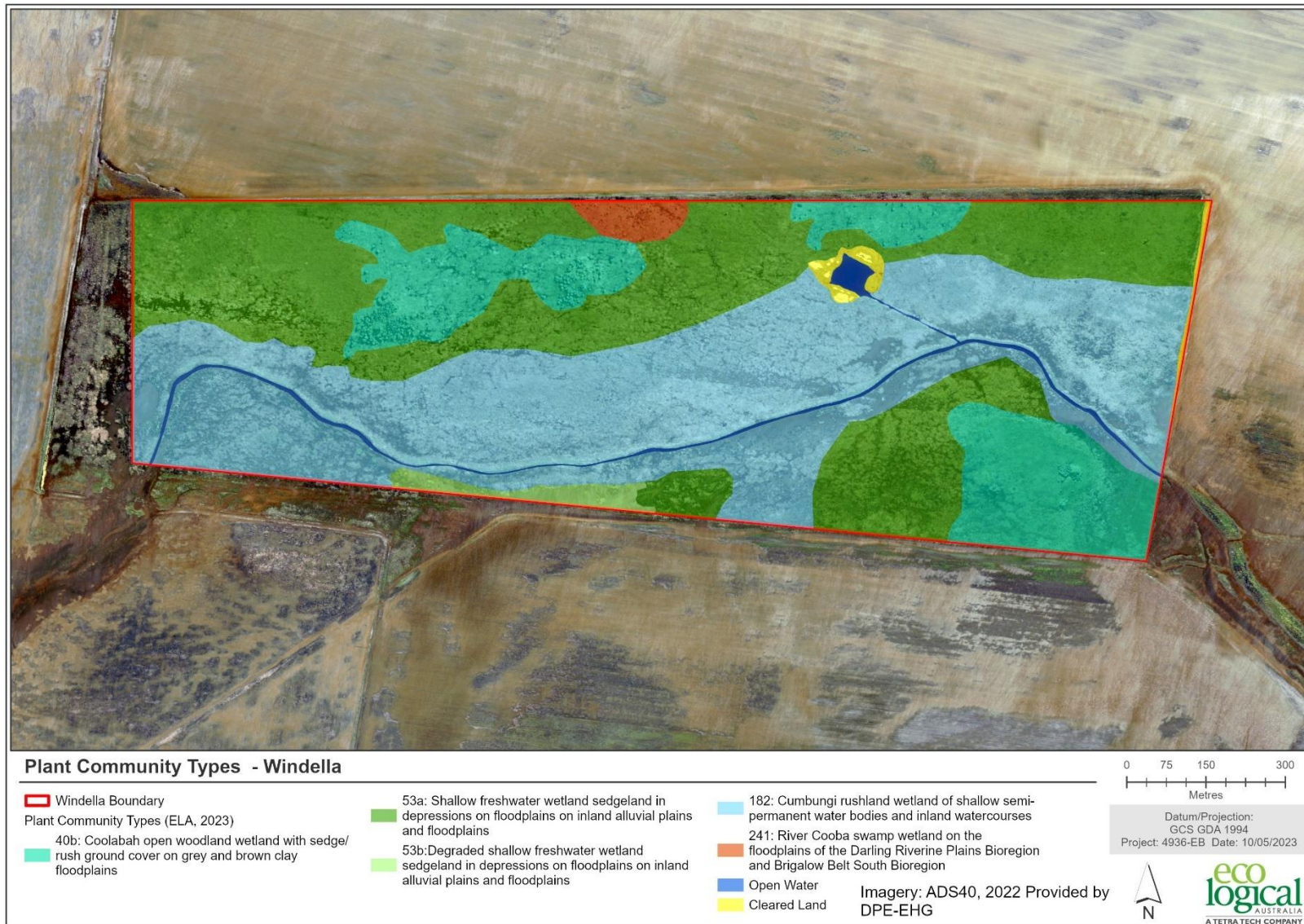


Figure 10: PCT mapping of Windella Ramsar site. Imagery captured August 2022

## Tree demographic and full floristic plot surveys

### Crinolyn Ramsar site – full floristic results

A total of 70 flora species, comprising 50 native and 20 exotic species were recorded across the six full floristic plots established and surveyed within the Crinolyn Ramsar site (Table 20 – Appendix B). As plot CRIN\_4 is located on the boundary of two PCTs (40b and 53a) and shares components of both communities, analysis based on PCT type for this plot was undertaken for both representative PCTs. Plot CRIN\_6 (PCT 40a) recorded both the highest total and native species richness, whilst plot CRIN\_1 V26 (PCT 53a) recorded the lowest total species richness and equal lowest native species richness alongside plot CRIN\_3 (PCT 40b) (Table 11). No correlation was evident between species richness and PCT, or based on the spatial distribution of plots across the Crinolyn site (see Figure 3).

**Table 11: Crinolyn full floristic plot species richness results**

Plot No.	PCT	TSR	NSR	ESR
CRIN_1 V26	53a	18	14	4
CRIN_2	53a	28	18	10
CRIN_3	40b	19	14	5
CRIN_4	40b / 53a	20	17	3
CRIN_5	53a	22	18	4
CRIN_6	40a	35	26	9

TSR = Total Species Richness; NSR = Native Species Richness; ESR = Exotic Species Richness

Water Plant Functional Group (WPFG) (Brock and Casanova 1997) richness results from Crinolyn full floristic plots are presented below in Table 12. Aquatic WPFG species including Amphibious fluctuation responder (Arp), Amphibious fluctuation tolerator – emergent (Ate), Amphibious fluctuation tolerator – low-growing (ATI), Amphibious fluctuation tolerator – woody (ATw) and Perennial (Se) were recorded across all plots, reflective of the recent inundation across the Crinolyn site. Plots within PCT 53a recorded a mean aquatic WPFG species richness of 9, whilst PCT 40 plots (40a and 40b combined) recorded a mean aquatic WPFG species richness of 6 (Table 12). Consistent with the expected inundation regimes of the PCTs present within Crinolyn, aquatic WPFG species richness was lowest at PCT 40a plot CRIN\_6, whilst non-aquatic WPFG species richness Terrestrial damp (Tda), Terrestrial dry (Tdr) was highest at this site (Table 12).



**Table 12: Crinolyn full floristic plot water plant functional group species results. Numbers indicate the richness of species within each WPFPG at each plot**

Plot No.	ARp	ATe	ATI	ATw	Se	Tda	Tdr
CRIN_1 V26	2	6	2	1	1	3	3
CRIN_2	2	5	1	-	1	7	12
CRIN_3	2	4	1	-	-	4	8
CRIN_4	1	4	1	-	1	6	7
CRIN_5	1	5	1	1	-	4	10
CRIN_6	1	1	2	-	-	7	24

Water Plant Functional Group: ARp = Amphibious fluctuation responder – plastic; ATe = Amphibious fluctuation tolerator – emergent; ATI = Amphibious fluctuation tolerator – low-growing; ATw = Amphibious fluctuation tolerator – woody; Se = Perennial – emergent; Tda = Terrestrial damp; Tdr = Terrestrial dry

Condition class schemas for measuring community and tree stand condition of PCTs present within Crinolyn (PCT 40 and 53) have been developed by Bowen (2019) and were applied to full floristic plot data. Condition class schemas for PCT 40 and 53 are detailed in Appendix C and the full condition class assessment for all plots within both PCTs has been provided to DPE-EHG as an attachment to this report.

Table 13 below summarises the results of the condition class assessment, with PCT 53a plots CRIN\_1 V26 and CRIN\_2 both recording a maximum score of 20 and the associated Excellent/Benchmark condition class (Table 13). Whilst plot CRIN\_1 V26 recorded the equal lowest native species richness across all Crinolyn plots (Table 11), the plot's relatively low floristic diversity has not impacted upon its condition class because the condition class schema assessment is based on percent cover. The high scores for PCT 53 plots were driven by high native ground cover present within plots dominated by aquatic WPFPG species.

