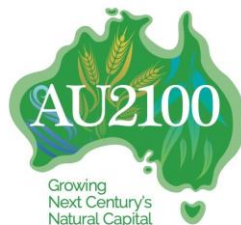


Roy Amer Reserve Wetland Management Action Plan (2023-2033).



Kerri L. Muller, Sylvia Zukowski and Greg Johnston

October 2023



Respect and Reconciliation

Kerri Muller NRM Pty. Ltd. (also trading as AU2100) and Nature Glenelg Trust acknowledge Aboriginal people as the First Peoples and Nations of the South Australian lands and waters we live and work upon and we pay our respects to their Elders past, present and emerging.

We acknowledge that the Port Adelaide region has sustained unique First Nations cultures since time immemorial. We also acknowledge the full range of First Nations' rights, interests and obligations, seek to support their equitable engagement. Furthermore, we acknowledge that Indigenous peoples' spiritual, social, cultural and economic practices come from their lands and waters, and they continue to maintain their Lore, cultural heritage, economies and languages, which are of ongoing importance.

We work across Australia with Indigenous Australians to conserve and sustain Country. Through this work we seek to improve the relationship between Indigenous and non- Indigenous Australians and build respect based on mutual understanding and acceptance of each other.

Acknowledgements

This Draft Roy Amer Reserve Wetland Management builds on a base of existing information, knowledge and expertise. In particular, we would like to thank Craig Hughes (City of Port Adelaide Enfield) for project initiation and management support, the Council's project team (Simon Trill, Peter Gehling, Andrew Smithson, Aleisa Lamanna, Dave Janzow, Ann Gibbons, Gabriel Catalini), local resident and citizen scientist, Gerry Kandelaars, Mellissa Bradley from Water Sensitive SA for her comments and suggestions and users of Roy Amer Reserve for their support during surveys.

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Summary Table: Roy Amer Reserve Wetland

Wetland Type	Residential stormwater wetland comprising six interconnected basins. Constructed: 1993 - 1994. Managed for stormwater flood mitigation and water conservation. Initially intended for Aquifer Storage and Recharge but design found to be unsuitable.
Wetland Location	Roy Amer Reserve, Sir Ross Smith Bvd., Oakden, SA 5086 Enquiries: T (08) 8405 6600 E service@cityofpae.sa.gov.au
Local Government	City of Port Adelaide Enfield
Traditional Owners	Kurna Nation
Coordinates	Latitude 34.86° S; Longitude 138.65° E
Rainfall	Mean 442.8 mm (Jan 1912 to June 2023, BoM).
Hydrology	Intermittent to permanent, depending on run-off volumes and patterns.
Size	Reserve 5.32 ha; Total Wetland Area: 1.8 ha. Basin A: 0.3ha, Basin B: 0.4ha, Basin C: 0.1ha, Basin D: 0.2ha, Basin E: 0.6ha, Basin F: 0.1ha.
Conservation Value	Roy Amer Reserve Wetlands support nesting habitat for Australian White Ibis (<i>Threskiornis molucca</i>) and Royal Spoonbill (<i>Platalea regia</i>) and a range of other native waterbirds, including Dusky moorhen (<i>Gallinula tenebrosa</i>), Australian wood duck (<i>Chenonetta jubata</i>) and Western swamp hen (<i>Poryphyrio porphyrio</i>). Native vegetation – no species of conservation significance but important habitat, aesthetics and water treatment services. The wetlands also support native yabbies, frogs, lizards and invertebrates.
Land Tenure	Local Government Open Space
Management Objectives	A. Improve water quality and reduce odours, particularly in Basin F. B. Increase the diversity and abundance of native plants across the wetland system. C. Maintain existing native bird populations and enhance habitats for other native fauna, such as native fish, frogs, lizards and invertebrates. D. Control pest plants and animals. E. Take opportunities to increase conservation status at a regional scale.
Ten-Year Action Plan Summary	1. Re-instate GPTs to control incoming pollutants. 2. Clean out silt and other matter from inlets monthly after flow. 3. Plant new and/or threatened native aquatic plants along the elevation gradient. 4. Install gabion structures planted with amphibious aquatic plants (Basins A, B and F). 5. Install bird-proof covers on bins to prevent access by wildlife. 6. Improve signage and increase community engagement to discourage bird feeding and the release of pest fish or other aquatic animals. 7. Remove Common carp by electrofishing and/or netting (will require boat ramp). 8. Remove pest plants and undesirable native seedlings. 9. Introduce threatened native fish, if feasible (Basin B as priority). 10. Collaborate, fill knowledge gaps and increase operational capacity.

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Executive Summary

Urban stormwater wetlands are a significant component of the contemporary landscape of the Adelaide Plains. Natural wetlands have declined due to water resources and catchment development and thus constructed wetlands play an important role in providing habitats for wetland flora and fauna, and delivering ecosystem services, such as flood mitigation, stormwater treatment and cooling the environment during heatwaves.

Roy Amer Reserve in Oakden, South Australia, contains a residential stormwater wetland system of six interconnected basins. The wetlands were constructed in 1993-1994 as part of the land development and were originally intended to treat water prior to injection into the groundwater as an Aquifer Storage and Recharge facility. These operations ceased in the early 2000s because it was found that the wetland design was not suitable to treat water to the standard required for injection.

The water regimes of the six wetland basins are intermittent to permanent, being primarily controlled by patterns of urban run-off and rates of evapotranspiration (i.e. evaporation from the water surface plus water used by vegetation). All six basins (Basins A to F) receive stormwater directly except for Basin C, which receives water from Basin B directly and Basin A indirectly. Basin F is the last in sequence, but it has the lowest quality water even though it has the longest treatment pathway due to inputs of faecal matter from the large resident populations of native and feral birds.

The Roy Amer Reserve Wetlands support nesting habitat for Australian White Ibis (*Threskiornis molucca*) and Royal Spoonbill (*Platalea regia*) and a range of other native waterbirds, including Dusky moorhen (*Gallinula tenebrosa*), Australian wood duck (*Chenonetta jubata*) and Western swamp hen (*Poryphyrio porphyrio*). The Australian White Ibis rookery on the island in Basin F is of regional conservation significance, being one of only nineteen breeding colonies of this protected, native bird on the Adelaide Plains. Small native fish, Big-headed gudgeons (*Philypnodon grandiceps*), were released by the Native Fish Association in the mid 1990s, but these have not survived. As well as native birds, the reserve supports large numbers of feral species (e.g. pigeons, doves and geese) that roost in a gum tree adjacent to the bridge between Basins D and F.

Unfortunately, the birds are accessing rubbish bins in the reserve and park users frequently feed the birds, which means that the populations are higher than if the birds were only feeding on natural foods. Larger populations of resident birds mean larger loads of nutrients from faeces for the wetlands to process and this coupled with the infestation of Common carp (*Cyprinus carpio*), and the persistent suspension of fine clays used during construction to line the basins, has resulted in the current poor water quality, dominance of algae over plants in the water column and odour issues.

It is also likely that some of the bread, and other human foods intended for the birds, enters the water column and feeds the feral fish (Common Carp, Eastern Gambusia (*Gambusia holbrooki*) and Goldfish (*Carassius auratus*)) and promotes algal growth, further contributing to the water quality issues.

The native trees and emergent wetland plants (e.g. reeds) have established well since construction, however, submerged and other amphibious aquatic plants have not, which is likely to be due to the high turbidity and high rates of herbivory or other damage caused by birds.

Site managers have little capacity to control water levels to address these issues because of the aseasonal and highly dynamic character of stormwater inputs that can be generated at any time of year following even very small rainfall events. During hot, dry periods the water levels in the basins drop, but in most years, water is retained in the deeper areas of Basins A, B and F. Refilling can occur at any time of year and can occur very quickly with water levels changing by tens of centimetres overnight following storm events. This requires managers to focus on management objectives and actions within the site that can be adapted to changing water levels.

Five management objectives have been developed for the Roy Amer Reserve Wetlands, namely:

- A. Improve water quality and reduce odours, particularly in Basin F.
- B. Increase the diversity and abundance of native plants across the wetland system.
- C. Maintain existing native bird populations and enhance habitats for other native fauna, such as native fish, frogs, lizards and invertebrates.
- D. Control pest plants and animals.
- E. Take opportunities to increase conservation status at a regional scale.

