

# Caryapundy Swamp Ecological Character Description

| Ramsar ecological character description   |  |
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| <p><b>Site name:</b></p> <p>Official name of site</p> <p>Jurisdiction/other identifier(s) (e.g., reference number)</p>  | <p><b>Caryapundy Swamp Ramsar site</b></p> <p>within the Narriearra Caryapundy Swamp</p> <p>National Park, New South Wales, Australia</p>  |
| 1. Summary  |  |
| <p><b>1.1 Site description &amp; values:</b></p> <p>Describe the site and why it is ecologically <i>distinctive</i>, based on the details below. Include reference to the criteria for which the site was listed.</p> | <p>Caryapundy Swamp Ramsar site is ~ 50 km ENE east of Tibooburra in far north-western New South Wales, Australia. The wetland and waterways of Caryapundy Swamp and the Bulloo Overflow that are within the Narriearra Caryapundy Swamp National Park boundary are part of the Ramsar site. The site does not include the entire area of the national park. The area of the Ramsar wetland is 70,176.24 ha, measuring a maximum length of 47.26 km from north to south, and a maximum width of 37.4 km east to west. The site borders Queensland along the dingo fence to the north, and Pindera Downs Aboriginal Area to the south. The Ramsar site is restricted in extent by the boundaries of the Narriearra Caryapundy Swamp National Park, which borders Queensland to the north (delineated by the dingo fence), pastoral stations to the east, west, and south, except for Pindera Downs Aboriginal Area which borders a section of the park to the south. The site map and shapefile for the site provide detailed and exact spatial boundaries of the site, which is irregularly shaped, following flood extent boundaries (derived from Crossman and Li 2015). A complete set of coordinates for the site are provided in Attachment 4 .</p> <p>In 2020, the site became a National Park under NSW state legislation, increasing the potential for monitoring and research in data deficient areas relating to the ecological character of the site. Recently developed satellite imaging capability may be employed in the future to address some of the hydrological and vegetation monitoring requirements.</p> <p>Climate change is predicted to exacerbate existing threats to the natural and cultural values of the wetland (BOM 2018). However, most importantly it relies on river flows from the Bulloo River in Queensland, largely a free-flowing river.</p> <p>Caryapundy Swamp meets Ramsar listing criteria 1, 2, 3 and 4:</p> <p><b>Criterion 1:</b> The site forms a substantial part of the large terminal basin in the Bulloo River Catchment which is a highly representative and relatively natural wetland area.</p> |

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|  | <p><b>Criterion 2:</b> The site provides habitat for threatened species listed nationally (under the EPBC Act) and/ or internationally (under the IUCN Redlist), including the Grey Falcon (<i>Falco hypoleucos</i>) and Plains-wanderer (<i>Pedionomus torquatus</i>). It includes almost 90% of the available habitat for the nationally threatened Bulloo Grey Grasswren (<i>Amytornis barbatus barbatus</i>).</p> <p><b>Criterion 3:</b> The site supports an abundance and diversity waterbirds, with up to 52 different species recorded from the site.</p> <p><b>Criterion 4:</b> The site supports migratory shorebirds listed under the Environment Protection and Biodiversity Conservation Act 1999 and international treaties (JAMBA, CAMBA, ROKAMBA, and the Convention on Migratory Species). It provides drought refuge for waterbirds and other fauna; and supports waterbird breeding.</p> <p>The site may also qualify under criteria 5 and 7. More data are required to support this.</p>  |
| <p><b>1.2 Critical components, processes and services:</b></p> <p>Describe which of the ecological component, processes and services outlined below are critical to determining the ecological character of the Ramsar site.</p> | <p>The following ecosystem components, processes and services form the basis of the ecological character of the Caryapundy Swamp Ramsar site:</p> <ul style="list-style-type: none"> <li>-<b>Geomorphology and climate:</b> the site forms a substantial part of the large endorheic, terminal basin in the Bulloo River Catchment. The region features low topographic gradients and extreme climatic variability, including high evaporation, erratic floods, extended dry periods, and highly pulsed ecosystem dynamics.</li> <li>-<b>Hydrological regime:</b> periodic inundation is required to maintain wetland habitats. The natural water regimes of drying and flooding are critical in these temporary wetlands as they determine the nature of species and community distribution. Biodiversity in the semi-arid area of Caryapundy Swamp is driven by unpredictable flooding and drying cycles, largely related to flows in the Bulloo River. This flooding and drying cycle affects water quality and the distribution and abundance of vegetation and fauna. The wetlands are shallow, with water retention subject to high evaporative loss (&gt;2.0m) particularly in warmer months and is dependent on inflows and rainfall (typically &lt;250 mm annually). Maintenance of natural flows in the Bulloo River is critical for the conservation of the ecological character of the Ramsar site, due to the connectedness between the river, and the floodplains and wetlands of the site. As such, upstream development of water infrastructure and increased water extraction and diversion presents a substantial risk to the ecological character of the site.</li> <li>-<b>Wetland type:</b> the wetlands of the site are ephemeral and dry most of the time with rare and very irregular wet phases in an endorheic, terminal drainage basin. Vegetated swamps dominated by lignum (<i>Duma</i></li> </ul> |

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|  | <p><i>florulenta</i>), and nitre goosefoot (<i>Chenopodium nitrariaceum</i>), and golden goosefoot (<i>Chenopodium auricomum</i>) provide critical foraging and breeding habitat for the Bulloo grey grasswren (<i>Amytornis barbatus barbatus</i>) and waterbirds.</p> <p><b>-Priority species:</b> The site supports globally and nationally threatened species including the Bulloo grey grasswren (<i>Amytornis barbatus barbatus</i>), curlew sandpiper (<i>Calidris ferruginea</i>), grey falcon (<i>Falco hypoleucos</i>), red knot (<i>Calidris canutus</i>), and plains-wanderer (<i>Pedionomus torquatus</i>). It provides non-breeding habitat for migratory shorebirds listed under the international treaties JAMBA, CAMBA, ROKAMBA, and the Convention on Migratory Species.</p> <p><b>-Waterbird abundance:</b> large numbers of waterbirds use the site (at least 38 species), with 52 different species recorded within the National Park to date.</p> <p><b>-Refugia:</b> the site provides refuge for waterbirds and other fauna when other wetlands in the region are dry, including wetlands and vegetated depressions historically subject to limited grazing activity.</p> <p><b>-Breeding:</b> the area supports waterbird breeding, for species such as the black swan (<i>Cygnus atratus</i>), black-tailed native-hen (<i>Tribonyx ventralis</i>), Eurasian coot (<i>Fulica atra</i>), Australasian swamphen (<i>Porphyrio melanotus</i>), red-kneed dotterel (<i>Erythrogonys cinctus</i>), and red-necked avocet (<i>Recurvirostra novaehollandiae</i>), and likely many more.</p> |
| <p><b>1.3 Conceptual models</b></p> <p>Conceptual models of key characteristics of the wetland should be included as an Appendix/ Attachment to this description.</p>            | <p>Refer Attachment 1.</p>  |
| <p><b>1.4 Other</b></p> <p>Images, maps and other information relevant to describing the ecological character may be included as Appendices/ Attachments to this description</p> | <p>Refer Attachment 1.</p>  |
| <p><b>2. Physical components</b></p>   |   |
| <p><b>2.1 Climate:</b></p> <p>Overview of prevailing climate type, zone and major features (precipitation, temperature, wind)</p>  | <p>Caryapundy Swamp Ramsar site is situated semi-arid Australia, which is broadly characterised by unpredictable and erratic rainfall patterns. The site is situated in a Dry Climate climatic region, and Subtropical Desert (Low-latitude desert) subregion.</p> <p>The nearest long-term rain gauge is situated at Tibooburra Post Office where mean annual rainfall is 225 mm, with slightly higher averages in summer (22-29 mm/ month) and lower in winter (11-16 mm/ month) (BOM 2021). Average minimum monthly temperatures range from 6°C in winter to 21°C in summer. Average monthly maximum temperatures range from 19°C in winter to 35°C in summer (BOM 2021).</p> <p>Broadly, the region receives low annual rainfall, and</p>   |

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|   | <p>can be subject to prolonged dry periods or droughts, and erratic wet periods which can drive flooding. As the terminal basin of the endorheic Bulloo River, some of the effects of extreme drying can be reduced due to flows in the river into the site caused by rainfall upstream. The site can be subject to hot temperatures during the day in summer (&gt;40°C), with night time temperatures particularly in the cooler months sometimes reaching below 0°C, as is typical for desert regions.</p> <p>Reduced rainfall and higher than average temperature as a result of climate change could be a major threat to the site, resulting in a reduction in the frequency and extent of inundation at the wetland. Broadscale trends of increased drying, and the increased severity, frequency, and duration of drought conditions could also be a major threat (BOM 2018). However, it is not yet well understood how climate change could affect the hydrology and ecological character of Caryapundy Swamp.</p>  |
| <p><b>2.2 Geomorphic setting:</b></p> <p>Include (as appropriate):</p> <ul style="list-style-type: none"> <li>- position in the landscape/catchment/river basin/coastal zone (whether the site is in the upper/mid/lower zone of catchment, distance to coast, etc)</li> <li>- elevation above sea level</li> </ul> | <p>Caryapundy Swamp Ramsar site is in the terminal basin of the endorheic Bulloo River Catchment, varying from 77-131m above sea level in elevation. The Bulloo River is an internally draining system not connected to either the Kati Thanda Lake Eyre or Murray-Darling Basins, draining into the Bulloo Lakes, Caryapundy Swamp, and the Bulloo Overflow. It remains a free-flowing river.</p>   |
| <p><b>2.3 Soil:</b></p> <p>Describe the geology, soils and substrates, and soil biology.</p> <p>Note whether soil salinity or acid sulfate soils are likely to be an issue.</p>   | <p>The soils of Caryapundy Swamp Ramsar site are predominantly vertosols (cracking clays; 37,055 ha) and rudosols (33,663 ha), with relatively small areas of chromosols (1,028 ha), and sodosols (307 ha) limited to the west of the site. Plants growing across these substrates, as is typical of environments where resources can be limited for long periods of time, typically produce seed banks (reserves of reproductive propagules, including the oospores of charophyte algae) that can survive prolonged drought dry periods and respond quickly when water is present. While changes in hydrological regimes associated with climate change are expected, the system is typically exposed to highly pulsed drought and flood conditions over large time periods. The cracking clays are likely to have higher nutrient levels and greater soil moisture retention than the loam and sandy areas of the site. In dry conditions, large holes can form in cracking clay soils, which can accumulate seeds thereby potentially affecting vegetation patterns in the landscape, and shelter fauna, providing a cool, moist micro climate away from the heat of summer.</p> <p>Under erratic flooding and drying regimes and more broadly in the context of a drying climate, soil salinity is likely to fluctuate and may increase with drying.</p> |
| <p><b>2.4 Water regime:</b></p>   | <p>Caryapundy Swamp is part of the terminal basin of the endorheic Bulloo River Catchment. As such, rainfall</p>   |

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| <p>Water source (surface and groundwater), inflow/outflow, evaporation, flooding frequency, timing, seasonality and duration; magnitude of flow and/or tidal regime, links with groundwater</p> | <p>and flows from upstream in the Bulloo River Catchment, as well as rainfall within the site itself drive surface water hydrology. The Bulloo River is largely undeveloped upstream with limited water infrastructure to divert flows, predominantly a free-flowing river, resulting in relatively natural, pulsed, hydrological patterns in the wetlands of the site. Importantly, the Bulloo River has a requirement under the Queensland Water Act 2000 that mean annual flow during the modelled (simulation) flow periods must be at least 99% of the pre-development flow (QLD Government 2017).</p> <p>Situated in one of the driest regions of NSW, flows and rainfall which fill the wetlands at the site are infrequent. There has been no regular monitoring of water quality or depth at the site, and the best available data on flows into the wetlands can be derived from Autumnvale, QLD upstream on the Bulloo River.</p> <p>Data 1968-2020 from Autumnvale on the Bulloo River (200 km upstream, but indicative of long-term trends in river flows) indicate larger flows predominantly occur in summer and autumn, compared to winter and spring (QLD Government 2021). Flow volume at Autumnvale varies, from no flow periods, to a maximum of 171.66 GL/day on 8th March 2010 (QLD Government 2021). Large flows in the Bulloo River can reach Caryapundy Swamp and lead to extensive inundation which can last for extended periods until eventually drying.</p> |
| <p><b>2.5 Connectivity of surface and groundwater</b></p>   | <p>There are no available data on surface and groundwater connectivity, but it is likely important connections exist.</p>  |
| <p><b>2.6 Stratification and mixing regime</b></p>  | <p>No available data.</p>  |
| <p><b>2.7 Sediment regime</b><br/>(erosion, accretion, transport and deposition of sediments)</p>   | <p>Sediment from upstream in the Bulloo River and Thompsons, Mt Wood, and Twelve Mile Creek are likely deposited in the wetlands of Caryapundy Swamp Ramsar site during high flow periods, and local rainfall likely drives transport and deposition of sediments from raised areas (e.g., dunes) into low-lying wetlands, interdunal swales, and claypans.</p>  |
| <p><b>2.8 Water turbidity and colour</b></p>  | <p>No available data.</p>  |
| <p><b>2.9 Light</b> - reaching the wetland (openness or shading); and attenuation in water</p>  | <p>The wetlands of Caryapundy Swamp Ramsar site are highly exposed to sunlight. Dense vegetation in some swamps (e.g., lignum <i>Duma florulenta</i> swamps) provides some shade, as do the limited regions of wooded creeks (e.g., river red gum <i>Eucalyptus camaldulensis</i>). However, the wetlands are shallow, with water retention subject to high evaporative loss particularly in summer months when ambient temperatures are high.</p>   |
| <p><b>2.10 Water temperature</b></p>  | <p>No available data.</p>  |