Plots within PCT 40 (40a and 40b) scored relatively low and within the Intermediate and Intermediate/Poor condition class. These scores were driven by low native grass cover (particularly for PCT 40b plots dominated by sedges and rushes at the time of survey), along with the scattered nature of Coolabah patches within Crinolyn resulting in relatively low PFC for this key indicator species. The above factors contributing to relatively high scores for PCT 53 and low scores for PCT 40 is demonstrated at plot CRIN\_4 which occurs across both PCT 40b and 53a and as such, has been assessed under both condition class schemas. Plot CRIN\_4 scored considerably higher under PCT 53 condition class schema (19 – Good) compared to PCT 40 (14.5 - Intermediate/Poor) (Table 13), which was scored down by its relatively low indicator species (Coolabah) cover.

**Table 13: Crinolyn condition class assessment results**

Plot No.	PCT	Assessment Score	Condition Class
CRIN_1 V26	53a	20	Excellent/Benchmark
CRIN_2	53a	20	Excellent/Benchmark
CRIN_3	40b	15	Intermediate
CRIN_4	40b	14.5	Intermediate/Poor

Plot No.	PCT	Assessment Score	Condition Class
CRIN_4	53a	19	Good
CRIN_5	53a	17	Intermediate
CRIN_6	40a	14	Intermediate/Poor

### Crinolyn Ramsar site – tree demographic results

A total of 24 Coolabah trees were assessed within tree demographic plot CRIN\_3 (PCT 40b), whilst a total of 15 Coolabah and six Belah trees were assessed within plot CRIN\_6 (PCT 40a) (Table 14). Both plot CRIN\_3 and CRIN\_6 recorded the same range of canopy PFC, however, CRIN\_6 recorded a lower mean score (Table 14). Whilst mean dead canopy scores were consistent between the two plots (45.2%), CRIN\_3 recorded a higher mean Live / Dead limb proportion score on account of having considerably more dead trees (10) compared with CRIN\_6 (4). Despite the ground stratum at plot CRIN\_3 indicating a more inundation prone hydrological regime compared to plot CRIN\_6 (see Table 5 - 6 and Table 12), this did not directly correlate with the tree condition results of both sites. The full Crinolyn tree demographic calculations and results have been provided to DPE-EHG as an attachment to this report.

**Table 14: Crinolyn tree demographic plot results**

Plot No.	Tree species and No. of trees	DBH range and mean (cm)	Canopy PFC range and mean (%)	Dead canopy range and mean (%)	Live / Dead limb proportion range and mean (%)
CRIN_3	Coolabah – 24	10 – 115 (33.3)	0 – 45 (29.7)	0 – 100 (45.2)	0 – 100 (46.1)
CRIN_6	Coolabah – 15 Belah – 6	5 – 77 (47.7)	0 – 45 (17.2)	10 – 100 (45.2)	0 – 100 (26.6)

### Windella Ramsar site – full floristic results

A total of 48 flora species, comprising 33 native and 15 exotic species were recorded across the six across full floristic plots established and surveyed within the Windella Ramsar site (Table 21 – Appendix B). As plot WIND\_5 is located on the boundary of two PCTs (53a and 182) and shares components of both communities, analysis based on PCT type for this plot is undertaken for both representative PCTs. Plot WIND\_6 (PCT 40b) recorded the highest total, native and exotic species richness, whilst plot WIND\_3 (PCT 40b) recorded the lowest total, native and equal lowest exotic species richness alongside plot WIND\_4 (PCT 182) (Table 15). No correlation was evident between species richness and PCT, however, the two plots with the highest overall species richness (WIND\_5 and WIND\_6) were the only two plots located in the southern section of Windella, south of the drainage channel (see Figure 4).

**Table 15: Windella full floristic plot species richness results**

Plot No.	PCT	TSR	NSR	ESR
WIND_1	53a	15	12	3
WIND_2	40b	12	10	2
WIND_3	40b	10	9	1
WIND_4	182	12	11	1

Plot No.	PCT	TSR	NSR	ESR
WIND_5	53a / 182	30	22	8
WIND_6	40b	34	23	11

TSR = Total Species Richness; NSR = Native Species Richness; ESR = Exotic Species Richness

WPGF species richness results from Windella full floristic plots are presented below in Table 15. Aquatic WPGF (ARp, ATe, ATI ATw, Se) species were recorded across all plots, reflective of the recent inundation across the Windella site. Consistent with the results for total species richness (Table 14), no correlation was evident between species richness and PCT, however, both WIND\_5 and WIND\_6 again recorded the highest species richness of aquatic WPGF species. Plot WIND\_3 located within PCT 40\_b recorded the highest proportion of aquatic WPGF species at 70% (Table 16).

**Table 16: Windella full floristic plot water plant functional group results**

Plot No.	ARp	ATe	ATI	ATw	Se	Tda	Tdr
WIND_1	2	4	1	-	1	6	1
WIND_2	2	4	-	-	1	2	3
WIND_3	2	3	1	-	1	3	-
WIND_4	2	3	1	-	1	2	3
WIND_5	2	6	2	1	1	11	7
WIND_6	2	6	2	-	1	12	11

Water Plant Functional Group: ARp = Amphibious fluctuation responder – plastic; ATe = Amphibious fluctuation tolerator – emergent; ATI = Amphibious fluctuation tolerator – low-growing; ATw = Amphibious fluctuation tolerator – woody; Se = Perennial – emergent; Tda = Terrestrial damp; Tdr = Terrestrial dry

Table 17 below summarises the results of the condition class assessment for full floristic plots surveyed within the Windella Ramsar site, with condition class schemas for PCT 40, 53 and 182 provided in Appendix C. As was the case at Crinolyn, PCT 53a plots recorded the highest condition class scores with WIND\_1 recording a maximum score of 20 and the associated Excellent/Benchmark condition class, whilst WIND\_5 recorded a score of 19 and condition class of Good (Table 17). Overall, PCT 40b sites recorded the lowest condition class scores which were either in the Intermediate or Intermediate/Poor class.

Plot WIND\_5 which occurs across both PCT 53a and 182 and as such, has been assessed under both condition class schemas. Plot WIND\_5 scored considerably higher under PCT 53 condition class schema (19 – Good) compared to PCT 182 (15 - Intermediate), with the relatively low indicator species (Narrow-leaved Cumbungi) cover reducing the PCT 182 score. The full condition class assessment for all Windella floristic plots have been provided to DPE-EHG as an attachment to this report.

**Table 17: Windella condition class assessment results**

Plot No.	PCT	Assessment Score	Condition Class
WIND_1	53a	20	Excellent/Benchmark
WIND_2	40b	16.5	Intermediate
WIND_3	40b	14.5	Intermediate/Poor
WIND_4	182	17	Intermediate
WIND_5	53a	19	Good
WIND_5	182	15	Intermediate
WIND_6	40b	13.5	Intermediate/Poor

### Windella Ramsar site – tree demographic results

A total of 41 Coolabah trees were assessed within tree demographic plot WIND\_2 (PCT 40b), with a total of 24 Coolabah trees also assessed within plot WIND\_3 (PCT 40b) (Table 18). Both plots recorded highly consistent results overall, which reflects the similar structure of each plot (one large Coolabah surrounded by abundant young trees 5 – 7 m in height – see Table 6). Both plots demonstrate the value of remnant mature trees in providing a source of natural regeneration, as well as habitat, with both large trees within each plot containing hollows and bird nests (Figure 13). The full Windella tree demographic calculations and results have been provided to DPE-EHG as an attachment to this report.