Nested under these objectives are the following ten management actions for staged implementation over the next 10 years (2023 to 2033):

- 1. Re-instate GPTs to control incoming pollutants.
- 2. Clean out silt and other matter from inlets monthly after flow.
- 3. Plant new and/or threatened native aquatic plants along the elevation gradient.
- 4. Install gabion structures planted with amphibious aquatic plants (Basins A, B and F) to increase the water treatment capacity and provide habitat (this includes replacing the retaining wall around Basin F with gabion rather than wet stone walls).
- 5. Install bird-proof covers on bins to prevent access by wildlife.
- 6. Improve signage and increase community engagement to discourage bird feeding and the release of pest fish or other aquatic animals.
- 7. Remove Common carp by electrofishing and/or netting (will require boat ramp).
- 8. Remove pest plants and undesirable native seedlings.
- 9. Introduce threatened native fish, if feasible (Basin B as priority).
- 10. Collaborate, fill knowledge gaps and increase operational capacity.

Achievement of these objectives and effective implementation of these actions will lead to improved ecological condition and the follow-on benefits for the community surrounding Roy Amer Reserve. Success will be dependent on strong engagement and collaboration with the users of the reserve and the surrounding residents to stop feeding the birds and allow them to exhibit more natural feeding behaviours.

A monitoring program has been developed to track progress against the site objectives and this incorporates a citizen science component to collect data on the type and numbers of birds utilising the reserve and their behaviours. There are also opportunities for the community, particularly school groups, to monitor water quality over time in the six basins. If Common Carp can be controlled, it may also be possible to re-introduce threatened native fish, thereby increasing the regional conservation significance of the wetlands further.

This plan will guide management of the Roy Amer Reserve Wetlands for the next ten years (2023 to 2033) and is scheduled for review in five years.

1 Introduction

The Roy Amer Reserve is one of over 100 reserves owned and managed by the City of Port Adelaide Enfield (Council) that add numerous green space and outdoor play values to the district, as well as providing significant habitat for local and regional flora and fauna.

Council has a commitment to the protection, restoration and promotion of the city's natural environment through a hierarchy of plans, including the Council's City Plan 2030, Living Environment Strategy, Biodiversity Management Plans and the Open Space Strategy. These documents provide direction in delivering on-ground outcomes, but there remains a need to develop a site-specific plan for the Roy Amer Reserve to ensure the conservation and enhancement of its biodiversity values and the wise management of the wetlands within the reserve as a stormwater treatment and flood mitigation facility.

Key management issues for the Roy Amer Reserve identified in consultation with Council include:

- Odours, noise, 'anti-social' behaviour and rubbish bin foraging associated with the Australian White Ibis colony on the island in Basin F.
- Poor water quality and odours, particularly in the most southerly basin that contains the island rookery and a large, resident population of feral pigeons and doves (Basin F).
- Large quantities of silt, rubbish and leaf litter entering the wetland basins with stormwater.
- Pest plants (weeds) establishing on the margins and within the wetlands.
- Loss of small native fish introduced after construction in the 1990s.
- Large numbers of alien fish (Common carp and Eastern gambusia), particularly in Basin F, and the contribution Common carp make to poor water quality and lack of aquatic plant cover.
- Poor uptake of amphibious and submerged aquatic plants that can provide water purification services (from original planting in mid-1990s and follow-up planting in 2010 during the reconstruction of Basins A, B, C and D).

This ten-year Roy Amer Reserve Wetland Management Action Plan (WMAP) was developed between March and September 2023 by Dr. Kerri Muller (Kerri Muller NRM, AU2100), Dr. Sylvia Zukowski (Nature Glenelg Trust) and Professor Greg Johnston, in consultation with Council staff. It has been informed by various ecological reports, management plans, the original wetland design, higher demand in maintenance requests, new data collected during Autumn 2023, site observations, discussions with citizen scientists who record bird data and a review of public comments regarding the wetland.

This WMAP will assist Council field staff, regional managers, citizen scientists and environmental community volunteers to work with a common understanding towards improving the stormwater treatment and ecological features of Roy Amer Reserve that addresses the key site management issues.

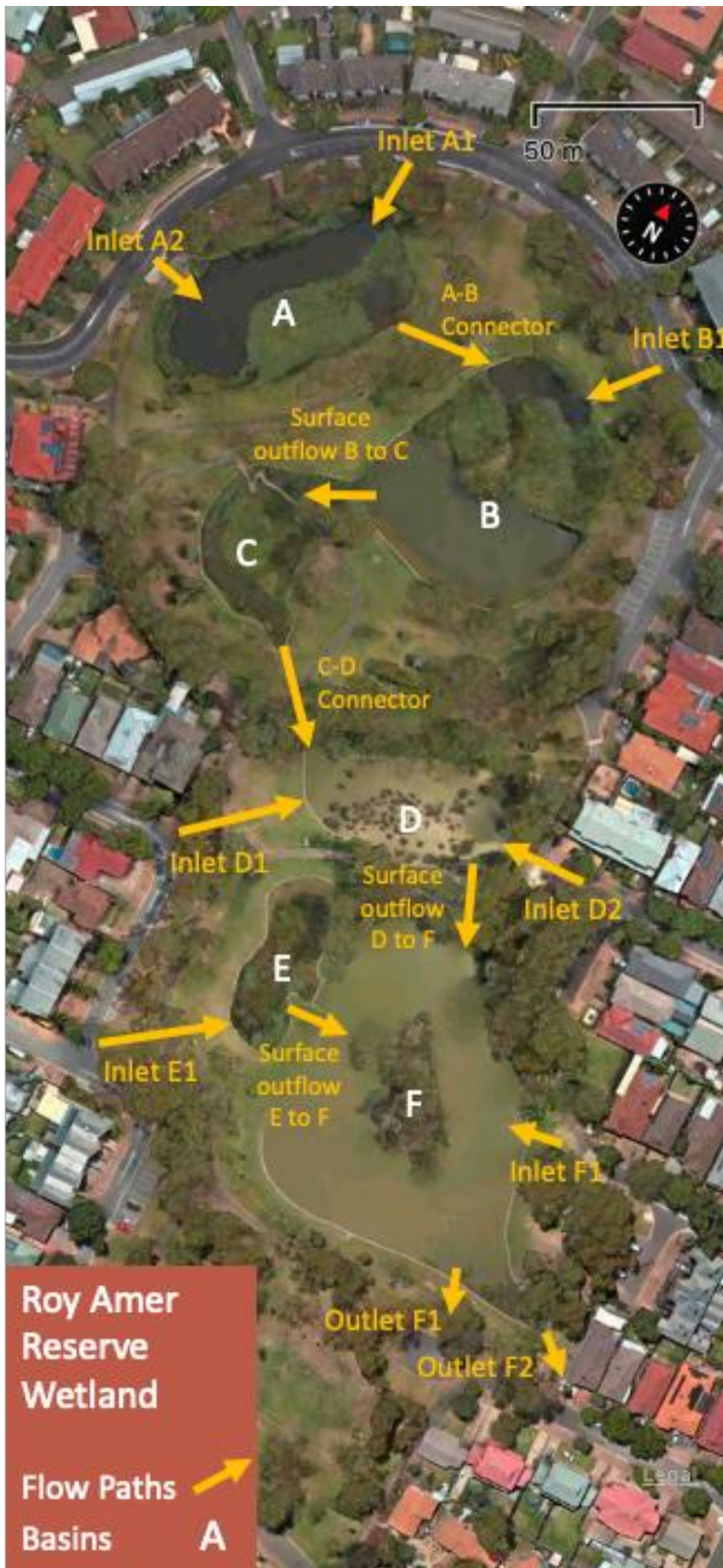
2 Physical Description

2.1 Location

The Roy Amer Reserve is a 5.32 ha reserve in the suburb of Oakden, approximately 10 km northeast of Adelaide, South Australia (Figure 1), within the City of Port Adelaide Enfield and the River Torrens catchment. It is a popular park providing a playground, walking trails around the wetlands, BBQs and other recreational opportunities.

2.2 Construction and Current Operations

The wetlands were constructed in 1994 as part of the Oakden residential development (Figure 1). Originally, they were intended to purify stormwater for injection into the underlying groundwater as an Aquifer Storage and Recovery (ASR) facility to provide water for irrigating the reserve. Water quality issues discovered in the early 2000s, and the realisation that the wetland design was unsuitable for this purpose, led to the cessation of ASR operations. See also Figure 12 to Figure 17.



Basins & Water Flows

Basin A – main entry pond (Inlets A1, A2); dense reedbeds filter water before entering Basin B; GPTs without baskets.

Basin B – entry pond (inlet B1), dense vegetation in shallow treatment area, low plant cover in deeper southern section; GPT without baskets.

Basin C – connector channel and floodway from Basins A/B to D; dense reedbeds and sparse floodplain vegetation.