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| <p><b>2.11 Water pH</b></p> <p>Note whether acid (pH &lt;5.5), circumneutral (pH 5.5 – 7.4), alkaline (pH &gt; 7.4). Does this vary (e.g. seasonally)?</p>  | <p>No available data.</p>   |
| <p><b>2.12 Water salinity</b></p> <p>Note whether fresh (&lt;0.5 g/L), mixohaline (brackish)/ mixosaline (0.5 – 30 g/L), euhaline/ eusaline (30-40 g/L), hyperhaline/ hypersaline (&gt; 40g/L).</p> <p>Does this vary over time and/or across the site?</p> | <p>Both saline and freshwater wetlands exist across the site which vary spatially and temporally. As flows enter the site from the Bulloo River and along the creeks to the west, they are predominantly fresh, but become increasingly saline as drying occurs, also dependent on where water settles (e.g., fresh water settled on saline claypans will become more saline than water settled in lignum swamps). No quantitative data are available.</p>  |
| <p><b>2.13 Dissolved gases in water</b></p>   | <p>No available data.</p>   |
| <p><b>2.14 Dissolved or suspended nutrients in Water</b></p> <p>Note whether eutrophic, mesotrophic, oligotrophic, or dystrophic. Does this vary over time and/or across the site?</p>  | <p>No available data.</p>   |
| <p><b>2.15 Dissolved organic carbon</b></p>   | <p>No available data.</p>   |
| <p><b>2.16 Redox potential of water and sediments</b></p>   | <p>No available data.</p>   |
| <p><b>2.17 Water conductivity</b></p>   | <p>No available data.</p>   |
| <p><b>2.18 Other</b></p>  |   |
| <p><b>3. Ecological components</b></p>  |   |
| <p><b>3.1 Area, boundary and dimensions:</b> Site shape (cross-section and plan view), boundaries, area, area of water/wet area (seasonal max/min where relevant), length, width, depth (seasonal max/min where relevant)</p>                               | <p>Caryapundy Swamp Ramsar site is ~ 50 km ENE east of Tibooburra in far north-western New South Wales, Australia. The wetland and waterways of Caryapundy Swamp and the Bulloo Overflow that are within the Narriearra Caryapundy Swamp National Park boundary are part of the Ramsar site. The site does not include the entire area of the National Park. The area of wetland for nomination is 70,176.24 ha, measuring a maximum length of 47.26 km from north to south, and a maximum width of 37.4 km east to west. The site borders Queensland along the dingo fence to the north, and Pindera Downs Aboriginal Area to the south. The Ramsar site is restricted in extent by the boundaries of the Narriearra Caryapundy Swamp National Park, which borders Queensland to the north (delineated by the dingo fence), pastoral stations to the east, west, and south, except for Pindera Downs Aboriginal Area which borders a section of the park to the south. The site map and shapefile for the site provide detailed and exact spatial boundaries of the site, which is irregularly shaped, following flood extent boundaries (derived from Crossman and Li 2015). A complete set of coordinates for the site are provided in Attachment 4.</p> |
| <p><b>3.2 Habitat types:</b> including Ramsar wetland types and comments on rarity, etc</p>   | <p>Broadly, the site hosts three Ramsar wetland types, and areas of terrestrial habitat. The Ramsar wetland</p>   |

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|  | <p>types include:</p> <p>Seasonal/intermittent saline/brackish/alkaline lakes and flats (R; 68,244.2 ha);</p> <p>Seasonal/intermittent/irregular rivers/streams/creeks (N; 830.1 ha); and</p> <p>Seasonal/intermittent freshwater lakes (over 8 ha) (P; 185.7 ha).</p> <p>Seasonal/intermittent saline/brackish/alkaline lakes and flats consist of a number of vegetation types including swamp canegrass (<i>Eragrostis australasica</i>), lignum (<i>Duma florulenta</i>), nitre goosefoot (<i>Chenopodium nitrariaceum</i>), and golden goosefoot (<i>Chenopodium auricomum</i>) vegetated wetlands which provide critical habitat for aquatic fauna.</p> <p>Seasonal/intermittent/irregular rivers/streams/creeks are largely vegetated by trees including river red gum (<i>Eucalyptus camaldulensis</i>), gidgee (<i>Acacia cambagei</i>), black box (<i>Eucalyptus largiflorens</i>), and coolabah (<i>Eucalyptus coolabah</i>).</p> <p>Seasonal/intermittent freshwater lakes (over 8 ha) occur mostly in the northern section of Caryapundy Swamp within the site, including areas of open water, sedgelands, and rats tail couch (<i>Sporobolus mitchellii</i>) sod grasslands.</p> <p>Terrestrial habitats consisting of chenopod shrublands, gibber grasslands, and dune mulga and whitewood – rosewood communities make up most of the terrestrial areas.</p> |
| <p><b>3.3 Key habitat areas &amp; habitat connectivity<sup>1</sup></b></p> <p>Include description of key habitat areas for feeding, breeding, roosting, nesting, nursery sites, refugia (e.g. in drought)</p> <p>Include information about connectivity between the various areas of habitat</p> | <p>Nitre goosefoot (<i>Chenopodium nitrariaceum</i>), golden goosefoot (<i>Chenopodium auricomum</i>), lignum (<i>Duma florulenta</i>) and swamp canegrass (<i>Eragrostis australasica</i>) communities which dominate much of the wetland areas of the site provide critical breeding and foraging habitat for the Bulloo grey grasswren (<i>Amytornis barbatus barbatus</i>), as well as many waterbirds. Even during dry periods, these sites provide a refuge for the Bulloo grey grasswren which is dependent on the environment created by the habitat, rather than the water.</p> <p>Aquatic fauna including waterbirds, frogs, and invertebrates (e.g., shield shrimps <i>Triops australiensis</i>) are also dependent on the ephemeral wetlands scattered throughout depressions in the dunes and stony landscapes. These regions host varying vegetation communities (e.g., lignum, nitre goosefoot, golden goosefoot, swamp canegrass, sedgelands) which in turn promote and support diverse aquatic faunal communities.</p> <p>Grasslands and shrublands on floodplains and rises support habitat for the plains-wanderer (<i>Pedionomus</i></p>  |

<sup>1</sup> Refer to the definition of ecological connectivity from the Convention on the Conservation of Migratory Species of Wild Animals (included at Attachment 3).

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|  | <p><i>torquatus</i>) as well as other important bird species in the region including flock bronzewing (<i>Phaps histrionica</i>) and spotted harrier (<i>Circus assimilis</i>).</p> <p>Large riparian trees along creeks, channels, and open woodland floodplain such as coolabah (<i>Eucalyptus coolabah</i>) which are the predominant hollow bearing species on the site provide critical nesting and roosting habitat for birds and bats, including budgerigars (<i>Melopsittacus undulatus</i>), as well as other parrots.</p> <p>Old man saltbush (<i>Atriplex nummularia</i>) is widespread across the site, providing dense shrub cover within and around Lignum swamps, which is likely important for small birds including the Bulloo grey grasswren and redthroat (<i>Pyrrholaemus brunneus</i>). Much of the Old man saltbush is large and in good condition, indicating this species has been spared from severe grazing.</p> <p>As part of the terminal basin of the endorheic Bulloo River Catchment, flows transport nutrients and biota from upstream into Caryapundy Swamp, some of which can be further transported through to the Bulloo Overflow. Aquatic fauna can move through this catchment when the creeks, swamps, and lakes are full (e.g., fish), while plant seeds, particularly aquatic plants, can also be transported downstream. Rainfall can lead to nutrient and seed transport from rises in the landscape to depressions, further leading to connectivity between these habitat types. Nomadic waterbirds use these wetlands when wet and may travel thousands of kilometres from other wetlands across Australia. Internationally migratory birds from the Northern Hemisphere annually migrate to the site during their non-breeding seasons. Overall, Caryapundy Swamp represents a highly connected and functional wetland system.</p> |
| <p><b>3.4 Ecological communities</b><br/>(including comments on threatened communities/<br/>threatened species within the community)</p> | <p>No ecological communities of national or international importance are found within Caryapundy Swamp Ramsar site.</p> <p>While not listed as threatened ecological communities under Australian legislation, the following communities contribute significantly to the ecological character of Caryapundy Swamp Ramsar site, providing critical habitat for threatened and diverse faunal and floral communities of the site:</p> <ul style="list-style-type: none"> <li>• <b>Arid shrublands (Chenopod sub-formation) - Riverine chenopod shrublands - Chenopod low open shrubland:</b> ephemeral partly derived forbland saline wetland on occasionally flooded pale clay scalds in the NSW North Western Plains.</li> <li>• <b>Semi-arid Floodplain Grasslands - Mitchell Grass grassland:</b> chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones.</li> <li>• <b>North-west Floodplain Woodlands:</b> Coolabah open woodland wetland with chenopod/grassy ground</li> </ul>   |



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|   | <p>cover on grey and brown clay floodplains.</p> <p>The following plant community types (NSW DPIE 2019) are considered critical components of the ecological character of the site in low-lying wetland regions, providing critical habitat for wetland and wetland vegetation-dependent fauna including waterbirds, the Bulloo grey grasswren (<i>Amytornis barbatus barbatus</i>), likely fish and frogs, and other species:</p> <ul style="list-style-type: none"> <li>• <b>Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains</b></li> <li>• <b>Golden goosefoot shrubland wetland in swamps of the arid and semi-arid (hot summer) zones</b></li> <li>• <b>Nitre goosefoot shrubland wetland on clays of the inland floodplains</b></li> <li>• <b>Lignum shrubland wetland on floodplains and depressions of the Mulga Lands Bioregion, Channel Country Bioregion in the arid and semi-arid (hot) climate zones</b></li> <li>• <b>Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)</b></li> </ul>   |
| <p><b>3.5 Key plant species and communities</b><br/>(including comments on threatened species)</p>  | <p>Survey effort for plant species and communities within Caryapundy Swamp Ramsar site have been limited and relatively recent. Across Narriearra Caryapundy Swamp National Park, a total of 351 native plant species have been recorded, which includes sampling from both within and outside the proposed Ramsar site (GBIF 2021; Marshall 2021). Within the Ramsar site and across the National Park, no plant species listed under the EPBC Act or the IUCN Red List have been recorded. However, three state-listed threatened species found on floodplains (a saltbush (<i>Atriplex sturtii</i>), cow vine (<i>Ipomea polymorpha</i>), and bindweed (<i>Convolvulus tedmoorei</i>)) have been recorded within the National Park, with the saltbush recorded within the Ramsar site.</p> <p>Several plant species found in Narriearra Caryapundy Swamp National Park are critical for forming key wetland habitats which significantly contribute to the ecological character of the site. These include: lignum (<i>Duma florulenta</i>), golden goosefoot (<i>Chenopodium auricomum</i>), nitre goosefoot (<i>Chenopodium nitrariaceum</i>), and swamp canegrass (<i>Eragrostis australasica</i>). Further communities of significant importance are detailed in section 3.3.</p> |
| <p><b>3.6 Key animal species and communities</b><br/>(including comments on threatened and migratory species and critical habitat [breeding, roosting, nursery, refugia] for these species)</p> | <p>Narriearra Caryapundy Swamp National Park provides habitat for many species, with 185 native fauna and 351 native plant species recorded within the National Park (Marshall 2021), including: 165 bird species (52 waterbirds), five frogs, nine mammals, and 12 reptiles (Marshall 2021). Within the Ramsar site</p>   |

between January 2010 and November 2021, 133 native plant species and 118 native animal species were recorded, including: 100 birds (38 waterbirds), 4 mammals, and 11 reptiles. The lack of recent fish, frog, and invertebrate records within the site is due to lack of survey effort for these taxa. However, the National Park and Ramsar site has rarely been surveyed, and the number of species currently recorded is almost certainly substantially lower than the true number, which will be tracked through future updates of the Ramsar Information Sheet.

Since 2010, the site has provided habitat for three fauna species that are listed as nationally (under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)) or internationally (under the IUCN Red List), including:

- Bulloo grey grasswren (*Amytornis barbatus barbatus*) (EPBC –endangered, IUCN - near threatened)
- curlew sandpiper (*Calidris ferruginea*) (EPBC – critically endangered, IUCN – near threatened)
- red knot (*Calidris canutus*) (EPBC –endangered, IUCN - near threatened)

There are records of two listed threatened species from within the National Park but outside of the Ramsar site. These species are also likely to occur within the Ramsar site. They include:

- grey falcon (*Falco hypoleucos*) (EPBC – vulnerable, IUCN - vulnerable)
- plains-wanderer (*Pedionomus torquatus*) (EPBC – critically endangered, IUCN - critically endangered)

While not currently listed as threatened nationally or internationally, the letter-winged kite (*Elanus scriptus*) is listed under IUCN as near threatened. It occurs within the National Park, and is likely to occur within the Ramsar site.

Aerial surveys across the entire area, comprising the connected Bulloo Overflow in 1990 recorded more than 100,000 waterbirds, including over 38,000 grey teal (*Anas gracilis*), over 29,000 pink-eared duck (*Malacorhynchus membranaceus*), and over 1,000 freckled duck (*Stictonetta naevosa*) (Kingsford et al. 1994). The site provides breeding and nonbreeding habitat for a number of waterbird species including pink-eared duck, grey teal, black-tailed native-hen (*Tribonyx ventralis*) and brolga (*Grus rubicunda*).

Internationally migratory species recently observed in the Ramsar site include: Caspian tern (*Hydroprogne caspia*), curlew sandpiper (*Calidris ferruginea*), glossy ibis (*Plegadis falcinellus*), gull-billed tern (*Gelochelidon nilotica*), marsh sandpiper (*Tringa stagnatilis*), red knot (*Calidris canutus*), ruddy turnstone (*Arenaria interpres*), and sharp-tailed

sandpiper (*Calidris acuminata*). The common greenshank (*Tringa nebularia*) has historically been recorded at the site and likely still occurs. Caryapundy Swamp acts as an important 'stop-over' site, particularly for migratory shorebirds including: curlew sandpiper, marsh sandpiper, red knot, ruddy turnstone, and sharp-tailed sandpiper. These species are listed as migratory under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and international migratory bird agreements. In general, inland wetlands in Australia provide suitable habitat for brief periods every few years, depending on flooding and rainfall cycles. However, they are still of major importance to migratory shorebirds, which need to refuel at these sites along their migratory route. It is understood that recruitment to populations is enhanced during years when inland wetland habitats are available to support feeding opportunities for internationally migratory waterbirds.