**Table 18: Crinolyn tree demographic plot results**

Plot No.	Tree species and No. of trees	DBH range and mean (cm)	Canopy PFC range and mean (%)	Dead canopy range and mean (%)	Live / Dead limb proportion range and mean (%)
WIND_2	Coolabah – 41	10 – 74 (16.5)	0 – 50 (29.5)	2 – 100 (8.6)	0 – 100 (2.7)
WIND_3	Coolabah – 24	11 – 142 (18.8)	15 – 40 (29.4)	2 – 45 (5.8)	0 – 25 (1.0)

## Incidental observations and other features

### Hydrological features

Landscape features or structures present within and surrounding the Crinolyn and Windella Ramsar sites which may influence inundation and hydrological regimes were noted during the field survey. The overall isolation and lack of connectivity between the vegetated wetlands of the two sites and both upstream and downstream wetlands is clearly evident in the aerial image of the two sites (e.g. Figure 1) and is also evident on ground. Figure 11a displays the eastern boundary of Crinolyn whilst Figure 11b displays the eastern boundary of Windella, both of which form the 'upstream' boundary of each site due to the predominant east to west flow of inundation in this part of the Lower Gingham Watercourse.

The micro-relief between the surrounding paddocks and the boundary of both sites is generally elevated 0.1 - 0.3 m in height. Whilst this is relatively minor, combined with the relatively dense ground cover at both sites (in particular Narrow-leaved Cumbungi at Windella), may provide some level of impediment to water flowing onto both sites. This is evident in an aerial image taken on 29 October 2022 during widespread flooding across the Lower Gingham Watercourse (Figure 12).



Figure 11: a) eastern boundary of Crinolyn facing south (left photo); and b) eastern boundary of Windella facing south (right photo)



**Figure 12: Aerial image with Windella in foreground and Crinolyn in background during flooding in October 2022 (Photo credit: David Jackson)**

Drainage channels have been constructed in both Crinolyn (Figure 13a) and Windella (Figure 13b) and are a key feature in distributing water flow across both sites. The drainage channel within Crinolyn did not contain surface water at the time of survey and is not directly connected to the Gingham Watercourse as is the case with Windella. The drainage channel within Windella and the dam which the drainage channel feeds into both contained water at the time of survey. Aerial imagery captured in August 2022 (Figure 12) whilst Crinolyn was partly inundated, demonstrates the role the drainage channel plays in distributing water through the site, as well as acting as a barrier to inundation. The drainage channel may limit inundation of the western portion of the site in certain flow events, as the western bank is built up approximately 0.9 – 1.6 m in height with the impact of this on inundation evident in the different forms of PCT 40 which occur on the eastern (PCT 40b) and western (PCT 40a) side of the channel (see Table 5).



**Figure 13: a) Crinolyn drainage channel (left photo); and b) Windella drainage channel (right photo)**

### Management issues

An elongated patch (Figure 14) of vegetation was observed in Windella where the dominant ground stratum species (including *Juncus aridicola* and Narrow-leaved Cumbungi) had mostly died back and both native and exotic invasive and colonial species had become abundant (Figure 14). The vegetation pattern and floristic composition was similar to that which occurred in patches of PCT 53b on the boundaries of both Crinolyn and Windella and which appear consistent with response resulting from aerial spray / drift (see Table 8). Away from site boundaries, and apart from *Lippia*, weed cover was generally low across both sites and no listed weed species for the region were recorded during field surveys (Local Land Services 2017). Evidence of two listed feral pest species, *Sus scrofa* (Feral Pig) and *Vulpes vulpes* (Red Fox) were recorded at Windella, with Red Fox also recorded at Crinolyn (Figure 16) (Local Land Services 2018). A silo facility was also under construction in cleared land, however, wholly contained within the southern boundary of the Crinolyn Ramsar site (Figure 16).



Figure 14: Aerial spray scar in Windella with invasive and colonial species in centre, contrasting with sedges and reeds on edges

### Opportunistic fauna observations

A diverse range of fauna species were opportunistically recorded during field surveys. Across Crinolyn, a total of 32 native and two introduced fauna species were recorded which included 26 bird species, one crustacean, three mammals and four reptile species (Table 26 - Appendix D). Both *Aegotheles cristatus* (Australian Owlet-nightjar) and Cockatiel were recorded utilising hollow-bearing trees (Figure 15a) and evidence of waterbird nesting was also recorded in the form of three eggs potentially belonging to *Threskiornis spinicollis* (Straw-necked Ibis) (Figure 15b) and a nest consistent with that of *Himantopus leucocephalus* (White-headed (Pied) Stilt).

A total of 46 native and three introduced fauna species were opportunistically recorded within Windella which included four amphibian species, 37 birds, one fish and one crustacean, four mammals and two reptiles (Table 27 - Appendix D). Both *Eolophus roseicapilla* (Galah) and Cockatiel were observed utilising hollow-bearing trees and three bird nests were also recorded within Coolabah woodland patches (Figure 17).



**Figure 15: a) Australian Owlet-nightjar in tree hollow in Crinolyn (left photo); b) potential waterbird nest found on bed of Flat Spike-sedge in Crinolyn (right photo)**