Basin D – connects Basins A/B/C to F and receives stormwater directly (Inlets D1 and D2); dense reedbeds filter water; GPTs without baskets.

Basin E – receives stormwater directly (Inlet E1) and discharges into Basin F; dense reedbeds filter water, no GPT.

Basin F – largest basin receives water from whole site via Basins D and E and directly (Inlet F1); also contains two outlets for whole system (one outlet at street level, Outlet F2, is overflow for main outlet underground pipe, Outlet F1); contains island that supports an Australian white ibis colony; very little aquatic plant cover; poorest water quality.

System outflows to Bristol Tce. and ultimately to the River Torrens.

Figure 1: Roy Amer Reserve Wetland Basins A to F showing flow direction, basins, inlets and outlets.

From February 2008 to February 2010, four basins (A, B, D & E) were reconstructed (Figure 2). Stone and concrete retaining walls were built to control erosion around the wetland edges generated by wave action. The exit pond was reconfigured from one basin into two basins, Basins D and F, to assist with slowing down the stormwater, trapping pollutants and creating benches for aquatic plants to grow in to increase the water filtration and purification capacity. Given that stormwater inflows could not be prevented, there was a need to undertake the works in late summer and pump out water that remained in the four basins into Basin F. Clay soils were imported and used to line Basins E and D. Some of this white clay (possibly bentonite) washed into Basin F and has remained in suspension.

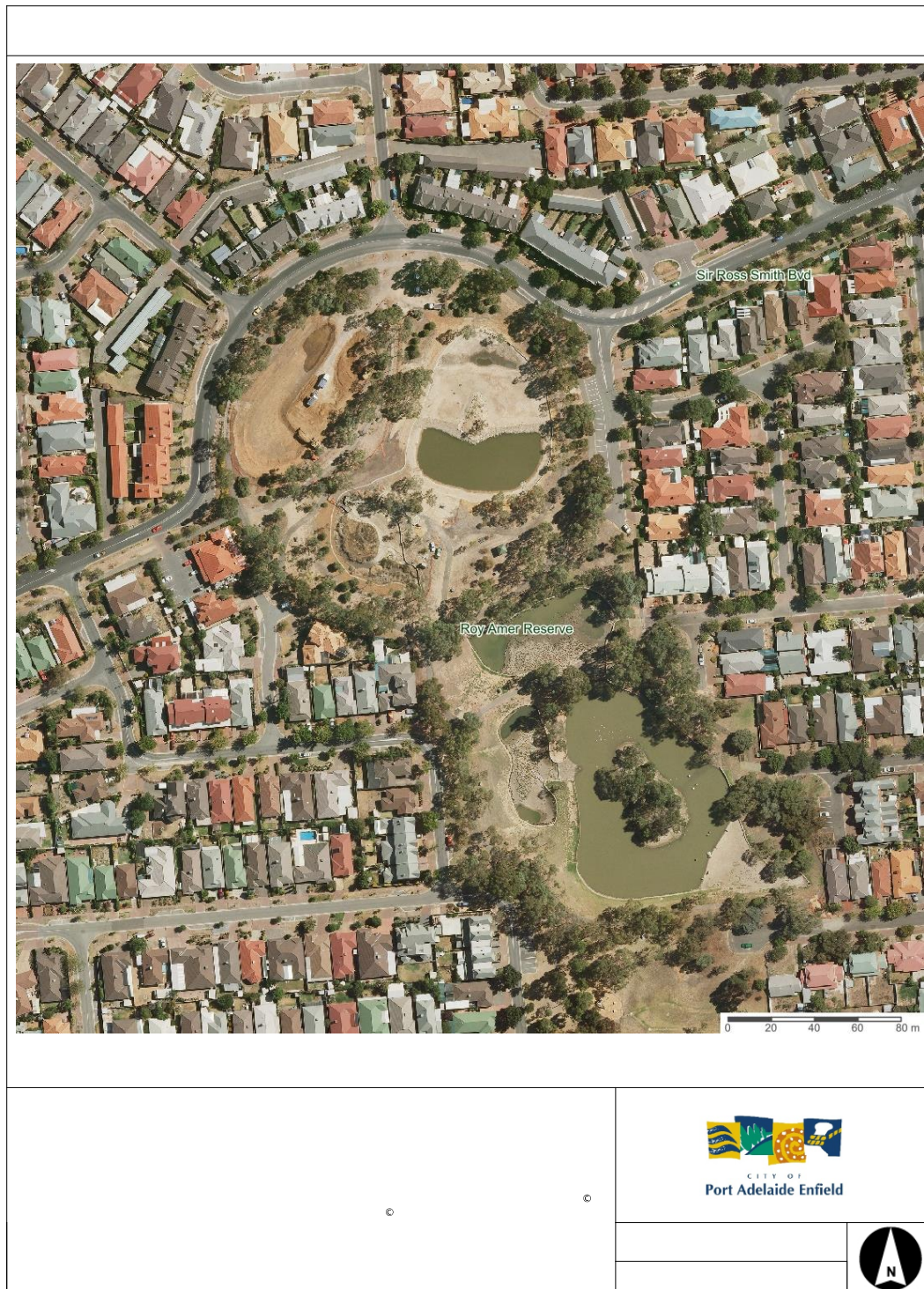


Figure 2: Aerial image of Roy Amer Reserve in February 2010 when four of the basins were reconstructed.
 Note: low water levels show deeper and shallower areas of each basin and water ponding near inlets.

2.3 Climate

The climate on the Adelaide Plains is warm temperate with most of the annual rainfall occurring between May and November (Figure 3). The long-term average (mean) for the period 1912 to 2023 was 442.8 mm, although annual rainfall has varied from ~250 mm to ~750 mm over the record.

Winter and spring 2023 were relatively wet compared to the long term mean and median data (Figure 4) with November 2023 having similar rainfall to the winter peak. This meant that the wetlands were at capacity during the time that this plan was developed.

It is assumed that stormwater will enter the wetlands following any rainfall event of 1 mm or more, at any time of year, due to the predominance of hard surfaces in the catchment area (See Section 2.4).

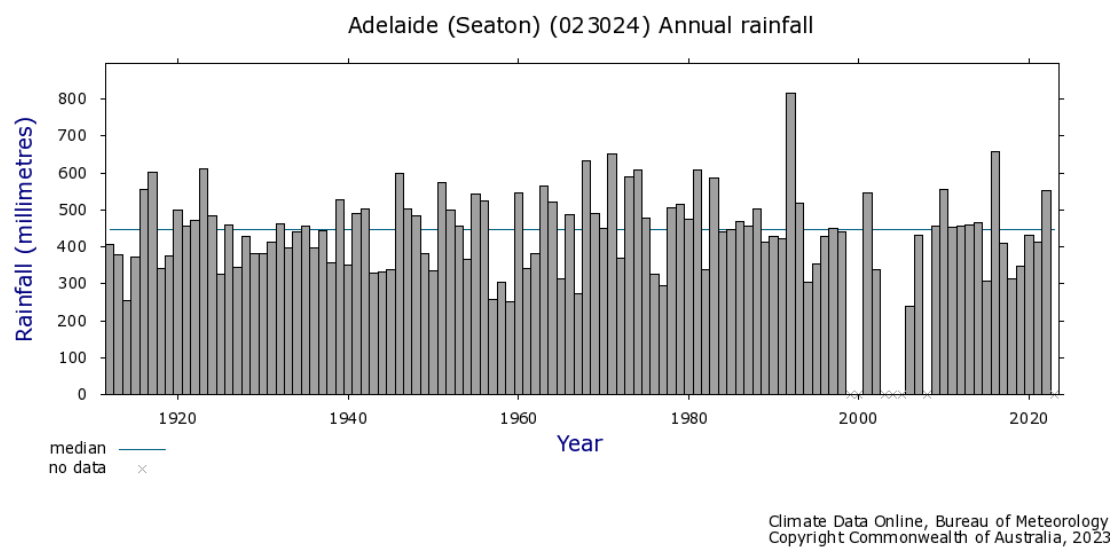


Figure 3: Annual rainfall (mm) at Seaton on the Adelaide Plains for the period January 1910 to June 2023.