Under the *Biodiversity Conservation Act 2016* (NSW), 12 bird species and one reptile which were recently recorded in Caryapundy Swamp Ramsar site are listed as threatened, including: black falcon (*Falco subniger*), flock bronzewing (*Phaps histrionica*), redthroat (*Pyrrholaemus brunneus*), blacksoil whipsnake (*Demansia rimicola*), and a saltbush (*Atriplex sturtii*) and others (Marshall 2021). While not recorded within the proposed Ramsar site, it is probable the five frog species recorded in the National Park also occur in the Ramsar site, including: crucifix frog (*Notaden bennettii*), Suddell's frog (*Neobatrachus sudellae*), wrinkled toadlet (*Uperoleia rugosa*), knife-footed frog (*Cyclorana cultripes*), and water-holding frog (*Cyclorana platycephala*). These species contribute to the biodiversity of the site.

The site represents the largest single management area for threatened Bulloo grey grasswren, with nearly 90% of suitable habitat in New South Wales situated in Narriearra Caryapundy Swamp National Park. The subspecies was first collected at "Teurika" (on what is now Narriearra Caryapundy Swamp National Park, likely within the Ramsar site) in 1967 (Favoloro and McAvery 1967), but available habitat has since declined by 90% across their range which now represents only 8,000 ha (Hardy 2010). Letter-winged kite were recorded breeding in the national park in 2021.

The large wetland area of Caryapundy Swamp Ramsar site also plays a crucial role for the survival of many animal species in the immediate and surrounding areas. Nomadic waterbird species known to move long distances such as the grey teal and pink-eared duck have been recorded at the site, likely using it to survive periods of drought and potentially to

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|  | <p>breed.</p> <p>Caryapundy Swamp acts as a refuge for waterbirds and other fauna during dry periods and/or as other wetlands dry. Waterbirds tend to congregate at inland wetlands, often in response to flooding conditions. As these areas dry out, waterbirds and other wetland dependent species will move to areas which hold water for the longest period of time. As the site is in the terminal basin of the endorheic Bulloo River Catchment, it acts as a drought refuge for wetland species – when water is present the broader area can support over 100,000 waterbirds (Kingsford et al. 1994). The wetlands within the site fill primarily from flows down the Bulloo River which can fill Caryapundy Swamp, and intermittently the southern wetlands can also fill from flows in the creeks from the west. After large floods and/or rainfall, water can remain in the site for over a year.</p> <p>Many waterbirds in western NSW, particularly ducks, breed on temporary waters and then move to more permanent waters to survive dry periods. The wetlands of Caryapundy Swamp are an important source of water for other fauna species such as arid desert birds. An estimated 40% of Australian desert land birds are thought to be water dependent.</p> <p>While no direct surveys of the site for fish exist, it is likely the Caryapundy Swamp Ramsar site hosts an important fish biodiversity, including the Bulloo golden perch (<i>Macquaria</i> sp. A subsp. B), which is endemic to the Bulloo River and proliferates in flood years. Caryapundy Swamp is likely to be a significant nursery habitat for this species and supports recruitment in consecutive flood years. Likewise, there is a representative fish community including various catfish, spangled perch etc. There are no exotic fish species in the catchment and most notably, carp (<i>Cyprinus carpio</i>) are absent (Negus et al. 2015). The fish community is considered intact and is of significant ecological value. The river snail (<i>Notopala sublineata</i>) is also found in the Bulloo Catchment, which is rare in the nearby Murray-Darling Basin. Molluscs and invertebrates will form the basis of the food chain at the site and their protection is paramount in sustaining higher order species.</p> |
| <p><b>3.7 Other</b></p>                  |   |
| <p><b>4. Ecological processes</b></p>    |   |
| <p><b>4.1 Primary production (S)</b></p> | <p>Primary production is most prolific at Caryapundy Swamp when large flows from the Bulloo River, as well as those from Thompsons, Mt Wood, and Twelve Mile Creeks and significant rainfall events, reach the wetlands of the site. Flows bring water which is the key limiting resource in this dry landscape, which in turn support seed germination and growth of</p>   |

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|   | vegetation across the site.   |
| <b>4.2 Nutrient cycling (S)</b>   | Nutrient cycling within the site has not been investigated in detail. However, key nutrients are likely transported into the site via flows from the Bulloo River and Thompsons, Mt Wood, and Twelve Mile Creeks, as well as some associated with runoff from dunes and elevated areas into depressions, during rainfall events. Further nutrient input into the system likely occurs when highly abundant faunal communities (e.g., waterbirds) arrive to forage and breed in the wetlands of the site. Nitrates and ammonium from guano likely represents a significant nitrogen input during these periods into this ecosystem. Nutrient input and uptake decline after the wetlands have dried, primary productivity slowed, and nomadic/ephemeral faunal communities departed to refuges or suitable habitat elsewhere.  |
| <b>4.3 Carbon cycling</b>   | Carbon cycling within the site has not been investigated in detail. However, large fluxes in carbon at the site would occur with the pulsed dynamics of water availability and primary productivity at the site, associated with flows from the Bulloo River, its tributaries, local creeks and rainfall. Arid temporary wetlands are typically highly productive when suitably wet, and sustain biodiversity through drying stages, but become relatively unproductive once dry. Largely, this is due to populations of nomadic and ephemeral fauna species (e.g., waterbirds, fish, small mammals, and frogs), which can increase during wet periods, but decline substantially during dry periods.   |
| <b>4.4 Animal reproductive productivity</b>   | Nomadic, irruptive, and ephemeral animals capitalise on productive conditions in arid regions across Australia. The Bulloo Overflow has supported over 100,000 waterbirds during wet periods (Kingsford et al. 1994), some of which were recorded breeding, and with further monitoring of the site under National Park management, counts and records of breeding waterbirds at the site will become available. Invertebrates, and subsequently frogs and fish likely breed rapidly in response to productive conditions, which in turn promotes the breeding of waterbirds. Specifically, crustaceans and aquatic insects are important food sources for waterbirds such as herons, egrets, ducks and spoonbills, especially during the large breeding events that may follow a large flood. Small mammals which have not been comprehensively surveyed on the site can also respond rapidly to productive conditions and breed prolifically. |
| <b>4.5 Vegetational productivity, pollination, regeneration processes, succession, role of fire, etc.</b> | There are no available data on vegetation productivity and associated processes at the site. Broadly however, both terrestrial and aquatic flora respond rapidly to water when available in arid/semi-arid landscapes. Seeds in the soil seedbank, particularly for annual and short-lived terrestrial and aquatic plants, typically germinate and grow rapidly in response to suitable   |

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|   | water availability from rainfall and flooding.  |
| <p><b>4.6 Notable species interactions</b>, including grazing, predation, competition, diseases and pathogens</p> | <p>Livestock grazing occurred on the site, however many areas have sustained a diverse seedbank and large shrubs, indicating the effects of grazing have been limited across many habitats (Marshall 2021). Notably, prior management of grazing of the site was free range, open gate, and did not exceed maximum stocking rates, which has allowed habitats to persist through highly pulsed wet-dry conditions (Marshall 2021). Livestock have been removed from the site, however limited vegetation damage associated with grazing may remain for many years.</p> <p>Invasive animals recorded on the site include only three mammals: European fox (<i>Vulpes vulpes</i>), European rabbit (<i>Oryctolagus cuniculus</i>), and feral pig (<i>Sus scrofa</i>). Under the EPBC Act and the <i>Biodiversity Conservation Act 2016</i> all these species are listed as key threatening processes:</p> <ul style="list-style-type: none"> <li>-Predation by European foxes;</li> <li>-Predation, habitat degradation, competition and disease transmission by feral pigs;</li> <li>-Competition and grazing by feral European rabbits.</li> </ul> <p>Pigs and rabbits have been in low densities within the National Park in recent times (Marshall 2021). Other species likely to occur in the proposed Ramsar site (though yet to be recorded) include: feral cats (<i>Felis catus</i>), feral goats (<i>Capra hircus</i>), and feral horses (<i>Equus ferus</i>), all of which are also listed as key threatening processes. Updates in the presence and impact of these species within the Ramsar site are likely in the future.</p> |
| <p><b>4.7 Notable aspects concerning animal and plant dispersal</b></p>   | <p>Highly nomadic and ephemeral populations of wetland species, such as waterbirds which can travel thousands of kilometres to exploit wetlands, are a key feature of the biodiversity of Caryapundy Swamp Ramsar site. While not studied explicitly, the transport of seeds and invertebrate eggs in flows in the Bulloo River and Twelve Mile Creek also likely occurs during floods. Waterbirds are known to transport eggs and seeds (Green et al. 2008).</p>   |
| <p><b>4.8 Notable aspects concerning migration</b></p>  | <p>Internationally migratory species recently observed in the Ramsar site include: Caspian tern (<i>Hydroprogne caspia</i>), curlew sandpiper (<i>Calidris ferruginea</i>), glossy ibis (<i>Plegadis falcinellus</i>), gull-billed tern (<i>Gelochelidon nilotica</i>), marsh sandpiper (<i>Tringa stagnatilis</i>), red knot (<i>Calidris canutus</i>), ruddy turnstone (<i>Arenaria interpres</i>), and sharp-tailed sandpiper (<i>Calidris acuminata</i>). The common greenshank (<i>Tringa nebularia</i>) has historically been recorded at the site and likely still occurs.</p> <p>Caryapundy Swamp acts as an important 'stop-over' and feeding site, particularly for migratory shorebirds</p>  |

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|   | <p>including: curlew sandpiper, marsh sandpiper, red knot, ruddy turnstone, and sharp-tailed sandpiper. These species are listed as migratory under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) and international migratory bird agreements. In general, inland wetlands in Australia provide suitable habitat for brief periods every few years, depending on flooding and rainfall cycles. However, they are still of major importance to migratory shorebirds, which need to refuel at these sites along their migratory route. It is understood that recruitment to populations is enhanced during years when inland wetland habitats are available to support feeding opportunities for internationally migratory waterbirds (Nebel et al. 2008).</p> |
| <p><b>4.9 Pressures, vulnerabilities and trends</b><br/>concerning any of the above, and/or concerning ecosystem integrity</p>  | <p>Reduced rainfall and higher than average temperature as a result of climate change could be a major threat to the ecological character of Caryapundy Swamp Ramsar site, resulting in a reduction in the frequency and extent of inundation at the wetland. Broad scale trends of increased drying, and the increased severity, frequency, and duration of drought conditions could also be a major threat (BOM 2018). However, it is not yet well understood how climate change will specifically affect local conditions at Caryapundy Swamp Ramsar site. Any development of the Bulloo River (e.g. building of dams and diversion of water) could also threaten the area.</p>   |
| <b>5. Ecosystem services</b>  |  |
| <b>5.1 Provisioning services</b>  |  |
| <p><b>5.1.1 food for humans</b><br/>(e.g. fish, molluscs, grains)</p>   | Not applicable currently.  |
| <p><b>5.1.2 fresh water</b><br/>(e.g. drinking water for humans and/or livestock, water for agriculture, water for industry, water for hydro-electricity energy production)</p>                             | Caryapundy Swamp Ramsar site is situated within the terminal basin of the endorheic Bulloo River Catchment, and drains into the Bulloo Overflow, which is situated on leasehold land on which livestock are grazed. This likely represents an important water source for livestock, which the wetlands of the site directly influence.   |
| <p><b>5.1.3 wetland non-food products</b><br/>(e.g. timber, fibre, peat, livestock fodder, reeds)</p>   | Not applicable.  |
| <p><b>5.1.4 biochemical products</b><br/>(e.g. extraction of material from biota)</p>   | Not applicable.  |
| <p><b>5.1.5 genetic materials</b><br/>(e.g. medicinal products, genes for tolerance to certain conditions (e.g. salinity), genes for resistance to plant pathogens, ornamental species (live and dead))</p> | Not applicable.  |
| <b>5.2 Regulating Services</b>  |  |

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| <p><b>5.2.1 Maintenance of hydrological regimes</b><br/>(e.g. groundwater recharge and discharge; storage and delivery of water as part of water supply systems for agriculture and industry)</p>   | <p>The ecological character of the site is defined by erratic, unpredictable, and ephemeral water resources via flows and/or rainfall into the site. The site is a representative region of the terminal basin of the endorheic Bulloo River Catchment and is fundamental for the capture, throughflow, and drying of water which defines the site's ecological character.</p> <p>While not analysed on the site, it is likely connections between surface and groundwater through recharge and discharge processes are significant regulating services within the larger wetlands of the site (e.g., Caryapundy Swamp).</p> |
| <p><b>5.2.2 Erosion control</b><br/>(e.g. soil, sediment and nutrient retention)</p>  | <p>Not applicable.</p>   |
| <p><b>5.2.3 Pollution control and detoxification</b><br/>(e.g. water purification/ waste treatment or dilution)</p>   | <p>Not applicable.</p>   |
| <p><b>5.2.4 Climate regulation</b><br/>(e.g. local climate regulation/ buffering of change; regulation of greenhouse gases, temperature, precipitation and other climatic processes)</p>            | <p>Not applicable.</p>   |
| <p><b>5.2.5 Biological control of pests and diseases</b><br/>(e.g. support of predators of agricultural pests, such as birds feeding on locusts).</p>   | <p>Caryapundy Swamp Ramsar site can support waterbirds such as straw-necked ibis, which may (but have not yet been observed to) breed at the site, and which feed on locusts.</p>  |
| <p><b>5.2.6 Hazard reduction</b><br/>(e.g. flood control, flood storage; coastal shoreline and riverbank stabilisation and storm protection).</p>   | <p>The large creeks, channels, depressions, and wetlands of Caryapundy Swamp Ramsar site control the distribution of water during large rainfall and flood events. This provides a predictability associated with the distribution of water during floods critical to informing management and structural development of infrastructure on the site as it becomes a national park.</p>   |
| <p><b>5.3 Supporting Services</b></p>   |  |
| <p><b>5.3.1 Biodiversity</b><br/>(e.g. supports a variety of all life forms including plants, animals and microorganisms, the genes they contain and the ecosystems of which they form a part).</p> | <p>Caryapundy Swamp Ramsar site supports a high diversity of life forms, particularly plants and birds (see section 3. <i>Ecological Components</i>). While invertebrates have not been comprehensively surveyed, this community is likely to be highly diverse and important in the maintenance of ecosystem functioning and processes at the site.</p>   |
| <p><b>5.3.2 Soil formation</b><br/>(e.g. sediment retention, accumulation of organic matter)</p>  | <p>While not explicitly studied at the site, as part of the terminal basin of the endorheic Bulloo River, as well as Thompsons, Mt Wood, and Twelve Mile Creeks, with some low-lying areas subject to runoff from dunes and other rises, sediments and organic matter retention in wetlands and deposition from upstream are likely to be important services contributing to the formation and ecology of wetland soils (e.g., cracking clays), thereby influencing the ecological character of the site.</p>  |
| <p><b>5.3.3 Nutrient cycling</b><br/>(e.g. storage, recycling, processing and acquisition)</p>  | <p>While not explicitly studied at the site, transport, and nitrogen and carbon cycling are likely to be critical ecosystem services especially during wet periods (as</p>   |