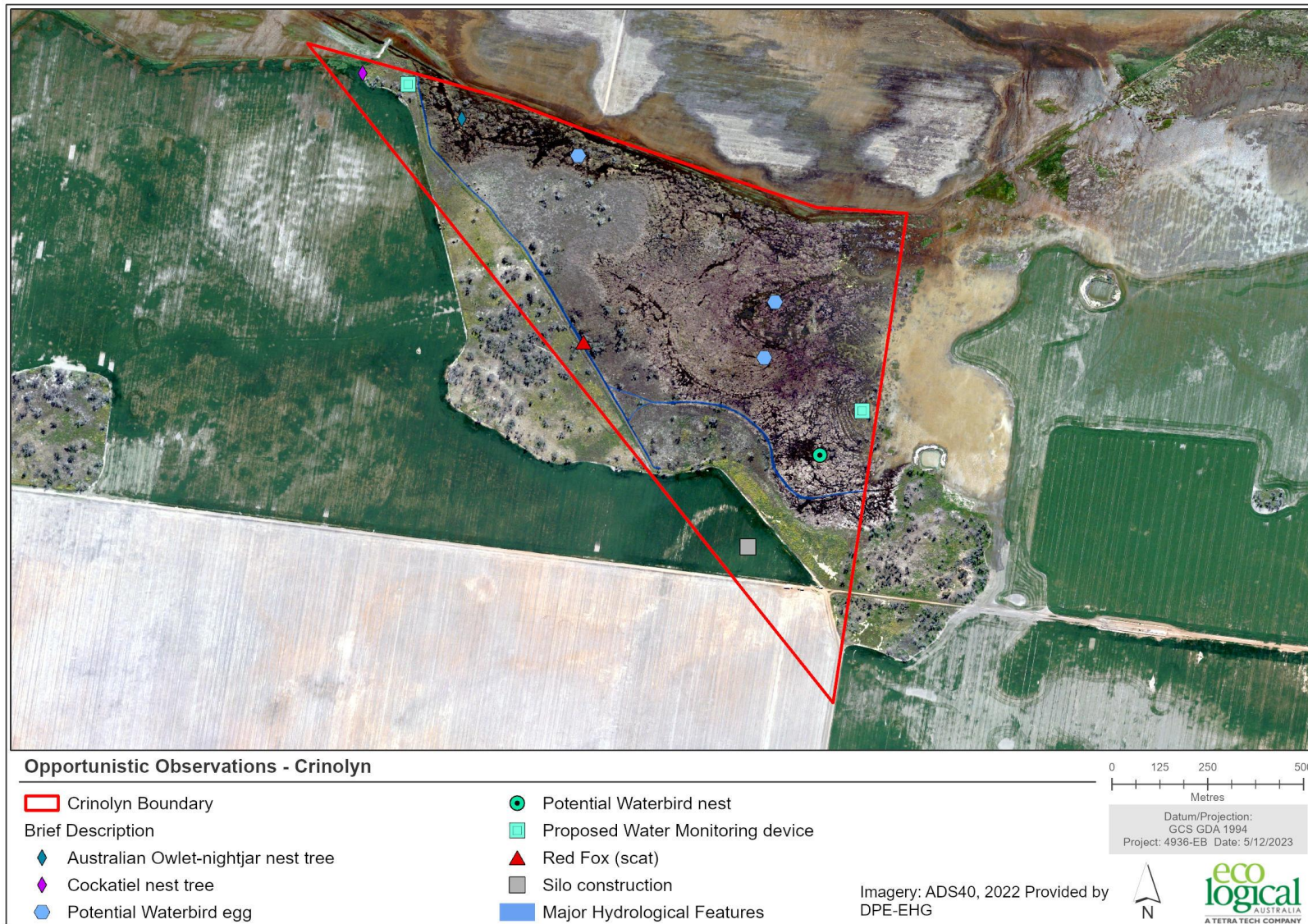
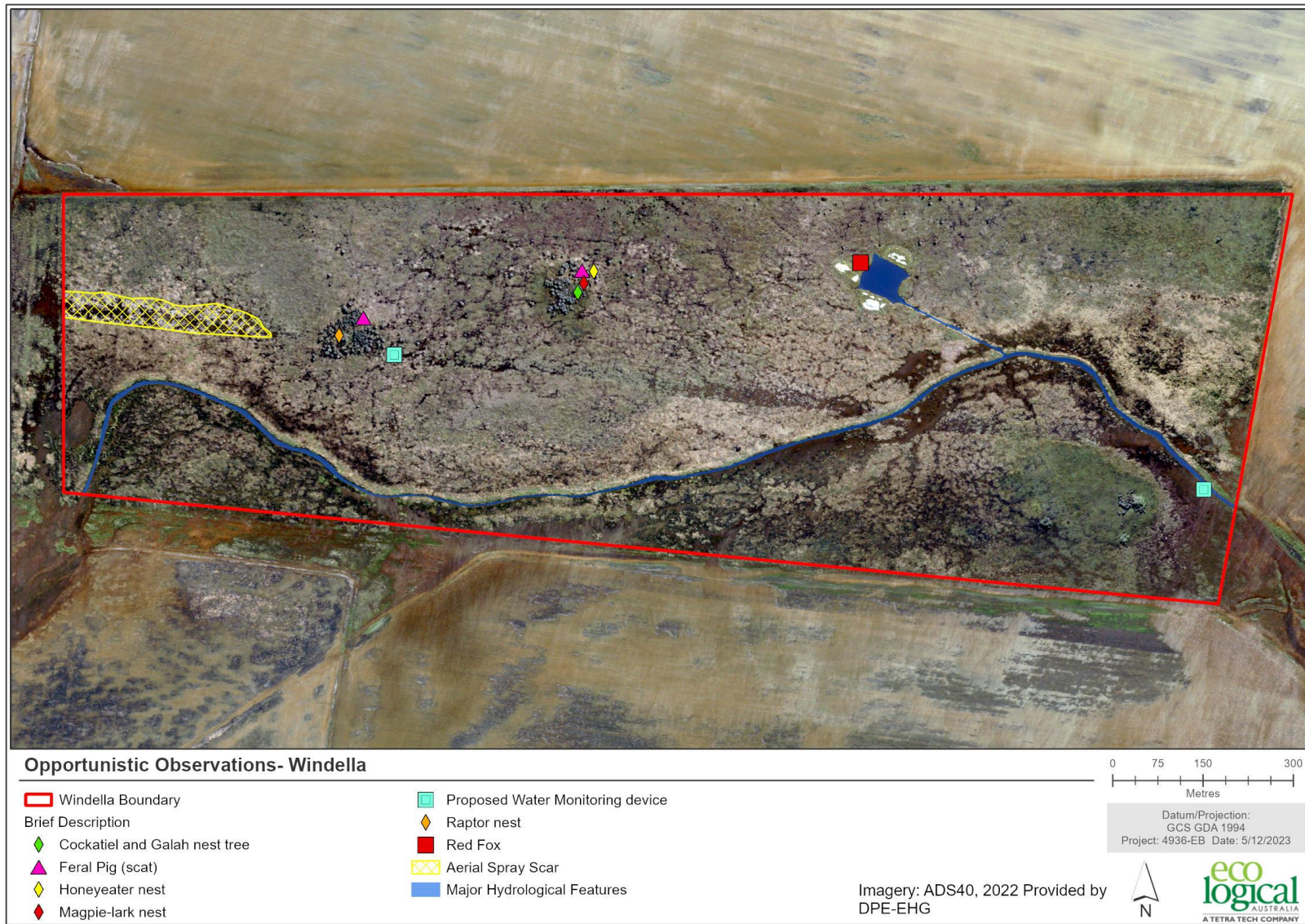


Figure 16: Opportunistic observation recorded across Crinolyn Ramsar site. Imagery captured in August 2022



**Figure 17: Opportunistic observation recorded across Windella Ramsar site. Imagery captured in August 2022**

## Conclusion and Recommendations

### Field survey conclusions

ELA was engaged to undertake vegetation surveys within the Crinolyn and Windella Ramsar sites in the Gwydir Wetlands, to help address gaps in ecological knowledge, as well as improve understanding as to the potential constraints that may impact future environmental water deliveries. Survey methodologies successfully completed included desktop and in-field PCT mapping and tree demographic and full floristic plot survey and establishment.

Within Crinolyn, three PCTs were recorded, two (PCT 40 and 53) of which occur in two distinct forms and form the dominant vegetation communities within the site (Table 4). A total of four PCTs were recorded within Windella, one of which (PCT 53) occurs in two distinct forms (Table 4). Coolabah woodland (PCT 40a and 40b) occupied a considerable extent (33.02 ha combined) of Crinolyn and the presence of dead Coolabah throughout areas of PCT 53a (Table 7), indicate a greater previous extent of Coolabah woodland within and surrounding the site. The extent of Coolabah woodland (PCT 40b) across Windella is less extensive, consisting mostly of patches featuring one mature tree and surrounding saplings and seedlings (Table 6 and Figure 10). PCT 182, characterised by dense stands of Narrow-leaved Cumbungi, dominates the central and southern portions of Windella (Figure 10). Following recent inundation, Narrow-leaved Cumbungi is widespread across the majority of the site, featuring as a measurable component of the remaining three other PCTs (Table 21 – Appendix).

A total of two tree demographic plots and four full floristic monitoring plots were established in both the Crinolyn and Windella Ramsar sites (Table 1 and Figure 5 – 6) and surveyed consistent with the methodology detailed in *Field method for the assessment of floodplain and wetland vegetation communities - DPEW Environmental Outcomes Monitoring Program* (Bowen 2022). A total of 70 flora species (comprising 50 native and 20 exotic species) were recorded within Crinolyn full floristic plots, whilst a total of 48 flora species (comprising 33 native and 15 exotic species) were recorded within Windella full floristic plots.

Condition class schemas developed for flood-dependent PCTs were applied to Crinolyn and Windella full floristic plot data. Condition class results were consistent for PCTs across both Crinolyn and Windella, with PCT 40 plots (PCT 40a and 40b) assessed as either Intermediate/Poor or Intermediate, whilst PCT 53a plots ranged from Intermediate to Good or Excellent/Benchmark and PCT 182 plots were assessed as Intermediate.

A total of 45 trees were assessed within the two tree demographic plots (CRIN\_3 – PCT 40b and CRIN\_6 – PCT 40 a) established and surveyed within Crinolyn Coolabah woodland patches. Despite the two plots occurring in the two different forms of Coolabah woodland within Crinolyn, major differences in tree condition between the two sites were not apparent. A total of 65 trees were assessed within the two tree demographic plots (WIND\_2 and WIND\_3 – both PCT 40 b) established and surveyed within Windella Coolabah woodland patches. Both plots recorded consistent results, reflective of the similar structure of the Coolabah woodland patches present within Windella.