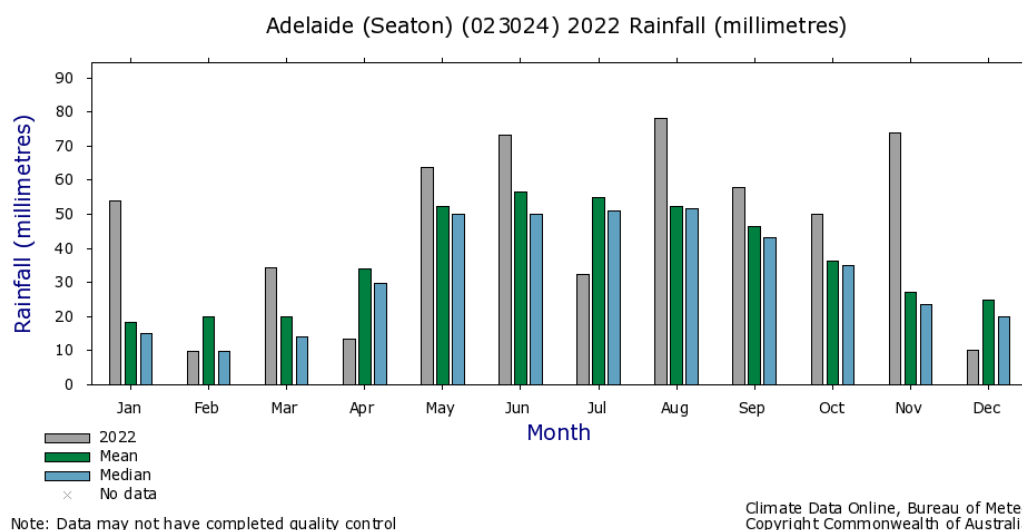


Figure 4: Monthly rainfall at Seaton on the Adelaide Plains showing rainfall in 2023 compared to the long-term mean and median data (1910 to 2023).

2.4 Catchment Area

The Roy Amer Reserve wetlands were built to treat and store stormwater draining from the surrounding residential land. The polygon shown in Figure 5 approximates the stormwater catchment area for the Roy Amer Reserve wetlands as determined by analysing the invert heights and connections between infrastructure on the Locations SA website. The hard surfaces mean that very little rainfall soaks into the ground and that very little rain is needed to generate run-off into the wetlands (assumed that runoff occurs after 1 mm of rain or more).

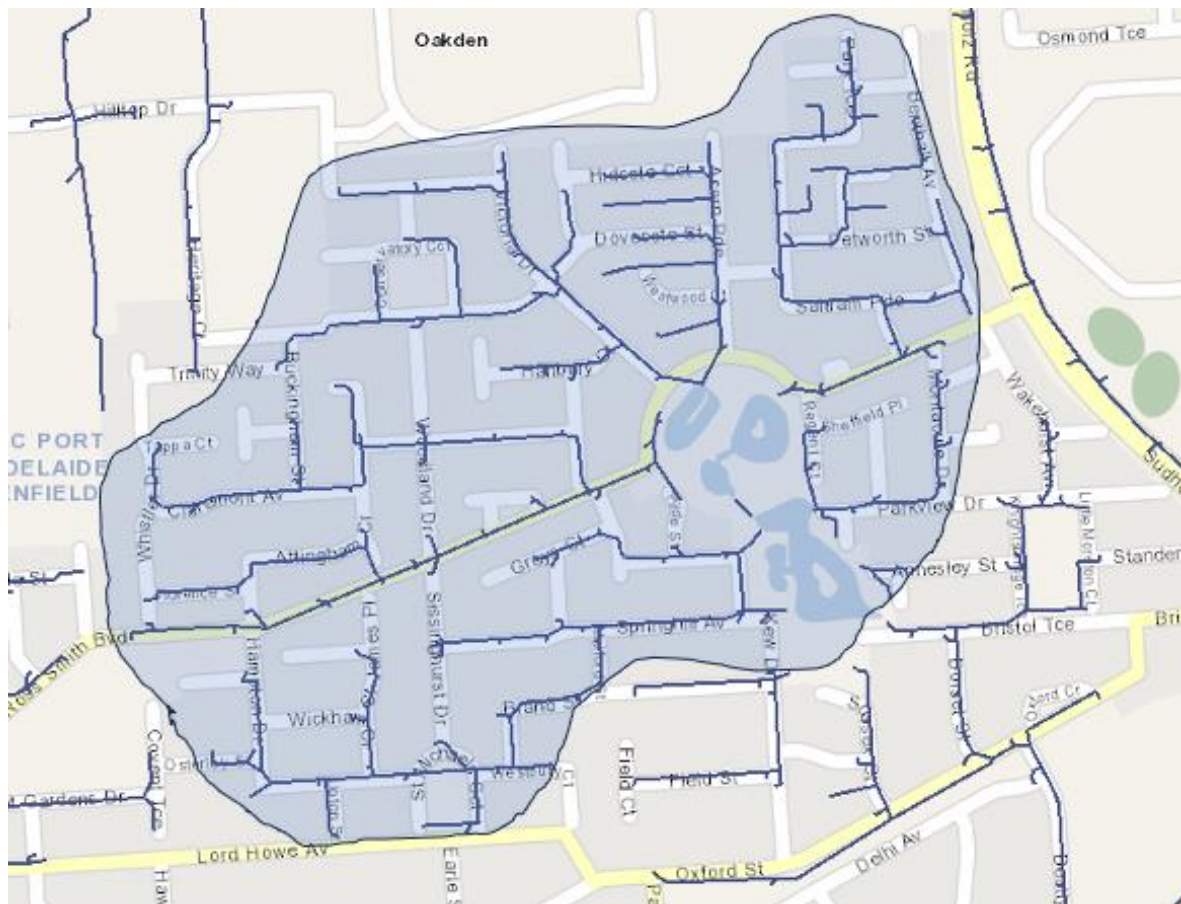


Figure 5: Approximate catchment area for Roy Amer Reserve wetlands based on infrastructure mapped on Location SA.

3 Ecological Features

3.1 Vegetation

3.1.1 Native plants

Water regime is the principal driver of a wetland's character and function (Boulton and Brock 1999). Plants and other wetland components do not just respond to water levels, they respond to a whole water regime, which includes the timing, duration and depth of inundation and the degree of exposure experienced at the plant habitat scale. As a consequence, aquatic plants are excellent indicators of the actual water regime at a location in a wetland system and will grow in bands indicative of the how wet or dry a given part of the wetland is.

Given that these are constructed wetland basins, the majority of the plants in them have been planted. The original planting lists from 1994 were not available, however, the plans and species lists prepared by Barrie Ormsby, Landscape Architect, in 2008 for planting Basins D and E after their reconstruction in 2010, have been used and form the basis of the species lists in Table 1. It is assumed that similar plant species were planted into Basins A, B and C when they were established.

Table 1: The current relative abundance of native aquatic plant species observed in autumn 2023, separated into those known to have been planted in 2010 when Basins D and E were reconstructed and self-colonising plants, across the six basins. Dark green indicates dense and abundant stands, mid green indicates present but not dominant, light green indicates present but sparse and white indicates not observed.

The letter r indicates that the species is recruiting.

Species	Common Name	A	B	C	D	E	F
Species planted into Basins D and E in 2010 observed in autumn 2023							
<i>Baumea articulata</i>	Jointed rush						
<i>Bolboscheonus caldwellii</i>	Marsh club rush						r
<i>Carex appressa</i>	Tall sedge						r
<i>Centella cordifolia</i>	Heart-leaved pennywort	Not observed.					
<i>Cynogoten procerum</i>	Water ribbons	r	r	r	r	r	r
<i>Cyperus exaltatus</i>	Tall flat-sedge						
<i>Cyperus gymnocaulus</i>	Spiny flat-sedge						r
<i>Cyperus vaginatus</i>	Stiff flat-sedge						r
<i>Eleocharis acuta</i>	Spike rush						
<i>Eleocharis sphacelata</i>	Tall spike rush						
<i>Hydrocotyle verticillata</i>	Shield pennywort	Not observed.					
<i>Juncus</i> sp.	Rush						
<i>Marsilea drummondii</i>	Nardoo						
<i>Myriophyllum crispatum</i>	Water milfoils	Not observed.					
<i>Myriophyllum verrocosum</i>	Red water milfoils	Not observed.					
<i>Persicaria decipiens</i>	Slender knot weed	Not observed.					
<i>Phragmites australis</i>	Common reed						
<i>Scheonoplectus pungens</i>	Sharp club rush						
<i>Scheonoplectus validus</i>	River club rush						
Self-colonising 'volunteer' species or recruiting planted species (r) observed in autumn 2023.							
<i>Crassula helmsii</i>	Swamp crassula						
<i>Callistemon rugulosus</i>	Scarlet bottlebrush	r	r	r	r	r	
<i>Eucalyptus camaldulensis</i>	River red gum	r	r	r		r	
<i>Melaleuca lanceolata</i>	Dryland Tea Tree		r	r			
<i>Typha domingensis</i>	Bullrush	r	r			r	

In general, the sedges and rushes have established well. In both Basins D and E there are dense reed beds, dominated by *Baumea articulata*, *Juncus* sp., *Phragmites australis* and *Carex appressa* (Basin D), which appear to be effectively filtering the stormwater. The reedbeds in the shallower areas of Basins A and B (Figure 1) are also dominated by *Baumea articulata*, *Phragmites australis* and *Juncus* spp. The hard concrete edges around the wetland basins prevent the reedbeds from extending outwards and thus the bands of the plants that prefer intermittent watering are constrained around the edges of the more vigorous and dominant plants. No weedy *Juncus acutus* plants were observed.