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| of nutrients; carbon storage/ sequestration)   | detailed in sections 4.2-3).  |
| <b>5.3.4 Pollination</b><br>(e.g. support for pollinators)   | There are likely several plants and pollinators at the site influencing the ecological character of the site for which there is no information currently.   |
| <b>5.4 Cultural Services</b>   |   |
| <b>5.4.1 Recreation and tourism</b><br>(e.g. recreational hunting and fishing; water sports and activities; picnics, outings, touring; nature observation and nature-based tourism)  | Caryapundy Swamp Ramsar site has in the past (as Narriearra Station), and will continue to support visitors camping and/or visiting the site, particularly for birdwatching, but also other nature-based outings. As a national park, it is accessible to the public and although remote, will attract travellers (e.g., grey nomads) and tourists. Birdwatchers have historically visited, and with increased accessibility likely continue to visit, the site attracted by the chance of observing the Bulloo grey grasswren and a diverse community of other arid/semi-arid and wetland species.   |
| <b>5.4.2 Spiritual and inspirational</b><br>(e.g. inspiration; cultural heritage (historical and archaeological; contemporary cultural significance, including for arts and creative inspiration, and including existence values)  | There is significant evidence of historical and widespread use of Narriearra Caryapundy Swamp National Park by First Nations Australians, specifically the Malyangapa, Karengappa, and Wongkumara nations, and potentially others. Evidence of historical occupation and use of Narriearra Caryapundy Swamp National Park include hearths, stone arrangements/ceremonial sites, stone quarries, stone tools, burial sites, natural/mythological sites, and modified trees. The persistence of artifacts in the landscape are of continuing significance to both First Nations Australians and others, conserved in perpetuity in the national park. Details on the cultural heritage values of the site have been recorded in a technical report (Venn et al. 2021) and unpublished notes (Bonyhady 2021).  |
| <b>5.4.3 Scientific and educational</b><br>(e.g. educational activities and opportunities; important knowledge systems, importance for research (scientific reference area or site); long-term monitoring site; major scientific study site; 'type location' for a taxon). | <p>Scientific research has been conducted in the past on Narriearra Caryapundy Swamp National Park (formerly Narriearra Station), largely within the Caryapundy Swamp Ramsar site. Specifically, research into the ecology and conservation of the Bulloo grey grasswren continues at the site, through regular bird banding and in recent years tracking research (e.g., Hardy 2010; Farrell et al. 2018; 2019). The site represents a type location for this subspecies, first collected at "Teurika" (on what is now Narriearra Caryapundy Swamp National Park) in 1967 (Favoloro and McAvery 1967). This subspecies was first studied at the site between 1984 – 1996, and a comprehensive banding effort has occurred since 2000, representing a long-term monitoring site for the subspecies, which is threatened under state and federal legislation (Farrell et al. 2018).</p> <p>Educational opportunities, particularly through tertiary institutions are likely to increase as the site is established as a national park. As the site represents a critically important terminal basin region of a river system in relatively natural condition in arid Australia, which presents valuable, significant, and important research opportunities in the context of landscape and</p> |

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|   | ecosystem management and monitoring.  |
| <b>5.5 Other ecosystem services</b> (not included above)<br>(e.g. as refugia)   | Caryapundy Swamp Ramsar site represents an important drought refuge and critical habitat for diverse and pulsed flora and faunal communities. As the site has recently been listed as a national park under NSW legislation, there is likely to be an increase of monitoring, research, and educational activities and opportunities at the site over the coming years. |
| <i>Note. For nature conservation value as an ecosystem 'service' (S), see items under 'components' and 'processes' above)</i> |   |

| <b>6. Other factors affecting the ecological character</b>  |  |
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| <p><b>6.1 Climate</b></p> <p>If changing climatic conditions are affecting the site, include the nature of these changes. This may include climatic variability (e.g. ENSO effects) and/or climate change.</p>      | <p>Broadly, the site is likely to be subject to a pattern of increased drying, and the increased severity, frequency, and duration of drought conditions (BOM 2018). While the local effects of these patterns on the ecosystem supported within Narriearra Caryapundy Swamp National Park have not been directly investigated, it is likely that increases in drought periods will increase pressure on the site, and dependence on the site as a refuge during these conditions may increase. With increased monitoring effort, the way in which climate change will affect the site will become clearer.</p> <p>Caryapundy Swamp is in one of the driest regions of NSW. Mean annual rainfall is 225 mm, with slightly higher averages in summer (22-29 mm/ month) and lower in winter (11-16 mm/ month). Average minimum monthly temperatures range from 6°C in winter to 21°C in summer. Average monthly maximum temperatures range from 19°C in winter to 35°C in summer (BoM 2021).</p> <p>According to BoM and CSIRO (2020) projections for Australia's NRM Regions (Rangelands North), average temperatures will continue to increase in all seasons with more hot days and warm spells projected. Changes to rainfall are possible but unclear. There is likely to be increased intensity of extreme rainfall events.</p> <p>Reduced rainfall and higher than average temperature could be a major threat to Caryapundy Swamp, reducing the frequency and extent of inundation at the wetland. Broadscale trends of increased drying, and the increased severity, frequency, and duration of drought conditions could be a major threat.</p> |
| <p><b>6.2 Flows</b></p> <p>If changes to flows to the wetland (increased or reduced flows) due to land use change, climate change or other factors are affecting the site, include the nature of these changes.</p> | <p>Both monthly and annual flows are decreasing in the Bulloo River, likely associated with increased drying and the increased severity, frequency, and duration of drought conditions (BOM 2018). Specifically, annual flows in summer which provide the majority of flows from the Bulloo River Catchment have decreased over</p>  |

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|  | <p>a 52-year period from 1968-2020. As many aquatic and water-dependent species are dependent on inundating flows to create wetlands on the site for breeding and foraging, long-term and ongoing declines in flows present a significant threat to the ecological character of the site. As water infrastructure and diversion practices in the Bulloo River Catchment are relatively limited, it is critical to maintain the relatively natural state of flows in this system under the increasing threats of drying and flow reductions associated climate change.</p>   |
| <p><b>6.3 Land use</b></p> <p>Include information about features of the surrounding landscape and land use practices that might affect the site (e.g. urban developments, high population densities, agricultural, commercial or industrial land use).</p> | <p>As part of Narriearra Caryapundy Swamp National Park, Caryapundy Swamp Ramsar site will not be subject to high levels of industrial, commercial, or urban land use activities, and the land will be managed for conservation purposes. Relatively minor tourism and recreation infrastructure may lead to very minor localised disturbance.</p> <p>The surrounding areas includes the wetlands of the Bulloo Lakes to the north (in Queensland) and the Bulloo Overflow to the south-east, while the rest of the surrounding area consists largely of non-wetland dryland habitat types. Much of the Bulloo Lakes are on private land, managed for conservation within the Bulloo Downs Nature Refuge, while the Bulloo Overflow is on leasehold land. The surrounding areas of non-wetland habitat largely feature arid shrublands on leasehold pastoral properties.</p>  |
| <p><b>6.4 Invasive species</b></p> <p>Include any key invasive species that are present in the site and/ or surrounding landscape which are likely to cause significant impacts over time if not appropriately managed.</p>                                | <p>Invasive animals recorded on the site include only three mammals: European fox (<i>Vulpes vulpes</i>) and rabbit (<i>Oryctolagus cuniculus</i>), and feral pig (<i>Sus scrofa</i>). Under the EPBC Act and the <i>Biodiversity Conservation Act 2016</i> all these species are listed as key threatening processes:</p> <ul style="list-style-type: none"> <li>• Predation by European foxes;</li> <li>• Predation, habitat degradation, competition and disease transmission by feral pigs;</li> <li>• Competition and grazing by feral European rabbits.</li> </ul> <p>Pigs and rabbits have been in low densities within the National Park in recent times (Marshall 2021). Other species likely to occur in the proposed Ramsar site though yet to be recorded include: feral cats (<i>Felis catus</i>), feral goats (<i>Capra hircus</i>), and feral horses (<i>Equus ferus</i>), all of which are also listed as threatening processes. Updates in the presence and impact of these species within the proposed Ramsar site are likely in the future. While comprehensive monitoring for invasive animals at the site has not occurred, management of invasive populations should be prioritised. Notably, feral pigs, horses, and rabbits are in very low abundances or absent from the site currently but may increase with the persistence of wet</p> |

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|                            | <p>conditions (Marshall 2021).</p> <p>Only two species of invasive weeds are present on the Ramsar site (Spreading heliotrope <i>Heliotropium supinum</i> and Ruby dock <i>Rumex vesicarius</i>), while 21 weeds were found across the National Park (Marshall 2021). However, weeds tend to be highly localised and concentrated in disturbed areas (e.g., artificial waterpoints, homesteads), and local management should control these species within both the proposed Ramsar site and the National Park more broadly (Marshall 2021).</p> |
| <b>6.5 Pollution</b>       | Not applicable.   |
| <b>6.6 Offsite impacts</b> | Not applicable.   |
| <b>6.7 Other</b>           | Not applicable.   |

| <b>7. Change in ecological character</b> |                 |
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| <b>7.1 Assessment of change</b>          | Not applicable. |
| <b>7.2 Article 3.2 notification</b>      | Not applicable. |
| <b>7.3 New baseline</b>                  | Not applicable. |

| <b>8. Glossary and definitions</b> |   |
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| CPS                                | Ecosystem components, processes and benefits/ services.   |
| Critical CPS                       | Those components, processes and benefits/ services that most strongly determine/ influence the ecological character of the wetland.   |
| Ecological Character               | The combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time (Resolution IX.1 Annex A para 15).  |
| Ecological connectivity            | The unimpeded movement of species and the flow of natural processes that sustain life on Earth (from CMS, see Attachment 3).  |
| Ecosystem benefits                 | The benefits that people receive from ecosystems (Millennium Ecosystem Assessment 2005)   |
| Ecosystem components               | Include the physical, chemical and biological parts of a wetland (from large scale to very small scale, e.g. habitat, species, and genes) (Resolution IX.1 Annex A)   |
| Ecosystem processes                | Dynamic forces within an ecosystem. They include all those processes that occur between organisms and within and between populations and communities, including interactions with the non-living environment, that result in existing ecosystems and that bring about changes in ecosystems over time. They may be physical, chemical or biological (Australian Heritage Commission, 2002). |
| Ecosystem services                 | <p>Benefits that people receive or obtain from an ecosystem (Resolution IX.1 Annex A).</p> <p>The components of ecosystem services include:</p> <p>Provisioning services – such as food, fuel and freshwater</p>  |

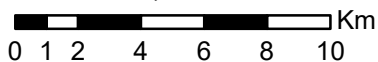
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|  | <p>Regulating services – the benefits obtained from the regulation of ecosystem processes, such as climate regulation, water regulation and natural hazard regulation.</p> <p>Cultural services – the benefits people obtain through spiritual enrichment, recreation, education and aesthetics</p> <p>Supporting services – the services necessary for the production of all other ecosystem services such as water cycling, nutrient cycling and habitat for biota. These services will generally have an indirect benefit to humans or a direct benefit in the long term<br/>(Millennium Ecosystem Assessment 2005).</p> |
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| 9. References                           |   |
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| Australian Heritage Commission (2002).  | <i>Australian Natural Heritage Charter for conservation of places of natural heritage significance</i> . Second Edition. Australian Heritage Commission. Canberra.<br><a href="http://www.ahc.gov.au/publications/ahnc/parta.html">http://www.ahc.gov.au/publications/ahnc/parta.html</a>   |
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|---------------------------|--|
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Datum/Projection: GCS GDA 1994