## General conclusions

Viewing the Crinolyn and Windella Ramsar sites at a close scale, the vegetation of both sites reflect functioning wetland systems which vary in form and condition across their extent, and in addition to their individual ecological value, are an important part of the wider Gwydir Wetlands. Within the areas of Coolabah woodland across both sites, nesting habitat is provided for a range of native fauna species and whilst some mature trees demonstrate canopy dieback, natural regeneration of the woodland is occurring (see Table 5). A diversity of wetland micro-habitats were also present within areas of PCT 53 across both sites (see Table 7). Low-lying micro-depressions form gilgai formations which hold moisture and a range of aquatic WPGF species, whilst surrounding micro-rises are occupied by tussocks of rushes and reeds, as well as Lignum.

However, when taking a wider view, the separation of both Crinolyn and Windella, from both one another and adjacent wetlands, is highly apparent. At this wide scale, the influence of external factors such as the scale and intensity of surrounding land use is also apparent, but is also evident on the ground, for example, through edge effects on vegetation composition and structure observed along the boundaries of both sites (see Table 8).

## Recommendations

The surveys detailed in this report were undertaken following a prolonged period of above average rainfall, which led to widespread flooding in the Gingham Watercourse and Gwydir Wetlands region, including the inundation of both Crinolyn and Windella Ramsar sites. As such, the vegetation and conditions within both sites were typical of a ‘wet’ period and may contrast considerably with ‘dry’ period conditions. There may be value in assessing condition changes across both sites through remote sensing and should the assessment suggest considerable changes and conditions allow, undertake a ‘dry’ period survey to monitor:

- the condition of Coolabah woodland patches, including changes to ground stratum composition (i.e. transition between sedge/rush and chenopod/grass woodland forms), tree condition metrics and ongoing natural regeneration
- Narrow-leaved Cumbungi density and extent changes in response to drying conditions.

The boundaries of both Crinolyn and Windella Ramsar sites do not fully correlate with the extent of intact and remnant vegetation which occurs within and immediately surrounding both sites (see Figure 5 and 6). At Crinolyn for example, relatively large patches of intact Coolabah woodland are located outside of the Ramsar boundary on the western (approximately 12 ha) and south-eastern boundaries (approximately 11.5 ha), despite being contiguous with woodland located within the boundary. In contrast, cleared land which is actively cultivated falls within the southern and northern boundaries of the site (Figure 5). If possible, a review of the boundaries for both sites would be worthwhile in order to maximise the extent of remnant vegetation and overall value of both sites.

DPE-EHG have indicated their desire to install up to two water monitoring devices across both Crinolyn and Windella sites that would preferentially feature telemetry to record and obtain the data remotely. Water depth monitoring devices with telemetry are available in the Australian market from suppliers including HyQuest Solutions and Xylem Analytics and expert water consultants are available to assist in

developing and implementing water monitoring systems specific to both Crinolyn and Windella Ramsar sites. During field work, ELA identified two locations at each site suitable for long term monitoring of natural flow events and environmental water releases. The proposed installation sites are displayed in Figure 16 and 17 and have been positioned towards the eastern and western boundaries of each site and on either side of the respective drainage channels. Each installation site is also located amongst or nearby to regenerating Coolabah woodland patches which may provide the possibility to assess links between inundation and ongoing regeneration.

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## Appendix A Plot locations

**Table 19: Crinolyn and Windella plot location data. Project GDA1994. Zone 55.**

Ramsar Site	Plot	Corner	Latitude	Longitude	Easting	Northing
Crinolyn	CRIN_1 V26	NE	-29.21973	149.126527	706709.0446	6765796.657
		SE	-29.219906	149.126497	706705.7741	6765777.203
		SW	-29.219831	149.126269	706683.7567	6765785.917
		NW	-29.219638	149.126339	706690.9504	6765807.185
	CRIN_2	NE	-29.216907	149.126991	706759.8312	6766108.727
		NW	-29.216867	149.126776	706739.0068	6766113.539
		SW	-29.217034	149.126694	706730.6983	6766095.174
		SE	-29.21709	149.126978	706758.1994	6766088.467
	CRIN_3	NE	-29.217011	149.121275	706203.8497	6766107.262
		NW	-29.217062	149.120766	706154.257	6766102.504
		SW	-29.217477	149.12089	706165.4821	6766056.29
		SE	-29.217467	149.121362	706211.3949	6766056.568
	CRIN_4	NE	-29.21209	149.118955	705988.1237	6766656.757
		SE	-29.21227	149.118912	705983.5823	6766636.882
		NW	-29.212022	149.118784	705971.6325	6766664.594
		SW	-29.212205	149.118678	705960.9593	6766644.497
	CRIN_5	NE	-29.213413	149.118946	705984.6007	6766510.138
		NW	-29.213412	149.118747	705965.2531	6766510.598
		SW	-29.213606	149.118743	705964.4759	6766489.103
		SE	-29.213595	149.118996	705989.0981	6766489.878
	CRIN_6	NE	-29.211033	149.116571	705758.4274	6766778.093
		NW	-29.210767	149.115629	705667.3622	6766809.227
		SW	-29.210951	149.115533	705657.6599	6766789.001
		SE	-29.211294	149.116653	705765.879	6766749.021
Windella	WIND_1	NE	-29.199231	149.092064	703398.7795	6768128.885
		SW	-29.19946	149.091868	703379.2669	6768103.844
		NW	-29.199269	149.091864	703379.2551	6768125.02
		SE	-29.19943	149.09212	703403.8323	6768106.732
	WIND_2	NE	-29.200745	149.09573	703752.2907	6767954.723
		NW	-29.200677	149.095219	703702.7328	6767963.147
		SW	-29.201125	149.095222	703702.1383	6767913.488
		SE	-29.20117	149.095736	703752.0332	6767907.609
	WIND_3	NE	-29.199686	149.099599	704130.633	6768065.373

Ramsar Site	Plot	Corner	Latitude	Longitude	Easting	Northing
		SE	-29.200115	149.099604	704130.2688	6768017.817
		SW	-29.200128	149.099072	704078.5081	6768017.301
		NW	-29.199684	149.099087	704080.8467	6768066.485
	WIND_4	NE	-29.201025	149.109055	705047.5319	6767900.482
		NW	-29.200971	149.108858	705028.4821	6767906.811
		SW	-29.201156	149.108827	705025.0991	6767886.361
		SE	-29.201206	149.109069	705048.5329	6767880.397
	WIND_5	NE	-29.203604	149.101458	704303.6404	6767627.891
		NW	-29.203576	149.101245	704282.9832	6767631.365
		SW	-29.20376	149.101186	704276.8808	6767611.074
		SE	-29.203778	149.101428	704300.3778	6767608.658
	WIND_6	NE	-29.203098	149.106754	704819.6461	6767674.741
		NW	-29.203038	149.10654	704798.9553	6767681.764
		SW	-29.20321	149.10645	704789.8613	6767662.858
		SE	-29.203268	149.106705	704814.543	6767655.984



## Appendix B Flora species

**Table 20: Flora species recorded within Crinolyn full floristic plots**

Scientific Name	Common Name	Native / Exotic	Water Plant Functional Group	Growth Form	CRIN_1 V26	CRIN_2	CRIN_3	CRIN_4	CRIN_5	CRIN_6
<i>Alternanthera denticulata</i>	Lesser Joyweed	Native	Tda	F	X	X		X		X
<i>Amaranthus</i> spp.	Amaranth	Native	Tdr	F	X					
<i>Ammannia multiflora</i>	Jerry-jerry	Native	Tda	F		X		X		
<i>Aster subulatus</i>	Wild Aster	Exotic	Tda	F					X	
<i>Boerhavia dominii</i>	Tarvine	Native	Tdr	F					X	X
<i>Convolvulus</i> spp.	A Bindweed	Native	Tda	L					X	
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	Exotic	Tdr	F			X			X
<i>Cucumis myriocarpus</i> subsp. <i>leptodermis</i>	Paddy Melon	Exotic	Tdr	L		X				X
<i>Cynodon dactylon</i>	Common Couch	Native	Tda	G			X	X		
<i>Cyperus bifax</i>	Downs Nutgrass	Native	ATe	V			X			
<i>Cyperus difformis</i>	Dirty Dora	Native	ATI	V	X				X	X
<i>Cyperus</i> spp.	Flat-sedge	Native	ATe	V					X	
<i>Damasonium minus</i>	Starfruit	Native	ARp	F	X		X			
<i>Digitaria</i> spp.	A Finger Grass	Native	Tdr	G						X
<i>Diplachne fusca</i>	Brown Beetle Grass	Exotic	ATe	G	X					
<i>Duma florulenta</i>	Lignum	Native	ATw	S	X				X	
<i>Dysphania pumilio</i>	Small Crumbweed	Native	Tdr	C	X	X		X	X	X
<i>Einadia nutans</i>	Climbing Saltbush	Native	Tdr	C			X		X	X
<i>Eleocharis plana</i>	Flat Spike-sedge	Native	ATe	V	X	X		X	X	