Some species, such as *Eleocharis sphacelata*, *Marsilea drummondii*, *Scheonoplectus pungens*, *S. validus* and *Cyperus* spp. were still present in autumn 2023 but were not dominant and were generally in small numbers within stands of the more dominant reeds. *Cynogeton procerum* has established well and was observed to be setting seed in autumn 2023 and recruiting into shallow areas where sediment is accumulating (e.g. bare areas of Basin E, inlet Basin D, outlet pan of Basin F). Basin F is otherwise almost devoid of aquatic vegetation other than sparse reed beds near the outlet and near Basins D and E. Site

managers suggest that waterbirds have removed the plants that were originally planted in the water in Basin F. The plantings on the island were modified to limit ibis nesting opportunities (See Section 3.2).

No plants of the species with blank cells in Table 1 were observed in any of the basins in autumn 2023 across four plant survey visits (5th April, 5th May, 19th June, 4th July 2023). Of note, is the lack of submerged aquatic plants (e.g. *Myriophyllum* spp.) and riparian herbs in any of the basins (e.g. *Persicaria decipiens*, *Hydrocotyle verticillata*). Their absence may be due to being: removed by birds or Common carp, outcompeted by other plants, inability to access sufficient light to grow and/or that they did not establish strongly in the habitats they were planted into. The lack of these plants will be limiting the water treatment capacity of the basins, especially Basin F, which has a high nutrient load from the large populations of birds the reserve supports.

3.1.2 Pest Plants

The wetlands have very few pest plants overall. Introduced tree species were germinating in Basins A, B, C and E, especially *Acer* sp. seedlings around the inlet areas, which have presumably come in as seeds in the stormwater. Basin C has the highest pest plant cover with kikuyu, Burr clover and *Aster* sp. dominating the floodplain area along the western side of the basin. *Aster* sp., thistles and Burr clover were also present on the edges of Basins B and E.

Typha domingensis (Bullrush), which are wind dispersed and readily establish in any permanently wet soils, were present in low numbers in Basins A, B and E. In accordance with the planting notes provided by Barrie Ormsby, Landscape Architect responsible for replanting in 2010, these should be removed to prevent establishment, despite being a native plant, due to their tendency to form monocultures.

3.2 Birds

3.2.1 Australian White Ibis

Australian White Ibis are a protected, native waterbird that form nesting colonies on vegetation surrounded by water. They are declining in numbers in non-urban areas of South Australia, presumably in response to loss of natural wetland habitats due to land and water resources development. In contrast, they are increasing markedly on the urbanised Adelaide Plains, especially in areas that offer habitat (e.g. constructed wetland islands, near shore marine islands) and food resources (e.g. rubbish bins, landfill).

Not known to breed around Adelaide until 1990, these birds have now established 19 breeding colonies on the Adelaide Plains, one of which is the island in Basin F at Roy Amer Reserve (Figure 7). At least five of the 19 breeding colonies in the Adelaide region have been destroyed or vacated spontaneously. Unfortunately, the odours and noise associated with the colony in Basin F are a source of nuisance to nearby residents and Council has received complaints in relation to bird noise and faeces odour issues.

Most of the research into Australian White Ibis and their interactions with humans has been undertaken in the Eastern States. This has shown that these birds can move over large areas to feed and find nesting sites, therefore, management needs to happen at a regional scale. Site scale deterrents tend to be short-lived before the birds re-establish in the same location or they shift the birds to another nearby location and thereby shift the problem to another part of the same Local Government area or to a neighbouring Local Government area.

Green Adelaide Landscape Board has a regional project underway to assist Councils and landholders. Their project, *Wildlife and Waste*, will document the distribution, abundance, breeding success, movements and interactions of Australian White Ibis with human waste and other food resources. Birds that are captured will be weighed, measured and wing-tagged or fitted with electronic trackers to record their movements. Members of the public will be encouraged to report wing-tagged birds via a dedicated phone app and website (big city birds: <https://taronga.org.au/conservation-and-science/current-research/big-city-birds>).

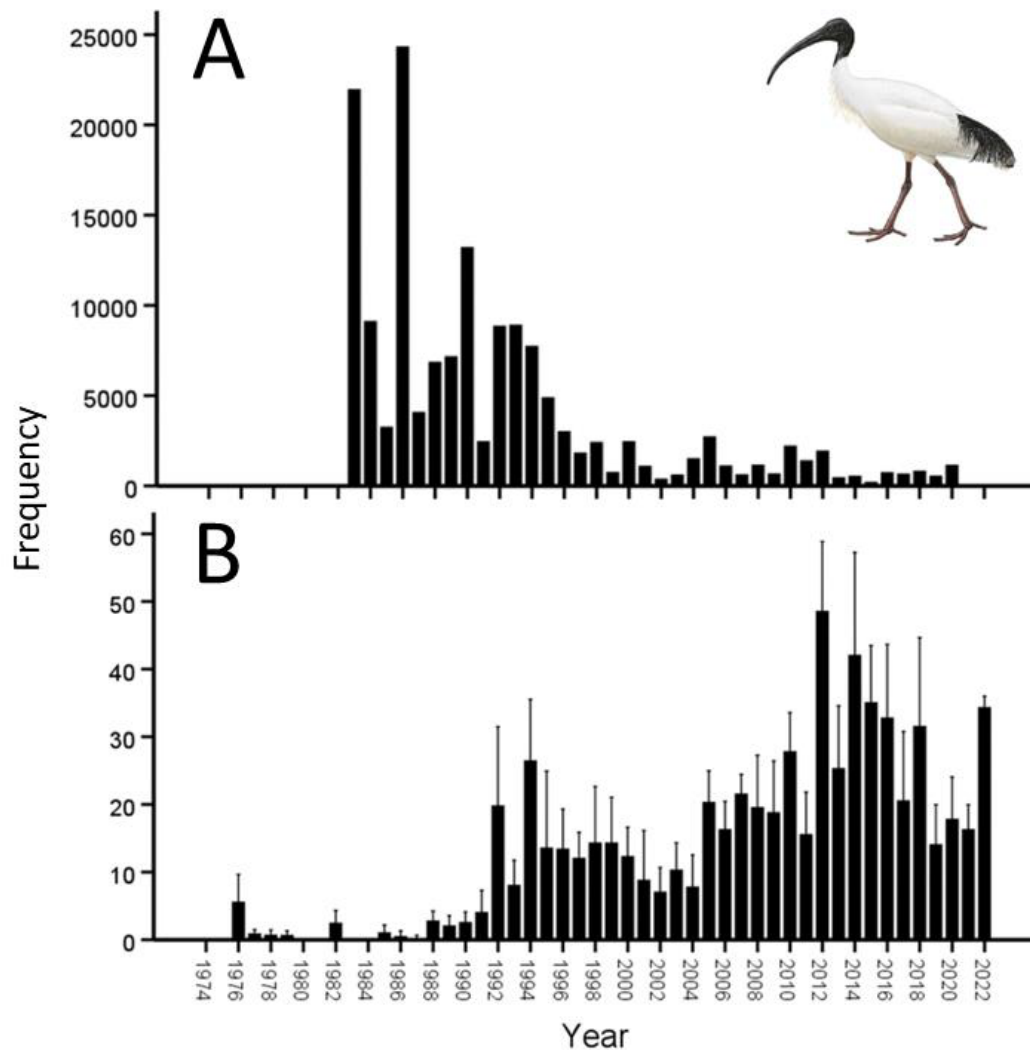


Figure 6: Australian White Ibis are declining in natural wetlands in South Australia, based on the East Australian Waterbird Survey 1983-2022 (A), whilst increasing in numbers in urban Adelaide areas based on Bob Whatmough's surveys along the River Torrens 1975-2022 (B) over the same time period.
Source: Johnston (2022).