- Ramsar site
- NPWS Estate

# Caryapundy Swamp Ramsar site

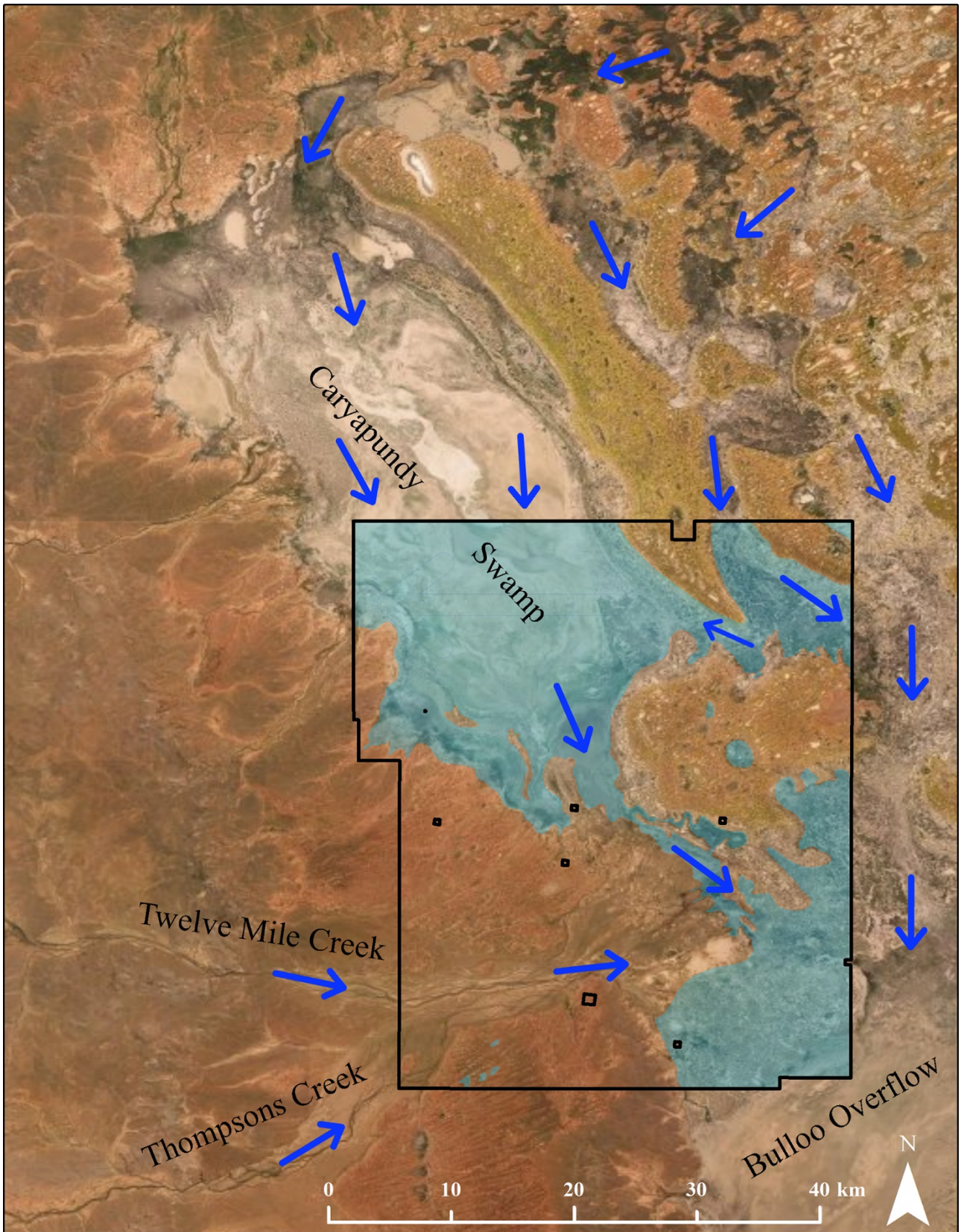
Prepared by the NPWS Landforms and Rehabilitation Unit, November 2021

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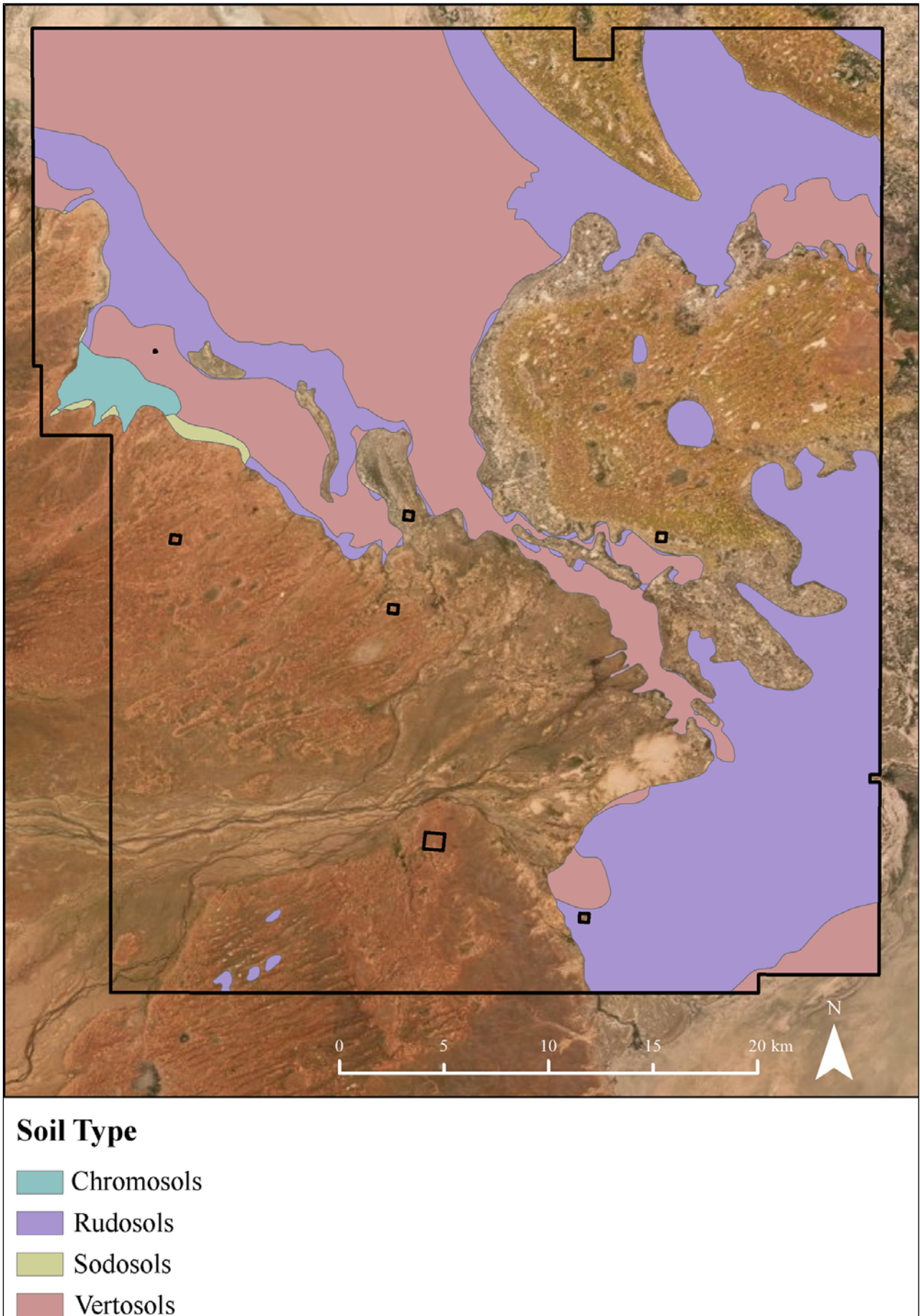


Figure 1. Map of Caryapundy Swamp Ramsar site

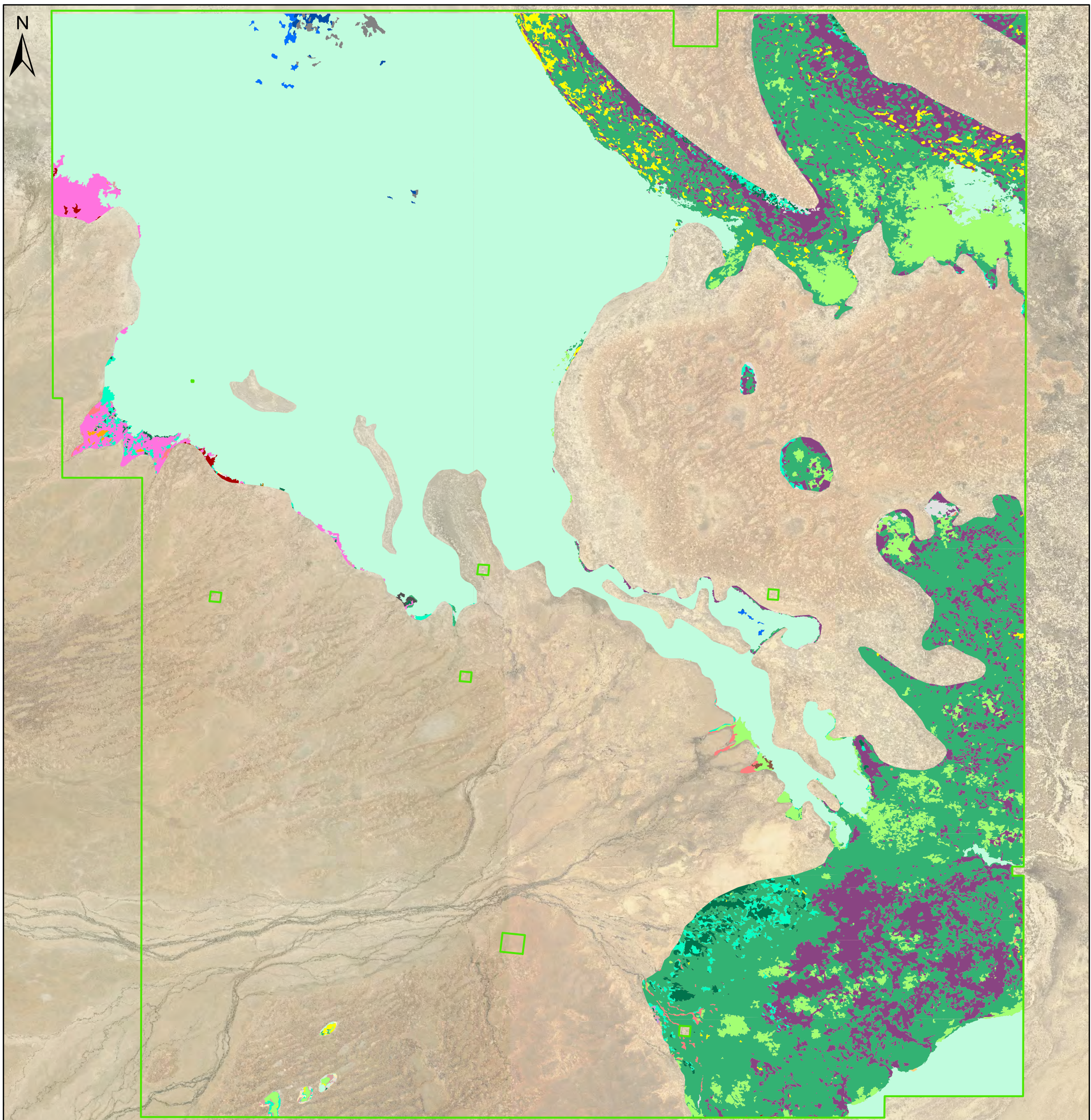




**Figure 2.** Direction of inflows (blue arrows) along the Bulloo River from the north, and Thompsons and Twelve Mile Creeks (note Mt Wood Creek separates and rejoins to Thompsons Creek) from the west (based on Fig. 2 from Farrell et al. 2018). Map created using ESRI ArcMap.



**Figure 3.** Map of soil classifications within Caryapundy Swamp Ramsar site derived from Australian Soil Classification (ASC) soil type map of NSW: <https://data.gov.au/dataset/ds-nsw-22b3123a-f119-4f2d-9e84-849f03e2d976/details?q=>). Map created using ESRI ArcMap



**Plant community type**

- |  |  |
|--|--|
| Black Box low woodland wetland lining ephemeral watercourses or fringing lakes and clay pans                 | Mulga - Rock Fuchsia-bush sparse shrubland of silcrete scarps and mesas of the Channel Country Bioregion             |
| Bottlewasher - Copperburr grassland of the arid zone   | Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland on semi-arid and arid sandplains and dunes                |
| Cabbage-tree Wattle shrubland of the inland plains and drainage lines  | Nitre Goosefoot shrubland wetland on clays of the inland floodplains   |
| Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains          | Not native vegetation  |
| Coolabah woodland wetland of intermittent watercourses in arid zone, mainly in the Channel Country Bioregion | Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains                                |
| Gidgee of the intermittent watercourses or the arid zone   | Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions                             |
| Golden Goosefoot shrubland wetland in swamps of the arid and semi-arid (hot summer) zones                    | Rats Tail Couch sod grassland wetland of inland floodplains  |
| Gypseous shrubland on rises in the semi-arid and arid plains   | River Red Gum open woodland wetland of intermittent watercourses   |
| Hooked Needlewood - Needlewood - Mulga - Turpentine Bush open shrubland of the semi-arid and arid plains     | River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains                              |
| Lignum shrubland wetland of the semi-arid (warm) plains  | Senna - Mulga - Needlewood open shrubland on loam-clay soils in swales and on the edges of claypans in the arid zone |
| Lignum shrubland wetland on floodplains and depressions  | Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains         |
| Mitchell Grass - saltbush grassland/shrubland of the gibber downs of the arid climate zone                   | Sparse saltbush forland wetland of the irregularly inundated lakes   |
| Mitchell Grass grassland - chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones  | Spiny Lignum - Slender Glasswort open forland sailine wetland on lake edges in the semi-arid and arid climate zones  |
| Mulga - Dead Finish on stony hills mainly of the Channel Country Bioregion and Broken Hill Complex Bioregion | Whitewood - Western Rosewood low woodland of the NSW north western plains  |