Scientific Name	Common Name	Native / Exotic	Water Plant Functional Group	Growth Form	CRIN_1 V26	CRIN_2	CRIN_3	CRIN_4	CRIN_5	CRIN_6
<i>Eleocharis pusilla</i>	Small Spike Rush	Native	ATe	V				X		
<i>Enchylaena tomentosa</i>	Ruby Saltbush	Native	Tdr	CW						X
<i>Enteropogon acicularis</i>	Curly Windmill Grass	Native	Tdr	G					X	X
<i>Eucalyptus coolabah</i>	Coolabah	Native	Tda	T			X	X		X
<i>Euphorbia dallachyana</i>	Mat Spurge	Native	Tdr	F						X
<i>Euphorbia drummondii</i>	Caustic Weed	Native	Tdr	F				X		X
<i>Heliotropium europaeum</i>	Potato Weed	Exotic	Tdr	F		X		X		
<i>Juncus aridicola</i>	Tussock Rush	Native	ATe	R	X	X	X	X	X	
<i>Lachnagrostis filiformis</i>	Blown Grass	Native	ATe	G	X		X		X	
<i>Lepidium pseudohyssopifolium</i>	Peppergrass	Native	Tda	F		X		X		
<i>Lepidium</i> spp.	A Peppergrass	Native	Tdr	F				X		
<i>Ludwigia peploides subsp. montevidensis</i>	Water Primrose	Native	ARp	F		X				
<i>Malva parviflora</i>	Small-flowered Mallow	Exotic	Tdr	F		X		X		
<i>Malvastrum americanum</i>	Spiked Malvastrum	Exotic	Tdr	F			X			
<i>Marsilea drummondii</i>	Common Nardoo	Native	ARp	E	X	X	X	X	X	X
<i>Medicago polymorpha</i>	Burr Medic	Exotic	Tdr	F		X				
<i>Oenothera stricta</i>	Common Evening Primrose	Exotic	Tdr	F					X	
<i>Panicum decompositum</i>	Native Panic	Native	Tdr	G	X	X	X		X	X
<i>Paspalidium jubiflorum</i>	Warrego Grass	Native	Tda	G		X	X	X	X	X
<i>Paspalum distichum</i>	Water Couch	Native	ATe	G				X	X	
<i>Persicaria</i> spp.	Knotweed	Native	ATe	F			X			X
<i>Phyla canescens</i>	Lippia	Exotic	ATI	F	X	X	X	X		X

Scientific Name	Common Name	Native / Exotic	Water Plant Functional Group	Growth Form	CRIN_1 V26	CRIN_2	CRIN_3	CRIN_4	CRIN_5	CRIN_6
<i>Physalis minima</i>	Wild Gooseberry	Exotic	Tda	F	X	X				
<i>Polygonum aviculare</i>	Wireweed	Exotic	Tdr	F		X	X			X
<i>Portulaca oleracea</i>	Pigweed	Native	Tdr	F		X				X
<i>Pratia concolor</i>	Poison Pratia	Native	ATe	F	X	X				
<i>Ranunculus undosus</i>	Swamp Buttercup	Native	ATe	F	X	X				
<i>Rapistrum rugosum</i>	Turnip Weed	Exotic	Tdr	F					X	
<i>Rorippa palustris</i>	Yellow Cress	Exotic	Tda	F	X	X				
<i>Rumex brownii</i>	Swamp Dock	Native	Tda	F					X	
<i>Rumex spp.</i>	Dock	Native	Tda	F		X				
<i>Salsola tragus</i>	Buckbush	Native	Tdr	CW		X				X
<i>Sclerolaena bicornis var. horrida</i>	Goathead Burr	Native	Tdr	CW						X
<i>Sclerolaena birchii</i>	Galvanized Burr	Native	Tdr	CW						X
<i>Sclerolaena muricata</i>	Black Roly-poly	Native	Tdr	CW		X	X	X	X	X
<i>Sesbania cannabina</i>	Sesbania Pea	Native	Tda	S						X
<i>Sida corrugata</i>	Corrugated Sida	Native	Tdr	F				X		
<i>Sida trichopoda</i>	High Sida	Native	Tda	F			X			X
<i>Solanum esuriale</i>	Quena	Native	Tda	F						X
<i>Solanum nigrum</i>	Black-berry Nightshade	Exotic	Tdr	F		X	X			X
<i>Sonchus oleraceus</i>	Common Sowthistle	Exotic	Tdr	F		X				X
<i>Sporobolus caroli</i>	Fairy Grass	Native	Tdr	G			X			X
<i>Stellaria angustifolia</i>	Swamp Starwort	Native	ATe	F		X				
<i>Tetragonia tetragonioides</i>	New Zealand Spinach	Native	Tdr	F						X
<i>Tribulus terrestris</i>	Cat-head	Exotic	Tdr	F						X

Scientific Name	Common Name	Native / Exotic	Water Plant Functional Group	Growth Form	CRIN_1 V26	CRIN_2	CRIN_3	CRIN_4	CRIN_5	CRIN_6
<i>Typha domingensis</i>	Narrow-leaved Cumbungi	Native	Se	R	X	X		X		
<i>Vachellia farnesiana</i>	Mimosa Bush	Native	Tdr	S					X	
<i>Verbena gaudichaudii</i>	Verbena	Native	Tdr	F						X
<i>Verbena supina</i>	Trailing Verbena	Exotic	Tdr	F					X	
<i>Xanthium occidentale</i>	Noogoora Burr	Exotic	Tda	F						X
<i>Xanthium spinosum</i>	Bathurst Burr	Exotic	Tdr	F						X

**Water Plant Functional Group:** ARp = Amphibious fluctuation responder – plastic; ATe = Amphibious fluctuation tolerator – emergent; ATI = Amphibious fluctuation tolerator – low-growing; ATw = Amphibious fluctuation tolerator – woody; Se = Perennial – emergent; Tda = Terrestrial damp; Tdr = Terrestrial dry. Growth Form: C = Chenopod; CW = Chenopod Weed; E = Fern; F = Forb; G = Grass; L = Vine; R = Rush; S = Shrub; T = Tree; V = Sedge

**Table 21: Flora species recorded within Windella full floristic plots**

Scientific Name	Common Name	Native / Exotic	Water Plant Functional Group	Growth Form	WIND_1	WIND_2	WIND_3	WIND_4	WIND_5	WIND_6
<i>Alternanthera denticulata</i>	Lesser Joyweed	Native	Tda	F	X		X	X	X	X
<i>Alternanthera nodiflora</i>	Common Joyweed	Native	Tda	F					X	
<i>Ammannia multiflora</i>	Jerry-jerry	Native	Tda	F	X				X	
<i>Aster subulatus</i>	Wild Aster	Exotic	Tda	F	X				X	X
<i>Centipeda cunninghamii</i>	Common Sneezeweed	Native	Tda	F						X
<i>Cyperus difformis</i>	Dirty Dora	Native	ATI	V					X	X
<i>Cyperus</i> spp.	Flat-sedge	Native	ATe	V						X
<i>Duma florulenta</i>	Lignum	Native	ATw	S					X	
<i>Dysphania pumilio</i>	Small Crumbweed	Native	Tdr	C				X	X	X
<i>Echinochloa crus-galli</i>	Barnyard Grass	Exotic	Tda	G						X