Australian White Ibis established at Roy Amer Reserve in 2008, increasing rapidly from 20 individual birds to a population of 100s within 18 months (EBS Ecology 2010). Management options proposed by EBS Ecology (2010) included further studies of site usage and food sources, improving visibility of public signage to discourage visitors feeding birds, removing roosting shrubs and understorey vegetation (*Melaleuca* spp., *Callistemon rugulosus*) on the island and removal of eggs and/or nests.

The roosting plants were removed from the island in March 2013 and the Australian White Ibis population appears to have stabilised since these modifications were undertaken. Bird numbers are still greatest on the island in Basin F and totalled approximately 200 birds in autumn 2023 (approximately 100 pairs) based on counts using binoculars from the edges of Basin F (14:30 pm 5th May 2023). Citizen science records show that Australian White Ibis represented 70% of the bird population at Roy Amer Reserve and that 1410 out of 1484 bird observations over the summer 2022/23 period were from the island in Basin F (PAE 2023). The ibis were observed using the rest of the reserve in autumn 2023 to collect sticks for their nests and forage for food, including the removal of food waste from rubbish bins.

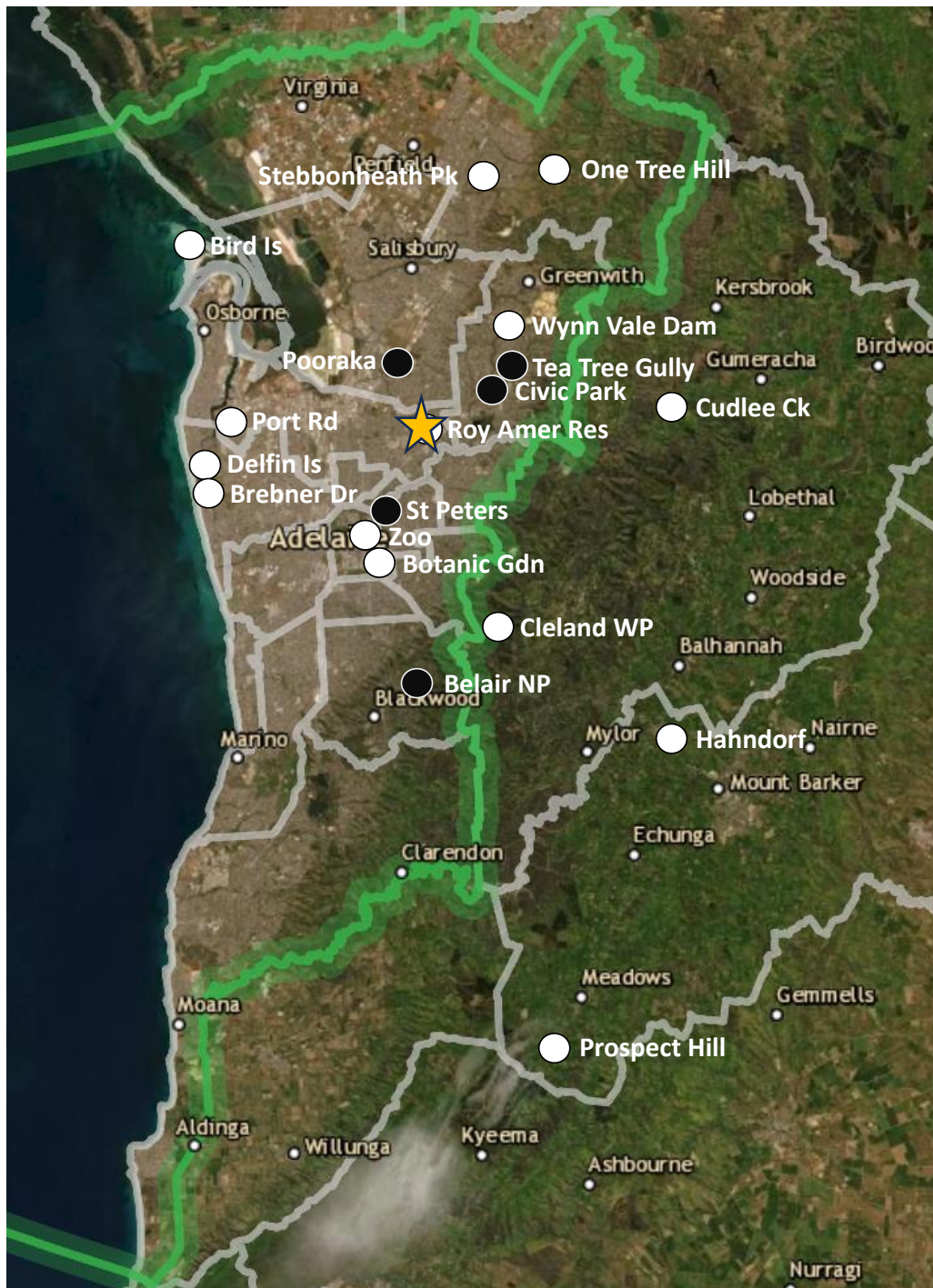


Figure 7: Roy Amer Reserve (yellow star) is one of nineteen Australian White Ibis colonies on the Adelaide Plains and one of three in the City of Port Adelaide Enfield area. Green line is the Green Adelaide boundary and grey lines are Local Government boundaries.

3.2.2 Other Birds

Australian White Ibis are the most dominant bird at Roy Amer Reserve (70%; Figure 8), mostly utilising the island in Basin F. There are, however, a number of other native birds that utilise the site, including Western swamphens, Royal spoonbills, ducks and Dusky moorhen. Western swamp hens, or purple swamp hens, are nesting in Basins D and E and may be increasing in number. Feral rock doves, or common pigeons, are the second most numerous bird species and these are concentrated around a large River red gum next to the bridge between Basins D and F. In addition to the species recorded in Figure 8, one or two native Little Grebes were observed on each of three visits in autumn 2023.

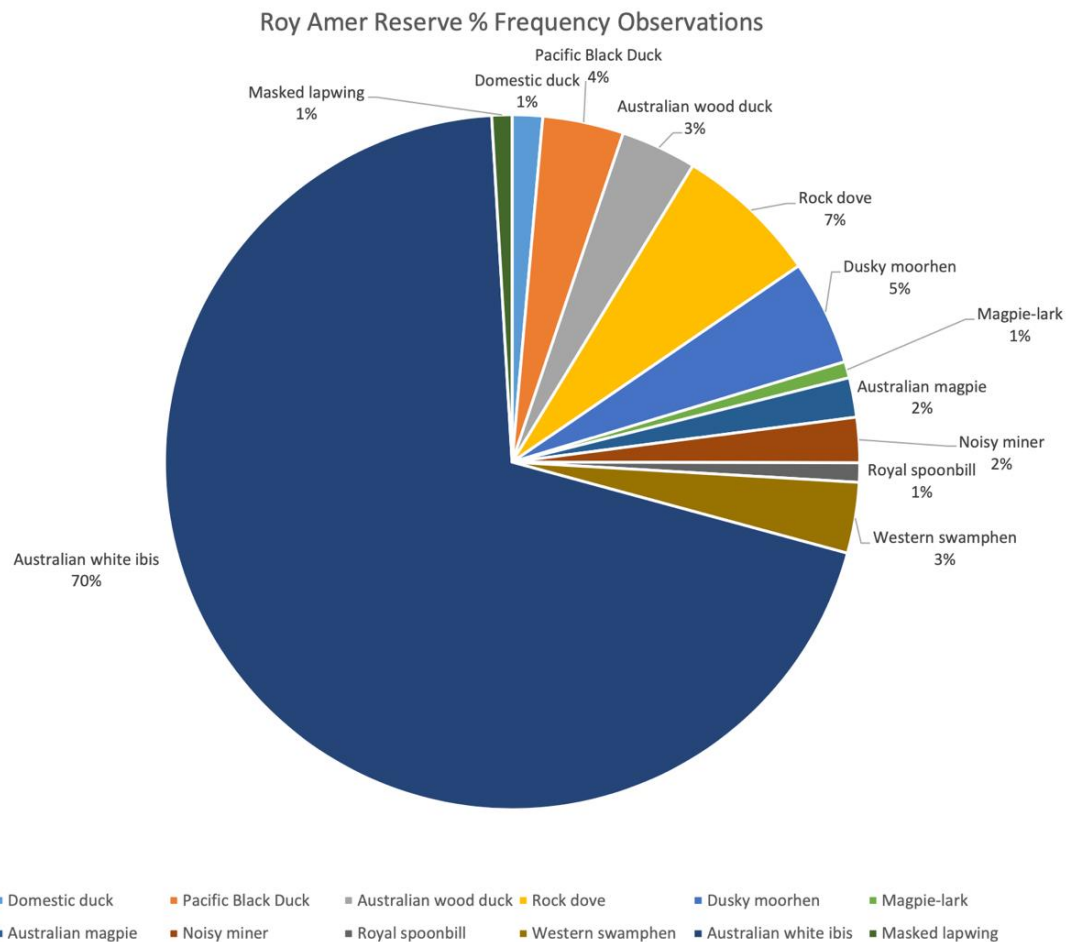


*Figure 8: Frequency of different bird species at Roy Amer Reserve as observed by citizen scientists.
Source: PAE 2023.*