Datum/Projection: GCS GDA 1994

0 1 2 4 6 8 Km

Narriearra Caryapundy Swamp National Park

## Vegetation communities within Caryapundy Swamp Ramsar site

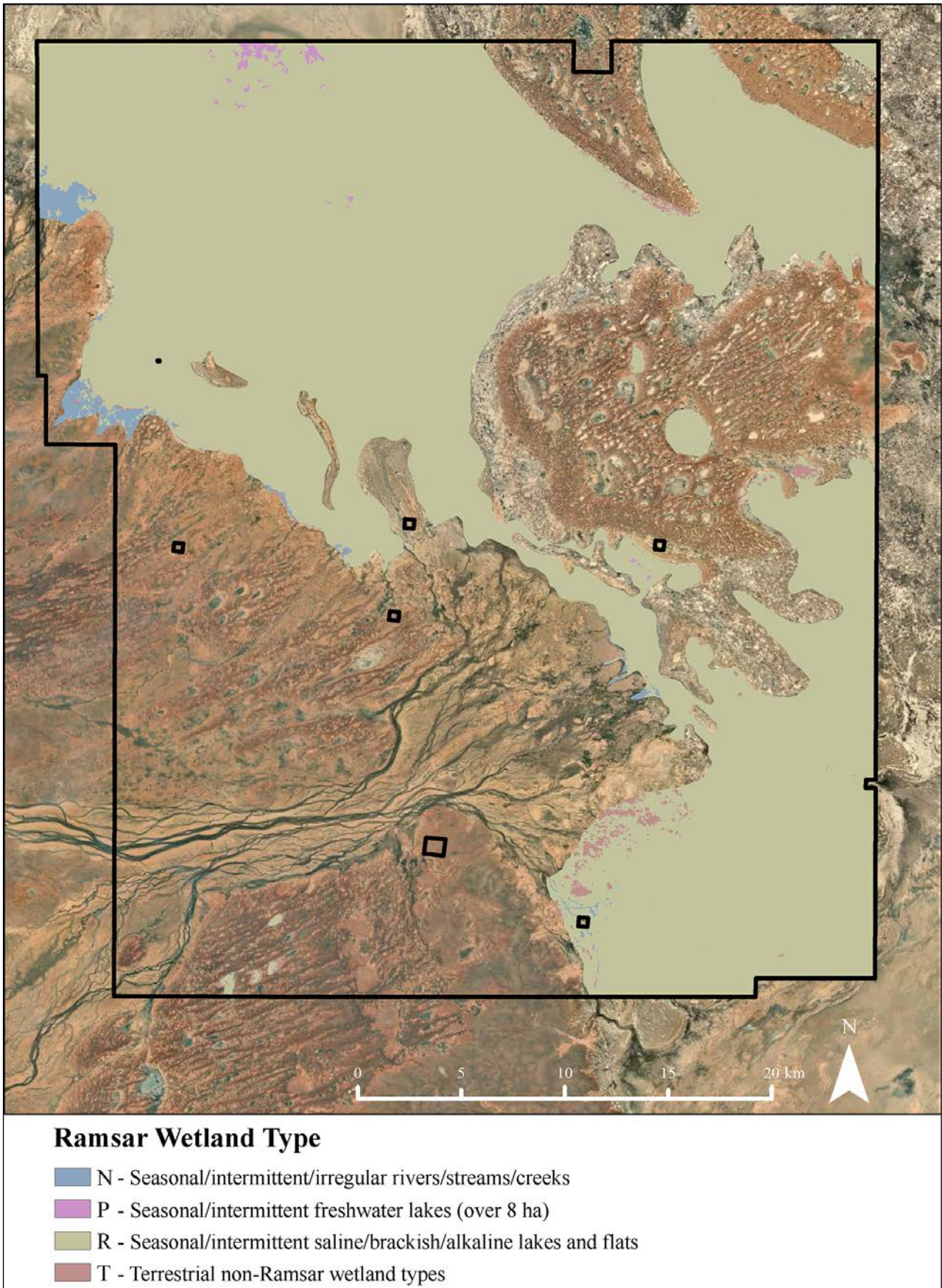
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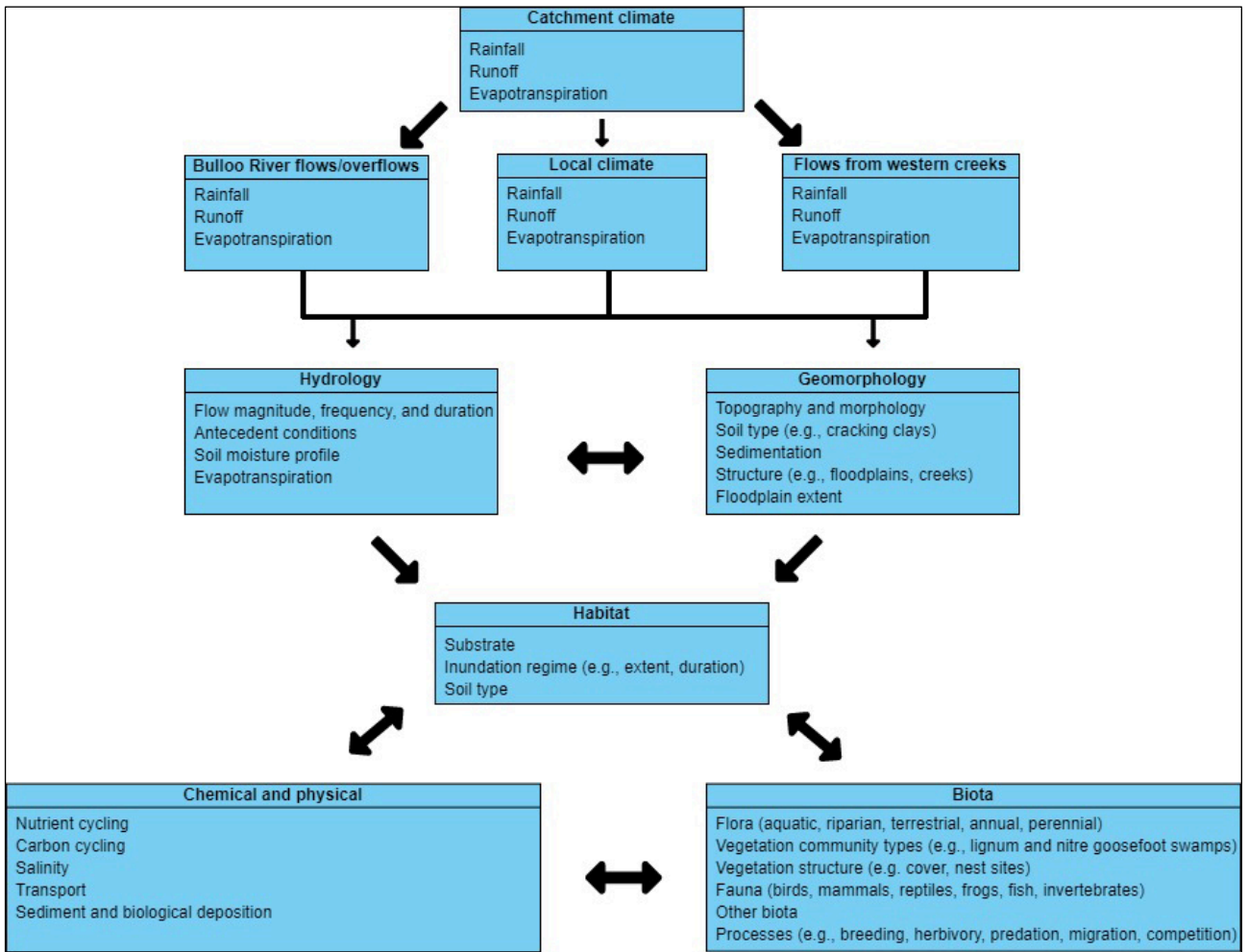
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Figure 4. Plant community types within the Caryapundy Swamp Ramsar site



**Figure 5.** Distribution of Ramsar wetland types and non-Ramsar habitat types within the Caryapundy Swamp Ramsar site (map created using ESRI ArcMap).



**Figure 6.** Conceptual model for Caryapundy Swamp Ramsar site

**Table 1.** List of all animals recorded within the Caryapundy Swamp Ramsar site between 2010 – 2021 ordered by class, with relevant state (*Biodiversity Conservation Act 2016*; BC Act: V=Vulnerable, E=Endangered) and federal (*Environment Protection and Biodiversity Conservation Act 1999*; EPBC Act: E=Endangered, CE=Critically Endangered) threatened species listings, and migratory species agreements recognised under the EPBC Act (C=CAMBA, J=JAMBA, K=ROKAMBA). Asterisks denote introduced species.

| Class | Species                         | BC Act | EPBC Act | Migratory | Introduced  |
|-------|---------------------------------|--------|----------|-----------|-------------|
| Aves  | <i>Acrocephalus australis</i>   |        |          |           |             |
|       | <i>Amytornis barbatus</i>       | E      | E        |           |             |
|       | <i>Anas gracilis</i>            |        |          |           |             |
|       | <i>Anas superciliosa</i>        |        |          |           |             |
|       | <i>Anthus novaeseelandiae</i>   |        |          |           |             |
|       | <i>Aquila audax</i>             |        |          |           |             |
|       | <i>Ardea modestus</i>           |        |          |           |             |
|       | <i>Ardea pacifica</i>           |        |          |           |             |
|       | <i>Ardeotis australis</i>       | E      |          |           |             |
|       | <i>Arenaria interpres</i>       |        |          |           | C,J,K, Bonn |
|       | <i>Artamus cinereus</i>         |        |          |           |             |
|       | <i>Artamus personatus</i>       |        |          |           |             |
|       | <i>Artamus superciliosus</i>    |        |          |           |             |
|       | <i>Aythya australis</i>         |        |          |           |             |
|       | <i>Cacatua sanguinea</i>        |        |          |           |             |
|       | <i>Calidris acuminata</i>       |        |          |           | C,J,K, Bonn |
|       | <i>Calidris canutus</i>         |        | E        |           | C,J,K, Bonn |
|       | <i>Calidris ferruginea</i>      | E      | CE       |           | C,J,K, Bonn |
|       | <i>Certhionyx variegatus</i>    | V      |          |           |             |
|       | <i>Chalcites basalis</i>        |        |          |           |             |
|       | <i>Chalcites osculans</i>       |        |          |           |             |
|       | <i>Charadrius ruficapillus</i>  |        |          |           |             |
|       | <i>Chenonetta jubata</i>        |        |          |           |             |
|       | <i>Cheramoeca leucosterna</i>   |        |          |           |             |
|       | <i>Chlidonias hybrida</i>       |        |          |           |             |
|       | <i>Cincloramphus cruralis</i>   |        |          |           |             |
|       | <i>Circus approximans</i>       |        |          |           |             |
|       | <i>Circus assimilis</i>         | V      |          |           |             |
|       | <i>Corvus bennetti</i>          |        |          |           |             |
|       | <i>Corvus coronoides</i>        |        |          |           |             |
|       | <i>Cygnus atratus</i>           |        |          |           |             |
|       | <i>Dromaius novaehollandiae</i> |        |          |           |             |
|       | <i>Egretta novaehollandiae</i>  |        |          |           |             |
|       | <i>Elanus scriptus</i>          |        |          |           |             |
|       | <i>Euseyonis melanops</i>       |        |          |           |             |
|       | <i>Eolophus roseicapilla</i>    |        |          |           |             |
|       | <i>Epthianura albifrons</i>     | V      |          |           |             |
|       | <i>Epthianura aurifrons</i>     |        |          |           |             |
|       | <i>Epthianura tricolor</i>      |        |          |           |             |
|       | <i>Erythronyx cinctus</i>       |        |          |           |             |
|       | <i>Falco berigora</i>           |        |          |           |             |
|       | <i>Falco cenchroides</i>        |        |          |           |             |
|       | <i>Falco longipennis</i>        |        |          |           |             |

|                                      |   |      |
|--------------------------------------|---|------|
| <i>Falco subniger</i>                | V |      |
| <i>Gavicalis virescens</i>           |   |      |
| <i>Gelochelidon nilotica</i>         |   | C    |
| <i>Geopelia cuneata</i>              |   |      |
| <i>Grallina cyanoleuca</i>           |   |      |
| <i>Grus rubicunda</i>                | V |      |
| <i>Gymnorhina tibicen</i>            |   |      |
| <i>Haliastur sphenurus</i>           |   |      |
| <i>Himantopus himantopus</i>         |   |      |
| <i>Hirundo neoxena</i>               |   |      |
| <i>Hirundo nigricans</i>             |   |      |
| <i>Hydroprogne caspia</i>            |   | J    |
| <i>Lalage sueurii</i>                |   |      |
| <i>Lophochroa leadbeateri</i>        | V |      |
| <i>Malacorhynchus membranaceus</i>   |   |      |
| <i>Malurus lamberti</i>              |   |      |
| <i>Malurus leucopterus</i>           |   |      |
| <i>Megalurus gramineus</i>           |   |      |
| <i>Melopsittacus undulatus</i>       |   |      |
| <i>Merops ornatus</i>                |   |      |
| <i>Microcarbo melanoleucos</i>       |   |      |
| <i>Milvus migrans</i>                |   |      |
| <i>Neophema chrysostoma</i>          |   |      |
| <i>Neopsephotus bourkii</i>          |   |      |
| <i>Northiella haematogaster</i>      |   |      |
| <i>Nycticorax caledonicus</i>        |   |      |
| <i>Nymphicus hollandicus</i>         |   |      |
| <i>Ocyphaps lophotes</i>             |   |      |
| <i>Pachycephala rufiventris</i>      |   |      |
| <i>Pelecanus conspicillatus</i>      |   |      |
| <i>Peltohyas australis</i>           |   |      |
| <i>Petroica goodenovii</i>           |   |      |
| <i>Phaps chalcoptera</i>             |   |      |
| <i>Phaps histrionica</i>             | E |      |
| <i>Platalea flavipes</i>             |   |      |
| <i>Platalea regia</i>                |   |      |
| <i>Plegadis falcinellus</i>          |   | Bonn |
| <i>Poliocephalus poliocephalus</i>   |   |      |
| <i>Porphyrio melanotus</i>           |   |      |
| <i>Porzana fluminea</i>              |   |      |
| <i>Porzana pusilla</i>               |   |      |
| <i>Psophodes cristatus</i>           |   |      |
| <i>Pyrrholaemus brunneus</i>         | V |      |
| <i>Recurvirostra novaehollandiae</i> |   |      |
| <i>Rhipidura leucophrys</i>          |   |      |
| <i>Stictonetta naevosa</i>           | V |      |
| <i>Stiltia isabella</i>              |   |      |
| <i>Tachybaptus novaehollandiae</i>   |   |      |
| <i>Taeniopygia guttata</i>           |   |      |
| <i>Threskiornis moluccus</i>         |   |      |

|          |                                 |   |             |
|----------|---------------------------------|---|-------------|
|          | <i>Threskiornis spinicollis</i> |   |             |
|          | <i>Tribonyx ventralis</i>       |   |             |
|          | <i>Tringa stagnatilis</i>       |   | C,J,K, Bonn |
|          | <i>Turnix velox</i>             |   |             |
|          | <i>Vanellus miles</i>           |   |             |
|          | <i>Vanellus tricolor</i>        |   |             |
|          | <i>Zapornia tabuensis</i>       |   |             |
| Mammalia | <i>Canis dingo</i>              |   |             |
|          | <i>Hydromys chrysogaster</i>    |   |             |
|          | <i>Macropus fuliginosus</i>     |   |             |
|          | <i>Macropus rufus</i>           |   |             |
|          | <i>Oryctolagus cuniculus</i>    |   | *           |
|          | <i>Sus scrofa</i>               |   | *           |
|          | <i>Vulpes vulpes</i>            |   | *           |
| Reptilia | <i>Ctenophorus fordi</i>        |   |             |
|          | <i>Ctenophorus pictus</i>       |   |             |
|          | <i>Ctenotus leonhardii</i>      |   |             |
|          | <i>Demansia rimicola</i>        | V |             |
|          | <i>Gehyra variegata</i>         |   |             |
|          | <i>Heteronotia binoei</i>       |   |             |
|          | <i>Pogona vitticeps</i>         |   |             |
|          | <i>Rhynchoedura ormsbyi</i>     |   |             |
|          | <i>Tiliqua rugosa</i>           |   |             |
|          | <i>Tympanocryptis</i>           |   |             |
|          | <i>tetraporophora</i>           |   |             |
|          | <i>Varanus gouldii</i>          |   |             |