Scientific Name	Common Name	Native / Exotic	Water Plant Functional Group	Growth Form	WIND_1	WIND_2	WIND_3	WIND_4	WIND_5	WIND_6
<i>Eleocharis plana</i>	Flat Spike-sedge	Native	ATe	V	X	X	X	X	X	X
<i>Eleocharis pusilla</i>	Small Spike Rush	Native	ATe	V					X	
<i>Eucalyptus coolabah</i>	Coolabah	Native	Tda	T		X	X			X
<i>Euphorbia drummondii</i>	Caustic Weed	Native	Tdr	F						X
<i>Haloragis glauca</i>		Native	Tda	F	X		X	X		X
<i>Heliotropium europaeum</i>	Potato Weed	Exotic	Tdr	F					X	
<i>Juncus aridicola</i>	Tussock Rush	Native	ATe	R	X	X	X	X		X
<i>Lachnagrostis filiformis</i>	Blown Grass	Native	ATe	G	X	X			X	X
<i>Lepidium pseudohyssopifolium</i>	Peppergrass	Native	Tda	F					X	
<i>Lepidium</i> spp.	A Peppergrass	Native	Tdr	F	X	X		X		
<i>Ludwigia peploides subsp. montevidensis</i>	Water Primrose	Native	ARp	F	X	X	X	X	X	X
<i>Malva parviflora</i>	Small-flowered Mallow	Exotic	Tdr	F						X
<i>Malvastrum americanum</i>	Spiked Malvastrum	Exotic	Tdr	F					X	
<i>Marsilea drummondii</i>	Common Nardoo	Native	ARp	E	X	X	X	X	X	X
<i>Oenothera stricta</i>	Common Evening Primrose	Exotic	Tdr	F					X	
<i>Panicum decompositum</i>	Native Panic	Native	Tdr	G		X			X	X
<i>Paspalidium jubiflorum</i>	Warrego Grass	Native	Tda	G					X	X
<i>Paspalum distichum</i>	Water Couch	Native	ATe	G					X	
<i>Persicaria</i> spp.	Knotweed	Native	ATe	F					X	X
<i>Phyla canescens</i>	Lippia	Exotic	ATI	F	X		X	X	X	X
<i>Physalis minima</i>	Wild Gooseberry	Exotic	Tda	F					X	X
<i>Polygonum aviculare</i>	Wireweed	Exotic	Tdr	F						X

Scientific Name	Common Name	Native / Exotic	Water Plant Functional Group	Growth Form	WIND_1	WIND_2	WIND_3	WIND_4	WIND_5	WIND_6
<i>Portulaca oleracea</i>	Pigweed	Native	Tdr	F				X	X	
<i>Ranunculus pumilio</i>	Ferny Buttercup	Native	ATe	F	X					X
<i>Ranunculus undosus</i>	Swamp Buttercup	Native	ATe	F		X	X	X	X	
<i>Rorippa palustris</i>	Yellow Cress	Exotic	Tda	F					X	X
<i>Rumex brownii</i>	Swamp Dock	Native	Tda	F					X	X
<i>Rumex</i> spp.	<i>Rumex</i> spp.	Native	Tda	F					X	
<i>Sclerolaena muricata</i>	Black Rolypoly	Native	Tdr	CW						X
<i>Sesbania cannabina</i>	Sesbania Pea	Native	Tda	S	X				X	X
<i>Sida corrugata</i>	Corrugated Sida	Native	Tdr	F						
<i>Solanum nigrum</i>	Black-berry Nightshade	Exotic	Tdr	F		X				X
<i>Sonchus oleraceus</i>	Common Sowthistle	Exotic	Tdr	F					X	
<i>Typha domingensis</i>	Narrow-leaved Cumbungi	Native	Se	R	X	X	X	X	X	X
<i>Urochloa panicoides</i>	Urochloa Grass	Exotic	Tdr	G						X
<i>Vachellia farnesiana</i>	Mimosa Bush	Native	Tdr	S						X
<i>Verbena gaudichaudii</i>	Verbena	Native	Tdr	F						X
<i>Verbena supina</i>	Trailing Verbena	Exotic	Tdr	F						X
<i>Xanthium occidentale</i>	Noogoora Burr	Exotic	Tda	F	X	X				X

## Appendix C PCT Condition Class Schemas

**Table 22: Condition Classes for all PCTs**

Condition Score Range (Sum of scores)	Condition Class
0 - 8.9	Very Poor
9 - 11.9	Poor
12 - 14.9	Intermediate/Poor
15 - 17.9	Intermediate
18 - 19.9	Good
20	Excellent/Benchmark

**Table 23: PCT 40 Condition Class schema**

PCT No.	Metric Name	Metric Description	Good (%)	Intermediate (%)	Poor (%)	Very Poor (%)	Good (Score)	Intermediate (Score)	Poor (Score)	Very Poor (Score)
40	Bare Ground /Litter	Sum of % Cover of Bare Ground + Litter	≤40	>40 - ≤60	>60 - ≤80	>80	2	1	0.5	0
40	Invasive Terrestrial (Woody Chenopod Shrubs)	Sum of %FC Invasive native terrestrial woody chenopods (Growth form = CW)	≤10	>10 - ≤40	>40 - ≤80	>80	3	2.5	1.75	0
40	Exotic Species	Sum of %FC Exotic Species (Exotic species = Y)	≤10	>10 - ≤40	>40 - ≤80	>80	3	2.5	1.75	0
40	Native Grasses	Sum of % Native Grasses (Exotic species = N, Growth form = G)	≥40	<40 - ≥10	<10 - ≥5	<5	3	2.5	2	0
40	Indicator Species in Lower Stratum	Sum of %FC Indicator Species in Lower Stratum (Scientific Name =	≥1	<1 - ≥0.5	< 0.5 - >0	0	1.5	1	0.5	0

PCT No.	Metric Name	Metric Description	Good (%)	Intermediate (%)	Poor (%)	Very Poor (%)	Good (Score)	Intermediate (Score)	Poor (Score)	Very Poor (Score)
		Eucalyptus coolabah)								
40	Indicator Species in Mid Stratum	Sum of %FC Indicator Species in Mid Stratum (Scientific Name = Eucalyptus coolabah)	≥5	>5 - ≤0.5	< 0.5 - >0	0	1.5	1	0.5	0
40	Indicator Species in Tallest Stratum	Sum of %FC Indicator Species in Tallest Stratum (Scientific Name = Eucalyptus coolabah)	≥10	<10 - ≥3	<3 - ≤1	<1	3	2.5	2	0
40	Aquatic And Damp Functional Species	Aquatic Functional Species (Sum of Functional Groups = ATw, ATe, ATI, ARp, ARI, Se, Sk)	≥30	<30 - ≥10	<10 - ≤5	<5	3	2	1	0

Table 24: PCT 53 Condition Class schema

PCT No.	Metric Name	Metric Description	Good (%)	Intermediate (%)	Poor (%)	Very Poor (%)	Good (Score)	Intermediate (Score)	Poor (Score)	Very Poor (Score)
53	Bare Ground /Litter	Sum of % Cover of Bare Ground + Litter	≤10	>10 - ≤40	>40 - ≤80	>80	4	3	2	0
53	Invasive Terrestrial (Woody Chenopod Shrubs)	Sum of %FC Invasive native terrestrial woody chenopods (Growth form = CW)	≤10	>10 - ≤40	>40 - ≤80	>80	4	3	2	0
53	Wetland Functional Species	Aquatic Functional Species (Sum of %FC of Functional Groups = ATw, ATe, ATI, ARp, ARI, Se, Sk)#	≥80	<80 - ≥40	<40 - ≥10	<10	8	6	4	0
53	Exotic Species	Sum of % FC Exotic Species (Exotic species = Y)	≤10	>10 - ≤40	>40 - ≤80	>80	4	3	2	0