3.2.3 Waterbird Management Recommendations

The best management actions for Roy Amer Reserve are to:

- Control access to food sources (i.e. modify bins)
- Engage with community members to stop feeding birds
- Record and monitor bird numbers
- Increase water purification capacity to treat bird faecal matter and reduce odours in Basin F
- Use vegetation on the gabion islands to visually detract from ibis nests

Other management options, such as egg oiling or nest removal, are not recommended primarily because these birds are native, protected and in decline at a regional scale. Secondly, they appear to have stabilised in number at the reserve, are relatively contained to the island in Basin F and other less destructive strategies, such as a stronger community engagement program to discourage hand-feeding of birds and securing bins to prevent ibis accessing food waste, can be implemented.

See Sections 56 for Management Objectives and Actions.

Australian White Ibis Key messages:

- Kurna totem (for discussion with Kurna Elders)
- A native bird that needs to be respected and managed at regional scale.
- A bird that is declining in numbers due to loss of natural wetland habitats.
- They can fly long distances (1000s kilometres) in response to water and food availability and have only bred on the Adelaide Plains since 1990 in response to changes in food and habitats.
- Not bullies - nest peacefully with other birds e.g. Royal Spoonbill on the island in Basin F
- Stabilised population in Basin F: ~110-150 nests, 200-300 birds maximum.
- Urban communities need live alongside native wildlife (e.g. Green Adelaide Landscape Plan)
- NP&WS Act 1972 – protects Australian White Ibis as a native animal.
- Links to PAE Biodiversity Strategic Plan – habitats and resources.
- Local school emblem – potential community engagement activity to involve kids in water quality monitoring.
- Please do not feed the birds. They need to forage naturally on worms and insects.
- Human foods are not natural foods for birds and feeding them leads to large populations, worse smells and poor water quality.

3.3 Fish

3.3.1 Fish sampling methods

Nature Glenelg Trust undertook fish surveys in May 2023 as part of the development of this plan. Fyke nets were deployed in Basins A, B and F due to safety concerns regarding electrofishing, which is the preferred sampling method (see Section 3.3.2 below).

Single-winged fyke nets (2 x small, 3 m wing, 4 mm mesh, 0.6 m d-entrance; 2 x large, 5 m wing, 4 mm mesh, 0.6 m d-entrance) were set overnight (with a float in the end to allow surface access for air-breathing by-catch e.g. turtles) to sample the widest range of fish species across varying aquatic microhabitats. Twelve fyke nets were set in Basin F and four fyke nets each were set in Basins A and B (Figure 9).

Any native fauna (fish, turtles, shrimp and yabbies) that were captured were identified, measured and released at point of capture. All sampled fish were identified to species level (Allen et al. 2002), counted and observed to obtain general biological information (reproductive condition and external disease or parasites). Total length (TL, mm) was recorded for up to 50 individuals for each species per site. Fork length (FL, mm) was also recorded for adult Common Carp. Introduced species were euthanized using AQUI-S solution upon capture.

All sampling was undertaken under the relevant permits to undertake the monitoring and harvest including the Ministerial exemption under Section 115 of the Fisheries Management Act 2007 (MINISTERIAL EXEMPTION – ME9903207) which Nature Glenelg Trust possess.



Figure 9: Fyke nets set in Roy Amber Basin F, May 2023.

3.3.2 Fish Population Structure

In 1993, Big headed gudgeons (*Philypnodon grandiceps*) were released into the Roy Amer Reserve basins by the Native Fish Society (commemorative plaque near Basin F). These are a native freshwater small-bodied species that are bottom dwelling and prefer abundant aquatic vegetation. This habitat is not provided in the Roy Amer Reserve wetlands, which may explain why they were not caught in the 2023 surveys. More recently, only alien fish species, Common Carp (*Cyprinus carpio*), Eastern Gambusia (*Gambusia holbrooki*) and Goldfish (*Carassius auratus*), have been caught in the Roy Amer Reserve basins.

3.3.3 Alien Fish Removal

Common Carp are a noxious, alien fish species that negatively impact aquatic habitats and water quality. These pest fish are bottom feeders, sucking sediment into their mouths, where food items are separated and retained, and the sediments are ejected back into the water. This can lead to increased turbidity (muddiness of the water) and the uprooting of aquatic plants. Unfortunately, Common Carp can survive in poor water quality conditions and reproduce quickly, efficiently and in high numbers during warmer weather. Common Carp, Goldfish and Eastern Gambusia predate on, and compete with, native fish species making establishment of native fish populations difficult without first removing alien species.

In March 2018, Common carp were harvested using boat electrofishing by Nature Glenelg Trust in Basin F with the aim of reducing the population abundance and thereby improving water quality. Fish were targeted in all habitats across the basin using boat electrofishing (5.0 kW Smith Root Model® GPP). In total, 287 Common Carp were harvested from Basin F. The size of fish ranged from 100 to 740 mm in length and 0.1 to 6.5 kg in weight, and the catch was dominated by juveniles (100–130 mm length), presumably from a similar age cohort (e.g. 1-3 years old).

In May 2023, Nature Glenelg Trust were unable to use boat electrofishing due to high water levels, unstable retaining walls and dense vegetation which prevented a safe boat launch option. Fyke nets, set overnight were used instead in Basins A, B and F at the locations shown in Figure 10. These nets can provide a good method for undertaking fish surveys and removing alien fish species.

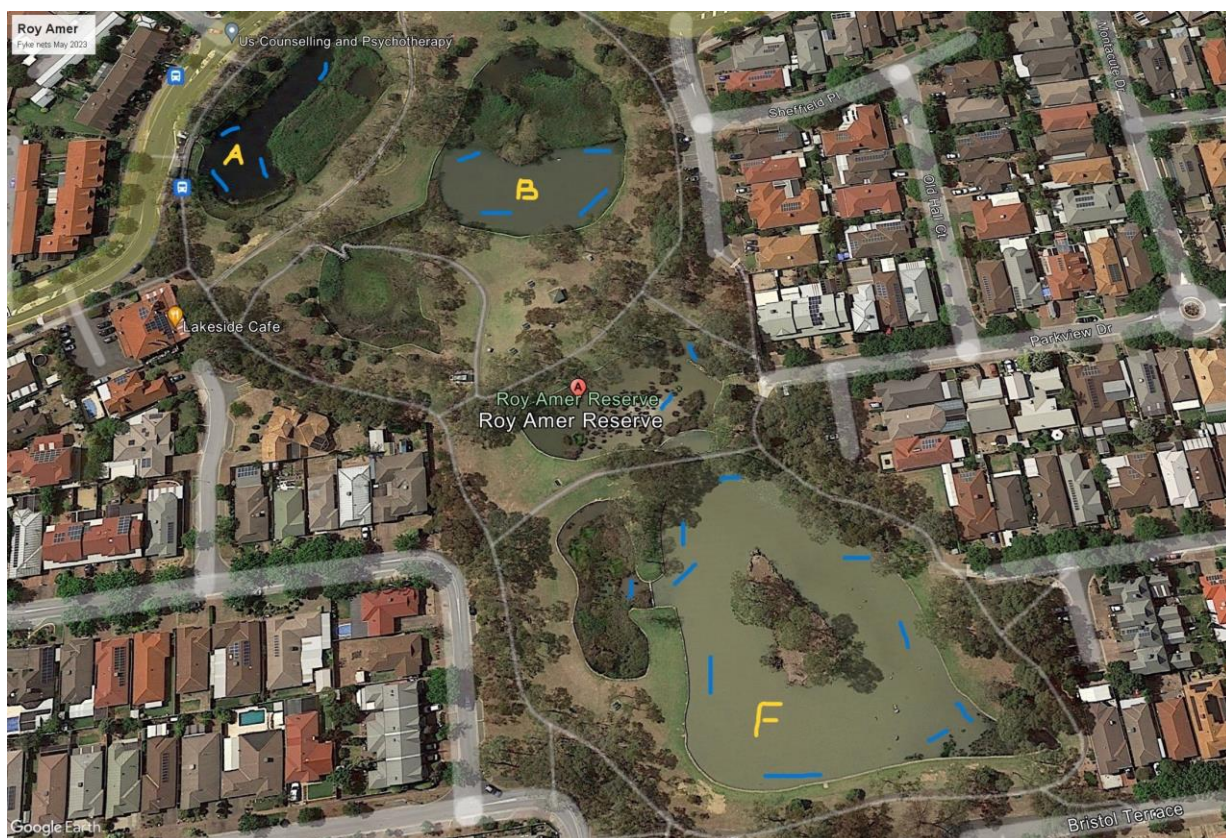


Figure 10: Location of the fyke nets (blue dashes) placed in Basins A, B and F at Roy Amer Reserve in May 2023.