**Table 2.** List of all plants recorded within the Caryapundy Swamp Ramsar site between 2010 – 2021 ordered by family, with relevant state (*Biodiversity Conservation Act 2016*; BC Act) and federal (*Environment Protection and Biodiversity Conservation Act 1999*; EPBC Act) threatened species listings (note no species are listed under the EPBC Act. Asterisks denote introduced species).

| Family                    | Species                            | BC Act | EPBC Act | Introduced |
|---------------------------|------------------------------------|--------|----------|------------|
| Aizoaceae                 | <i>Gunnopsis quadrifida</i>        |        |          |            |
|                           | <i>Tetragonia moorei</i>           |        |          |            |
|                           | <i>Trianthema clavata</i>          |        |          |            |
|                           | <i>Trianthema ufoensis</i>         |        |          |            |
| Amaranthaceae             | <i>Alternanthera sessilis</i>      |        |          |            |
|                           | <i>Ptilotus nobilis</i>            |        |          |            |
| Amaryllidaceae            | <i>Crinum flaccidum</i>            |        |          |            |
| Apiaceae                  | <i>Daucus glochidiatus</i>         |        |          |            |
| Asphodelaceae             | <i>Bulbine alata</i>               |        |          |            |
| Asteraceae                | <i>Brachyscome lineariloba</i>     |        |          |            |
|                           | <i>Calotis ancyrocarpa</i>         |        |          |            |
|                           | <i>Calotis hispidula</i>           |        |          |            |
|                           | <i>Centipeda thespidioides</i>     |        |          |            |
|                           | <i>Gnephosis arachnoidea</i>       |        |          |            |
|                           | <i>Gnephosis eriocarpa</i>         |        |          |            |
|                           | <i>Laphangium luteoalbum</i>       |        |          |            |
|                           | <i>Leiocarpa brevicompta</i>       |        |          |            |
|                           | <i>Minuria denticulata</i>         |        |          |            |
|                           | <i>Polycalymma stuartii</i>        |        |          |            |
|                           | <i>Rhodanthe moschata</i>          |        |          |            |
|                           | <i>Rhodanthe stricta</i>           |        |          |            |
|                           | <i>Rhodanthe troedelii</i>         |        |          |            |
|                           | <i>Rhodanthe uniflora</i>          |        |          |            |
|                           | <i>Senecio glossanthus</i>         |        |          |            |
|                           | <i>Senecio gregorii</i>            |        |          |            |
|                           | <i>Streptoglossa adscendens</i>    |        |          |            |
| <i>Vittadinia sulcata</i> |                                    |        |          |            |
| Boraginaceae              | <i>Heliotropium supinum</i>        |        |          | *          |
|                           | <i>Plagiobothrys plurisepalus</i>  |        |          |            |
| Brassicaceae              | <i>Arabidella eremigena</i>        |        |          |            |
|                           | <i>Harmsiodoxa puberula</i>        |        |          |            |
|                           | <i>Lepidium muelleriferdinandi</i> |        |          |            |
|                           | <i>Lepidium oxytrichum</i>         |        |          |            |
|                           | <i>Lepidium phlebopetalum</i>      |        |          |            |
|                           | <i>Lepidium sagittulatum</i>       |        |          |            |
| Campanulaceae             | <i>Wahlenbergia gracilis</i>       |        |          |            |
|                           | <i>Wahlenbergia tumidifruca</i>    |        |          |            |
| Caryophyllaceae           | <i>Polycarpaea arida</i>           |        |          |            |
| Chenopodiaceae            | <i>Atriplex angulata</i>           |        |          |            |
|                           | <i>Atriplex holocarpa</i>          |        |          |            |
|                           | <i>Atriplex limbata</i>            |        |          |            |
|                           | <i>Atriplex lobativalvis</i>       |        |          |            |
|                           | <i>Atriplex nessorhina</i>         |        |          |            |
|                           | <i>Atriplex nummularia</i>         |        |          |            |

|                           |                                |   |
|---------------------------|--------------------------------|---|
|                           | <i>Atriplex spongiosa</i>      |   |
|                           | <i>Atriplex sturtii</i>        | E |
|                           | <i>Chenopodium auricomum</i>   |   |
|                           | <i>Dysphania pumilio</i>       |   |
|                           | <i>Einadia hastata</i>         |   |
|                           | <i>Einadia nutans</i>          |   |
|                           | <i>Maireana coronata</i>       |   |
|                           | <i>Maireana microcarpa</i>     |   |
|                           | <i>Neobassia proceriflora</i>  |   |
|                           | <i>Osteocarpum acropterum</i>  |   |
|                           | <i>Osteocarpum</i>             |   |
|                           | <i>diptercarpum</i>            |   |
|                           | <i>Rhagodia spinescens</i>     |   |
|                           | <i>Salsola kali</i>            |   |
|                           | <i>Sclerolaena bicornis</i>    |   |
|                           | <i>Sclerolaena calcarata</i>   |   |
|                           | <i>Sclerolaena decurrens</i>   |   |
|                           | <i>Sclerolaena glabra</i>      |   |
|                           | <i>Sclerolaena lanicuspis</i>  |   |
|                           | <i>Sclerolaena longicuspis</i> |   |
|                           | <i>Sclerolaena muricata</i>    |   |
|                           | <i>Sclerolaena stelligera</i>  |   |
|                           | <i>Sclerolaena tricuspis</i>   |   |
|                           | <i>Tecticornia indica</i>      |   |
| Convolvulaceae            | <i>Convolvulus clementii</i>   |   |
| Crassulaceae              | <i>Crassula sieberiana</i>     |   |
| Euphorbiaceae             | <i>Euphorbia tannensis</i>     |   |
| Fabaceae (Faboideae)      | <i>Cullen graveolens</i>       |   |
|                           | <i>Lotus cruentus</i>          |   |
|                           | <i>Swainsona campylantha</i>   |   |
|                           | <i>Swainsona phacoides</i>     |   |
|                           | <i>Trigonella suavissima</i>   |   |
| Fabaceae<br>(Mimosoideae) | <i>Acacia farnesiana</i>       |   |
|                           | <i>Acacia oswaldii</i>         |   |
|                           | <i>Neptunia gracilis</i>       |   |
| Frankeniaceae             | <i>Frankenia serpyllifolia</i> |   |
| Geraniaceae               | <i>Erodium aureum</i>          |   |
|                           | <i>Erodium crinitum</i>        |   |
| Goodeniaceae              | <i>Goodenia fascicularis</i>   |   |
| Haloragaceae              | <i>Haloragis aspera</i>        |   |
| Juncaginaceae             | <i>Triglochin isingiana</i>    |   |
| Lamiaceae                 | <i>Teucrium racemosum</i>      |   |
| Malvaceae                 | <i>Abutilon indicum</i>        |   |
|                           | <i>Abutilon oxycarpum</i>      |   |
|                           | <i>Sida goniocarpa</i>         |   |
|                           | <i>Sida trichopoda</i>         |   |
| Marsileaceae              | <i>Marsilea cryptocarpa</i>    |   |
|                           | <i>Marsilea drummondii</i>     |   |
|                           | <i>Marsilea hirsuta</i>        |   |
| Myrtaceae                 | <i>Eucalyptus coolabah</i>     |   |

|                |                                  |   |
|----------------|----------------------------------|---|
| Phrymaceae     | <i>Peplidium foecundum</i>       |   |
| Phyllanthaceae | <i>Phyllanthus lacunellus</i>    |   |
|                | <i>Plantago cunninghamii</i>     |   |
|                | <i>Plantago drummondii</i>       |   |
| Poaceae        | <i>Alloteropsis semialata</i>    |   |
|                | <i>Aristida anthoxanthoides</i>  |   |
|                | <i>Aristida contorta</i>         |   |
|                | <i>Chloris divaricata</i>        |   |
|                | <i>Chloris pectinata</i>         |   |
|                | <i>Digitaria divaricatissima</i> |   |
|                | <i>Enneapogon cylindricus</i>    |   |
|                | <i>Eragrostis australasica</i>   |   |
|                | <i>Eragrostis dielsii</i>        |   |
|                | <i>Eragrostis leptocarpa</i>     |   |
|                | <i>Eragrostis parviflora</i>     |   |
|                | <i>Eragrostis setifolia</i>      |   |
|                | <i>Eriochloa crebra</i>          |   |
|                | <i>Leptochloa fusca</i>          |   |
|                | <i>Panicum decompositum</i>      |   |
|                | <i>Panicum effusum</i>           |   |
|                | <i>Panicum laevinode</i>         |   |
|                | <i>Paspalidium jubiflorum</i>    |   |
|                | <i>Sporobolus actinocladus</i>   |   |
|                | <i>Sporobolus carolii</i>        |   |
|                | <i>Tripogonella loliiiformis</i> |   |
|                | <i>Triraphis mollis</i>          |   |
| Polygonaceae   | <i>Duma florulenta</i>           |   |
|                | <i>Rumex crystallinus</i>        |   |
|                | <i>Rumex vesicarius</i>          | * |
|                | <i>Calandrinia eremaea</i>       |   |
|                | <i>Calandrinia ptychosperma</i>  |   |
|                | <i>Calandrinia pumila</i>        |   |
|                | <i>Portulaca oleracea</i>        |   |
| Proteaceae     | <i>Hakea leucoptera</i>          |   |
| Rubiaceae      | <i>Synaptantha tillaeacea</i>    |   |
| Solanaceae     | <i>Nicotiana velutina</i>        |   |
|                | <i>Physalis angulata</i>         |   |
|                | <i>Solanum esuriale</i>          |   |
| Verbenaceae    | <i>Phyla nodiflora</i>           |   |
| Zygophyllaceae | <i>Roepera similis</i>           |   |

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**Table 3.** List of waterbirds recorded within Narriearra Caryapundy Swamp National Park (NCSNP), and between 2010-2021 in the Caryapundy Swamp Ramsar site.

| Common name             | Species                              | NCSNP | Caryapundy Swamp Ramsar site |
|-------------------------|--------------------------------------|-------|------------------------------|
| Chestnut Teal           | <i>Anas castanea</i>                 | x     |                              |
| Grey Teal               | <i>Anas gracilis</i>                 | x     | x                            |
| Pacific Black Duck      | <i>Anas superciliosa</i>             | x     | x                            |
| Australasian Darter     | <i>Anhinga novaehollandiae</i>       | x     |                              |
| Intermediate Egret      | <i>Ardea intermedia</i>              | x     |                              |
| Great Egret             | <i>Ardea modestus</i>                | x     | x                            |
| Pacific Heron           | <i>Ardea pacifica</i>                | x     | x                            |
| Ruddy Turnstone         | <i>Arenaria interpres</i>            | x     | x                            |
| Hardhead                | <i>Aythya australis</i>              | x     | x                            |
| Musk Duck               | <i>Biziura lobata</i>                | x     |                              |
| Sharp-tailed Sandpiper  | <i>Calidris acuminata</i>            | x     | x                            |
| Red Knot                | <i>Calidris canutus</i>              | x     |                              |
| Curlew Sandpiper        | <i>Calidris ferruginea</i>           | x     | x                            |
| Red-capped Plover       | <i>Charadrius ruficapillus</i>       | x     | x                            |
| Australian Wood Duck    | <i>Chenonetta jubata</i>             | x     | x                            |
| Whiskered Tern          | <i>Chlidonias hybrida</i>            | x     | x                            |
| Banded Stilt            | <i>Cladorhynchus leucocephalus</i>   | x     |                              |
| Black Swan              | <i>Cygnus atratus</i>                | x     | x                            |
| White-faced Heron       | <i>Egretta novaehollandiae</i>       | x     | x                            |
| Black-fronted Dotterel  | <i>Elseya melanops</i>               | x     | x                            |
| Red-kneed Dotterel      | <i>Erythronyx cinctus</i>            | x     | x                            |
| Eurasian Coot           | <i>Fulica atra</i>                   | x     |                              |
| Gull-billed Tern        | <i>Gelochelidon nilotica</i>         | x     | x                            |
| Brolga                  | <i>Grus rubicunda</i>                | x     | x                            |
| Pied Stilt              | <i>Himantopus himantopus</i>         | x     | x                            |
| Caspian Tern            | <i>Hydroprogne caspia</i>            | x     | x                            |
| Silver Gull             | <i>Larus novaehollandiae</i>         | x     |                              |
| Pink-eared Duck         | <i>Malacorhynchus membranaceus</i>   | x     | x                            |
| Little Pied Cormorant   | <i>Microcarbo melanoleucos</i>       | x     | x                            |
| Nankeen Night-heron     | <i>Nycticorax caledonicus</i>        | x     | x                            |
| Australian Pelican      | <i>Pelecanus conspicillatus</i>      | x     | x                            |
| Great Cormorant         | <i>Phalacrocorax carbo</i>           | x     |                              |
| Little Black Cormorant  | <i>Phalacrocorax sulcirostris</i>    | x     |                              |
| Yellow-billed Spoonbill | <i>Platalea flavipes</i>             | x     | x                            |
| Royal Spoonbill         | <i>Platalea regia</i>                | x     |                              |
| Glossy Ibis             | <i>Plegadis falcinellus</i>          | x     | x                            |
| Great Crested Grebe     | <i>Podiceps cristatus</i>            | x     |                              |
| Hoary-headed Grebe      | <i>Poliiocephalus poliocephalus</i>  | x     | x                            |
| Australasian Swamphen   | <i>Porphyrio melanotus</i>           | x     | x                            |
| Australian Crake        | <i>Porzana fluminea</i>              | x     | x                            |
| Baillon's Crake         | <i>Porzana pusilla</i>               | x     | x                            |
| Red-necked Avocet       | <i>Recurvirostra novaehollandiae</i> | x     | x                            |
| Australasian Shoveler   | <i>Spatula rhynchotis</i>            | x     |                              |
| Freckled Duck           | <i>Stictonetta naevosa</i>           | x     | x                            |
| Australian Pratincole   | <i>Stiltia isabella</i>              | x     | x                            |
| Australasian Grebe      | <i>Tachybaptus novaehollandiae</i>   | x     | x                            |
| Australian Ibis         | <i>Threskiornis moluccus</i>         | x     | x                            |

|                         |                                 |   |   |
|-------------------------|---------------------------------|---|---|
| Straw-necked Ibis       | <i>Threskiornis spinicollis</i> | x | x |
| Black-tailed Native-hen | <i>Tribonyx ventralis</i>       | x | x |
| Common Greenshank       | <i>Tringa nebularia</i>         | x |   |
| Marsh Sandpiper         | <i>Tringa stagnatilis</i>       | x | x |
| Masked Lapwing          | <i>Vanellus miles</i>           | x | x |

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**Definition of ecological connectivity - from the Convention on the Conservation of Migratory Species of Wild Animals**

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) includes the following definition for ecological connectivity:

“Ecological connectivity is the unimpeded movement of species and the flow of natural processes that sustain life on Earth”.