Table 25: PCT 182 Condition Class schema

PCT No.	Metric Name	Metric Description	Good (%)	Intermediate (%)	Poor (%)	Very Poor (%)	Good (Score)	Intermediate (Score)	Poor (Score)	Very Poor (Score)
182	Bare Ground /Litter	Sum of % Cover of Bare Ground + Litter	≤10	>10 - ≤40	>40 - ≤80	>80	4	3	2	0
182	Invasive Terrestrial (Woody Chenopod Shrubs)	Sum of %FC Invasive native terrestrial woody chenopods (Growth form = CW)	≤10	>10 - ≤40	>40 - ≤80	>80	4	3	2	0
182	Indicator Species	Sum of %FC Indicator Species in Lower Stratum (and mid) (Species = Typha ssp.-domingensis, orientalis etc)	≥80	<80 - ≥40	<40 - ≥10	<10	8	6	4	0
182	Exotic Species	Sum of %FC Exotic Species (Exotic species = Y)	≤10	>10 - ≤40	>40 - ≤80	>80	4	3	2	0

## Appendix D Fauna species

**Table 26: Fauna species recorded within Crinolyn Ramsar site**

Class	Scientific Name	Common Name	Native / Introduced
Aves	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	Native
Aves	<i>Anthus novaeseelandiae</i>	Australasian Pipit	Native
Aves	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	Native
Aves	<i>Columba livia</i>	Rock Dove	Introduced
Aves	<i>Corvus coronoides</i>	Australian Raven	Native
Aves	<i>Coturnix pectoralis</i>	Stubble Quail	Native
Aves	<i>Cracticus tibicen</i>	Australian Magpie	Native
Aves	<i>Cracticus torquatus</i>	Grey Butcherbird	Native
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Native
Aves	<i>Elanus axillaris</i>	Black-shouldered Kite	Native
Aves	<i>Falco berigora</i>	Brown Falcon	Native
Aves	<i>Falco cenchroides</i>	Nankeen Kestrel	Native
Aves	<i>Falco longipennis</i>	Australian Hobby Falcon	Native
Aves	<i>Grallina cyanoleuca</i>	Magpie-lark	Native
Aves	<i>Haliastur sphenurus</i>	Whistling Kite	Native
Aves	<i>Malurus cyaneus</i>	Superb Fairy-wren	Native
Aves	<i>Malurus leucopterus</i>	White-winged Fairy-wren	Native
Aves	<i>Manorina melanocephala</i>	Noisy Miner	Native
Aves	<i>Milvus migrans</i>	Black Kite	Native
Aves	<i>Nymphicus hollandicus</i>	Cockatiel	Native
Aves	<i>Ocyphaps lophotes</i>	Crested Pigeon	Native
Aves	<i>Platycercus adscitus</i>	Pale-headed Rosella	Native
Aves	<i>Rhipidura albiscapa</i>	Grey Fantail	Native
Aves	<i>Struthidea cinerea</i>	Apostlebird	Native
Aves	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	Native
Aves	<i>Vanellus tricolor</i>	Banded Lapwing	Native
Malacostraca	<i>Cherax destructor</i>	Freshwater Yabby	Native
Mammalia	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	Native
Mammalia	<i>Osphranter rufus</i>	Red Kangaroo	Native
Mammalia	<i>Sus scrofa</i>	Feral Pig	Introduced
Mammalia	<i>Vulpes vulpes</i>	Red Fox	Introduced
Reptilia	<i>Cryptoblepharus australis</i>	Inland Snake-eyed Skink	Native
Reptilia	<i>Diporiphora nobbi</i>	Nobbi Dragon	Native

Class	Scientific Name	Common Name	Native / Introduced
Reptilia	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	Native
Reptilia	<i>Pseudonaja textilis</i>	Eastern Brown Snake	Native

Table 27: Fauna species recorded within Windella Ramsar site

Class	Scientific Name	Common Name	Native / Introduced
Actinopterygii	<i>Cyprinus carpio</i>	European Carp	Introduced
Amphibia	<i>Crinia signifera</i>	Common Eastern Froglet	Native
Amphibia	<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog	Native
Amphibia	<i>Litoria caerulea</i>	Green Tree Frog	Native
Amphibia	<i>Litoria peronii</i>	Peron's Tree Frog	Native
Aves	<i>Anas superciliosa</i>	Pacific Black Duck	Native
Aves	<i>Anhinga novaehollandiae</i>	Australasian Darter	Native
Aves	<i>Anthus novaeseelandiae</i>	Australasian Pipit	Native
Aves	<i>Aprosmictus erythropterus</i>	Red-winged Parrot	Native
Aves	<i>Aquila audax</i>	Wedge-tailed Eagle	Native
Aves	<i>Ardea modesta</i>	Eastern Great Egret	Native
Aves	<i>Ardea pacifica</i>	White-necked Heron	Native
Aves	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	Native
Aves	<i>Cacatua sanguinea</i>	Little Corella	Native
Aves	<i>Chenonetta jubata</i>	Australian Wood Duck	Native
Aves	<i>Corvus coronoides</i>	Australian Raven	Native
Aves	<i>Cracticus tibicen</i>	Australian Magpie	Native
Aves	<i>Egretta novaehollandiae</i>	White-faced Heron	Native
Aves	<i>Elanus axillaris</i>	Black-shouldered Kite	Native
Aves	<i>Eolophus roseicapilla</i>	Galah	Native
Aves	<i>Grallina cyanoleuca</i>	Magpie-lark	Native
Aves	<i>Hirundo neoxena</i>	Welcome Swallow	Native
Aves	<i>Malurus cyaneus</i>	Superb Fairy-wren	Native
Aves	<i>Malurus leucopterus</i>	White-winged Fairy-wren	Native
Aves	<i>Manorina flavigula</i>	Yellow-throated Miner	Native
Aves	<i>Manorina melanocephala</i>	Noisy Miner	Native
Aves	<i>Megalurus timoriensis</i>	Tawny Grassbird	Native
Aves	<i>Milvus migrans</i>	Black Kite	Native
Aves	<i>Northiella haematogaster</i>	Blue Bonnet	Native
Aves	<i>Nymphicus hollandicus</i>	Cockatiel	Native
Aves	<i>Ocyphaps lophotes</i>	Crested Pigeon	Native

Class	Scientific Name	Common Name	Native / Introduced
Aves	<i>Petrochelidon nigricans</i>	Tree Martin	Native
Aves	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	Native
Aves	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	Native
Aves	<i>Podargus strigoides</i>	Tawny Frogmouth	Native
Aves	<i>Porphyrio melanotus</i>	Australasian Swamphen	Native
Aves	<i>Stiltia isabella</i>	Australian Pratincole	Native
Aves	<i>Taeniopygia guttata</i>	Zebra Finch	Native
Aves	<i>Threskiornis molucca</i>	Australian White Ibis	Native
Aves	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	Native
Aves	<i>Vanellus miles</i>	Masked Lapwing	Native
Aves	<i>Vanellus tricolor</i>	Banded Lapwing	Native
Malacostraca	<i>Cherax destructor</i>	Freshwater Yabby	Native
Mammalia	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	Native
Mammalia	<i>Osphranter rufus</i>	Red Kangaroo	Native
Mammalia	<i>Sus scrofa</i>	Feral Pig	Introduced
Mammalia	<i>Vulpes vulpes</i>	Red Fox	Introduced
Reptilia	<i>Chelodina longicollis</i>	Eastern Long-necked Turtle	Native
Reptilia	<i>Pseudonaja textilis</i>	Eastern Brown Snake	Native