The CMS definition is accompanied by the following supporting points that illustrate its key features.

*Ecological connectivity encompasses:*

- The conditions that are needed to support the movement of individuals and populations of species and the flow of natural processes on land, in the air and at sea;
- A central principle for ensuring ecological interlinkages and ecosystem services in line with social and cultural connections with nature, traditional knowledge systems, and the needs of human development.
- The conservation of existing intact ecosystems and the restoration of ecological integrity in ways that support the natural movements of animals;
- The conservation and recovery of species and ecosystem integrity in ways that support integrated risk management, including ecosystem-based approaches to climate change mitigation and adaptation, as well as disaster risk reduction;
- Connections across space and time;
- Connections facilitated by ecological networks and ecological corridors;
- Connections that are the basis for particular ecosystem services that benefit people;
- Connections that make animal migration possible;
- Connections that make pollination, dispersal, genetic mixing, hydrological cycling and other vital environmental processes possible;
- Connections within and across national borders;
- Connections that involve people and require cooperative approaches at all levels.

In the context of the Ramsar Convention on Wetlands, this particularly includes (for example):

- Hydrological connectivity at the river basin/ river catchment scale;
- Scaled up wetland ecosystem restoration, linked to the UN Decade on Ecosystems Restoration 2021-2030.

Reference:

2019/021: *Ecological Connectivity in the Post-2020 Global Biodiversity Framework*,

<https://www.cms.int/en/news/2019021-ecological-connectivity-post-2020-global-biodiversity-framework>

Coordinates of the Caryapundy Swamp Ramsar site in decimal degrees for latitude and longitude in Geocentric Datum of Australia 1994 (GDA94) Lambert NSW projection. Coordinates denote the vertices of the area of the Ramsar site, derived from the shapefile provided with Ramsar documentation.

| Latitude     | Longitude   | Datum and projection |
|--------------|-------------|----------------------|
| -29.40979    | 142.42754   | GDA94 Lambert NSW    |
| -29.4116     | 142.42652   | GDA94 Lambert NSW    |
| -29.4125     | 142.42665   | GDA94 Lambert NSW    |
| -29.41329    | 142.42717   | GDA94 Lambert NSW    |
| -29.41410697 | 142.427112  | GDA94 Lambert NSW    |
| -29.41409072 | 142.4226006 | GDA94 Lambert NSW    |
| -29.41342    | 142.42266   | GDA94 Lambert NSW    |
| -29.4115     | 142.4233    | GDA94 Lambert NSW    |
| -29.41037    | 142.42329   | GDA94 Lambert NSW    |
| -29.40992    | 142.42265   | GDA94 Lambert NSW    |
| -29.41027    | 142.42072   | GDA94 Lambert NSW    |
| -29.40971    | 142.41943   | GDA94 Lambert NSW    |
| -29.4087     | 142.41942   | GDA94 Lambert NSW    |
| -29.40472    | 142.42455   | GDA94 Lambert NSW    |
| -29.4045     | 142.42507   | GDA94 Lambert NSW    |
| -29.40461    | 142.4261    | GDA94 Lambert NSW    |
| -29.40528    | 142.42687   | GDA94 Lambert NSW    |
| -29.40765    | 142.42766   | GDA94 Lambert NSW    |
| -29.40979    | 142.42754   | GDA94 Lambert NSW    |
| -29.4079     | 142.4381    | GDA94 Lambert NSW    |
| -29.40904    | 142.43604   | GDA94 Lambert NSW    |
| -29.40904    | 142.43476   | GDA94 Lambert NSW    |
| -29.40814    | 142.43372   | GDA94 Lambert NSW    |
| -29.40746    | 142.43384   | GDA94 Lambert NSW    |
| -29.40588    | 142.43474   | GDA94 Lambert NSW    |
| -29.40374    | 142.43498   | GDA94 Lambert NSW    |
| -29.4026     | 142.43704   | GDA94 Lambert NSW    |
| -29.40259    | 142.43897   | GDA94 Lambert NSW    |
| -29.40316    | 142.43949   | GDA94 Lambert NSW    |
| -29.40485    | 142.43976   | GDA94 Lambert NSW    |
| -29.40632    | 142.43938   | GDA94 Lambert NSW    |
| -29.40711    | 142.439     | GDA94 Lambert NSW    |
| -29.4079     | 142.4381    | GDA94 Lambert NSW    |
| -29.40422    | 142.44425   | GDA94 Lambert NSW    |
| -29.40479    | 142.4427    | GDA94 Lambert NSW    |
| -29.40457    | 142.44206   | GDA94 Lambert NSW    |
| -29.404      | 142.4418    | GDA94 Lambert NSW    |
| -29.40152    | 142.44204   | GDA94 Lambert NSW    |
| -29.39972    | 142.44268   | GDA94 Lambert NSW    |
| -29.39835    | 142.44447   | GDA94 Lambert NSW    |
| -29.39778    | 142.44589   | GDA94 Lambert NSW    |
| -29.39766    | 142.44833   | GDA94 Lambert NSW    |
| -29.39867    | 142.44898   | GDA94 Lambert NSW    |
| -29.39969    | 142.44873   | GDA94 Lambert NSW    |
| -29.40093    | 142.44797   | GDA94 Lambert NSW    |
| -29.40422    | 142.44425   | GDA94 Lambert NSW    |

|              |             |                   |
|--------------|-------------|-------------------|
| -29.38256    | 142.44633   | GDA94 Lambert NSW |
| -29.38359    | 142.44428   | GDA94 Lambert NSW |
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| -29.38247    | 142.44195   | GDA94 Lambert NSW |
| -29.38145    | 142.44272   | GDA94 Lambert NSW |
| -29.37873    | 142.4458    | GDA94 Lambert NSW |
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| -29.37816    | 142.44824   | GDA94 Lambert NSW |
| -29.3785     | 142.44876   | GDA94 Lambert NSW |
| -29.37963    | 142.44864   | GDA94 Lambert NSW |
| -29.38166    | 142.44749   | GDA94 Lambert NSW |
| -29.38256    | 142.44633   | GDA94 Lambert NSW |
| -29.17774    | 142.63331   | GDA94 Lambert NSW |
| -29.17953    | 142.6303    | GDA94 Lambert NSW |
| -29.17821    | 142.61985   | GDA94 Lambert NSW |
| -29.172      | 142.61506   | GDA94 Lambert NSW |
| -29.16779    | 142.61476   | GDA94 Lambert NSW |
| -29.16346    | 142.6154    | GDA94 Lambert NSW |
| -29.1618     | 142.61689   | GDA94 Lambert NSW |
| -29.15981    | 142.61921   | GDA94 Lambert NSW |
| -29.15884    | 142.62306   | GDA94 Lambert NSW |
| -29.15921    | 142.62634   | GDA94 Lambert NSW |
| -29.16112    | 142.62989   | GDA94 Lambert NSW |
| -29.16694    | 142.63373   | GDA94 Lambert NSW |
| -29.17237    | 142.63499   | GDA94 Lambert NSW |
| -29.17774    | 142.63331   | GDA94 Lambert NSW |
| -29.14272    | 142.60418   | GDA94 Lambert NSW |
| -29.14316    | 142.60137   | GDA94 Lambert NSW |
| -29.14225    | 142.60019   | GDA94 Lambert NSW |
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| -29.13762    | 142.60012   | GDA94 Lambert NSW |
| -29.13309    | 142.60063   | GDA94 Lambert NSW |
| -29.13071    | 142.60224   | GDA94 Lambert NSW |
| -29.1311     | 142.604     | GDA94 Lambert NSW |
| -29.13253    | 142.60484   | GDA94 Lambert NSW |
| -29.1356     | 142.60583   | GDA94 Lambert NSW |
| -29.13734    | 142.60632   | GDA94 Lambert NSW |
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| -29.14198    | 142.60534   | GDA94 Lambert NSW |
| -29.14272    | 142.60418   | GDA94 Lambert NSW |
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| -28.99909066 | 142.7074804 | GDA94 Lambert NSW |
| -29.01284558 | 142.7074292 | GDA94 Lambert NSW |
| -29.01392106 | 142.7074252 | GDA94 Lambert NSW |
| -29.01233    | 142.70553   | GDA94 Lambert NSW |
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| -29.00395    | 142.69157   | GDA94 Lambert NSW |
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| -29          | 142.68643   | GDA94 Lambert NSW |
| -28.99905696 | 142.6855614 | GDA94 Lambert NSW |
| -28.99905729 | 142.6999863 | GDA94 Lambert NSW |
| -28.99905671 | 142.7074805 | GDA94 Lambert NSW |



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|--------------|-------------|-------------------|
| -28.99904239 | 142.5750539 | GDA94 Lambert NSW |
| -28.99943712 | 142.5750512 | GDA94 Lambert NSW |
| -28.9990428  | 142.5743586 | GDA94 Lambert NSW |
| -28.99904239 | 142.5750539 | GDA94 Lambert NSW |
| -29.04548    | 142.699     | GDA94 Lambert NSW |
| -29.04605    | 142.70182   | GDA94 Lambert NSW |
| -29.0447     | 142.70401   | GDA94 Lambert NSW |
| -29.0447     | 142.70465   | GDA94 Lambert NSW |
| -29.04527    | 142.70529   | GDA94 Lambert NSW |
| -29.04719    | 142.70593   | GDA94 Lambert NSW |
| -29.04787    | 142.70682   | GDA94 Lambert NSW |
| -29.04791221 | 142.7072989 | GDA94 Lambert NSW |
| -29.11480093 | 142.70705   | GDA94 Lambert NSW |
| -29.11216    | 142.7052    | GDA94 Lambert NSW |
| -29.11081    | 142.70521   | GDA94 Lambert NSW |
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| -29.10664    | 142.70637   | GDA94 Lambert NSW |
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| -29.10403    | 142.70343   | GDA94 Lambert NSW |
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| -29.09161    | 142.69808   | GDA94 Lambert NSW |
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| -29.09386    | 142.69601   | GDA94 Lambert NSW |
| -29.09792    | 142.69587   | GDA94 Lambert NSW |
| -29.0995     | 142.69638   | GDA94 Lambert NSW |
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| -29.10367    | 142.69431   | GDA94 Lambert NSW |
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| -29.09181    | 142.68677   | GDA94 Lambert NSW |
| -29.09011    | 142.68421   | GDA94 Lambert NSW |
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| -29.09315    | 142.68086   | GDA94 Lambert NSW |
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| -29.0962     | 142.68393   | GDA94 Lambert NSW |
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| -29.09766    | 142.68136   | GDA94 Lambert NSW |
| -29.09506    | 142.67957   | GDA94 Lambert NSW |
| -29.09427    | 142.67842   | GDA94 Lambert NSW |
| -29.09471    | 142.67623   | GDA94 Lambert NSW |
| -29.09426    | 142.67482   | GDA94 Lambert NSW |
| -29.09132    | 142.67226   | GDA94 Lambert NSW |
| -29.09109    | 142.67085   | GDA94 Lambert NSW |

|           |           |                   |
|-----------|-----------|-------------------|
| -29.09176 | 142.66995 | GDA94 Lambert NSW |
| -29.09469 | 142.6684  | GDA94 Lambert NSW |
| -29.09795 | 142.66312 | GDA94 Lambert NSW |
| -29.0985  | 142.66055 | GDA94 Lambert NSW |
| -29.09816 | 142.65773 | GDA94 Lambert NSW |
| -29.09759 | 142.65683 | GDA94 Lambert NSW |
| -29.09669 | 142.65683 | GDA94 Lambert NSW |
| -29.09455 | 142.65787 | GDA94 Lambert NSW |
| -29.09353 | 142.65787 | GDA94 Lambert NSW |
| -29.09285 | 142.65762 | GDA94 Lambert NSW |
| -29.09093 | 142.65544 | GDA94 Lambert NSW |
| -29.08834 | 142.65558 | GDA94 Lambert NSW |
| -29.08461 | 142.65354 | GDA94 Lambert NSW |
| -29.07942 | 142.65304 | GDA94 Lambert NSW |
| -29.0784  | 142.65228 | GDA94 Lambert NSW |
| -29.0784  | 142.65163 | GDA94 Lambert NSW |
| -29.0793  | 142.65035 | GDA94 Lambert NSW |
| -29.08177 | 142.64893 | GDA94 Lambert NSW |
| -29.08233 | 142.647   | GDA94 Lambert NSW |
| -29.08357 | 142.64519 | GDA94 Lambert NSW |
| -29.09337 | 142.64066 | GDA94 Lambert NSW |
| -29.0954  | 142.64053 | GDA94 Lambert NSW |
| -29.09664 | 142.64193 | GDA94 Lambert NSW |
| -29.10049 | 142.64436 | GDA94 Lambert NSW |
| -29.10375 | 142.64306 | GDA94 Lambert NSW |
| -29.10837 | 142.63932 | GDA94 Lambert NSW |
| -29.10904 | 142.63932 | GDA94 Lambert NSW |
| -29.10972 | 142.64008 | GDA94 Lambert NSW |
| -29.11018 | 142.64227 | GDA94 Lambert NSW |
| -29.11086 | 142.64175 | GDA94 Lambert NSW |
| -29.11198 | 142.63918 | GDA94 Lambert NSW |
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