In total, 952 individual fish from three alien species were sampled, removed and humanely euthanized in May 2023 (Table 1). No native fish species were sampled in any of the three basins. Alien fish numbers were much lower in Basins A and B than Basin F which was reflected in the turbid water and lack of plants in Basin F compared to Basins A and B. Fish were captured in size ranges of 21 to 58 mm for Eastern Gambusia, 180 to 410 mm for Common Carp and 190 to 220 mm for Goldfish (Table 2, Figure 11). Native freshwater shrimp and Common Yabbies were also found in the three basins.

Fyke nets work best for alien fish removal, however, when water levels are low to concentrate the fish and increase catchability. Whereas, during high water levels, like those experienced at Roy Amer Reserve in May 2023 when sampling was conducted, boat electrofishing is the recommended method for alien fish removal. Alien fish removal is also best undertaken during warmer seasons when fish are most active.

Table 2: Summary of fish catch using fyke nets in Roy Amer Reserve Basins A, B and F.

Site	Common Carp	Goldfish	Eastern Gambusia	Yabby	Shrimp
A	3	1	2	2	200
B	4	3	2	1	300
F	58	0	885	35	500



Figure 11: Common carp (left) and Eastern gambusia (right) captured during fish survey of Basin F.

3.3.4 Fish Management Recommendations

The primary recommendation is to continue alien fish control actions. Decreasing Common Carp abundance can lead to increased water quality, decreased siltation and ability of aquatic vegetation to grow. Alien fish such as Common Carp and Goldfish are often illegally transplanted into wetlands by residents who like to fish for them. Placing educational signage around wetlands can help to educate and build awareness about the negative environmental implications that arise from having alien species such as Common Carp present and to the illegal nature of releasing animals from aquaria or other water bodies.

The stormwater inputs to Roy Amer Reserve Wetlands make it difficult to achieve complete drying to extirpate alien fish. The only way to completely dry these basins would be to pump out one to another (e.g. pump out Basin F to Basin B), but this may transfer other problems, such as alien fish eggs, highly naïve rich water or fine clays. Where wetland basins cannot be dried completely, on-going alien fish management can be achieved using one or a combination of tools including netting (fyke nets and seine nets), and electrofishing, ideally undertaken during warmer seasons when fish are most active. Fyke nets are a passive methodology and can be set overnight to capture fish that swim into them. Seine netting is an active methodology where fish are captured using a seine net that is moved around the area trying to actively capture fish. Both these methods work best if the water body can be drawn down to increase catchability but they can be undertaken if drawdown is not possible. Boat electrofishing can be used to target and guide fish to capture and harvest them in nets when water levels are high, although it will be necessary to install a boat ramp to improve safety (Section 6). Ideally, boat electrofishing to harvest alien fish species would be undertaken annually in Spring or Summer.

3.4 Water Quality

In autumn 2023, the water levels in the whole system were high and the overflow outlet (Outlet F2; Figure 1) was full to the top of the concrete edging and spilling onto the lawns around the southern side of Basin F. The visual appearance of the water in the system in autumn 2023 was generally clear in all the basins, except for Basin D which had a milky appearance and Basin F which was both milky and containing algae.

At the time of fish sampling (May 2023), water quality in Basin F, as measured by a YSI 556 multiprobe water quality meter, was marginally alkaline (pH: 7.61), low in salinity (electrical conductivity: 213 μScm^{-1}), low in dissolved oxygen (dissolved oxygen: 3.5 mgL^{-1}) and had a water temperature of 13°C. In Basin B, the water quality was marginally alkaline (pH: 7.19), low in salinity (electrical conductivity: 148 μScm^{-1}), had moderate dissolved oxygen concentrations (dissolved oxygen: 5.5 mgL^{-1}) and a water temperature of 16°C. Turbidity was not measured.

4 Social and Economic Features

The wetlands were purpose built in 1993/94 to provide open space area in the centre of the surrounding Oakden residential development. In 2023, it is a highly utilised park where people walk with or without dogs, have picnics or BBQs, participate in exercise classes, visit the adjacent café and playground and enjoy the natural environment. The bridges are particularly enjoyed by children, giving them an immersive experience. There are numerous access points to the wetlands with car parks and roadways on all sides, connected by paths, lawns and gardens, which allow people to connect with different parts of the wetland reserve.

Feeding the resident birds appears to be a significant community activity, having been observed repeatedly on each day of field surveys and visits, and based on the learnt behaviours of resident birds that “mob” park users looking for food. Unfortunately whilst connecting with nature is strongly encouraged in the reserve, these foods are supporting large numbers of feral birds as well as feeding the White Australian Ibis, Western swamp hens and other native waterbirds large amounts of inappropriate foods (see Section 6.3.6). In addition to feeding the birds, bread and corn that enters the water will provide a food source to Common Carp, which are present in high numbers in Basin F. These processes increase odours and faecal loads, which are the subject of community complaints. Explanations of this feedback loop could form a key component of the community engagement strategy and be used on signage.

5 Wetland Management Objectives

The following five objectives were developed by evaluating the above evidence in consultation with site managers and in accordance with the Regional Biodiversity Strategy:

- A. Increase the diversity and abundance of native plants across all habitats.
- B. Improve water quality and reduce odours, particularly in Basin F.
- C. Maintain existing native bird populations and enhance habitats for other native fauna, such as native fish, frogs, lizards and invertebrates.
- D. Control pest plants and animals.
- E. Take opportunities to increase conservation status at a regional scale.

6 Wetland Management Actions (2023-2033)

Ten management actions have been identified that will make significant progress towards the five objectives for the wetlands and that can be achieved in the next ten years (

Table 3). The actions have been tailored for each of the six wetland basins and diagrams showing the current status and actions for each are shown in Figure 12 to Figure 17. Actions that improve the water quality and visual amenity of Basin F are a key focus, especially because the aim is to maintain the Australian White Ibis colony and thus the nutrient loads and odours will persist, if not actively managed.

Reinstatement of GPTs is recommended for all inlets that have GPT infrastructure (i.e. all inlets except Inlet E1). This will reduce pollutants entering the wetland system and underpin achievement of the other objectives. Other actions cover the whole reserve. All bins in the reserve need to be modified to prevent Australian White Ibis and other birds from accessing food waste and a comprehensive community engagement program that emphasizes the importance of not feeding the birds is required. Ideally, this would be a regional engagement program in collaboration with Green Adelaide and Local Government staff that manage areas with Australian White Ibis colonies (Figure 7). Site managers are also encouraged to collaborate with other wetland professionals to continuously improve their knowledge and operational capacity.

In implementing this Action Plan, it is important to acknowledge that this is a stormwater system and, therefore, site managers have very little or no capacity to alter water levels to achieve management objectives. Flows can occur at any time of year and therefore there is little or no capacity to predict

future water levels for planning purposes. This will, at times, require rescheduling of actions and an adaptive approach to implementation over the ten-year period.

6.1 Action Plan Summary (2023-2033)

The Action Plan is summarised in

Table 3, whilst Sections 6.2 and 6.3 provide the details for implementing each of the five management objectives and the ten management actions.

Table 3: Summary of Management Actions for each of the six wetland basins (Basins A to F) with levels of green shading and numbers showing priority order.

Objective	Action	Basin					
		A	B	C	D	E	F
A) Improve water quality & reduce odours, particularly in Basin F.	Actions 3, 4 and 7 will also contribute to achieving this objective						
	1. Re-instate GPTs to control incoming pollutants (all basins fitted with GPTs).	1	1		1		1
	2. Clean out silt and other matter from inlets monthly after flow.	1	1		1	1	1
B) Increase the diversity and abundance of native plants across all habitats	3. Plant new and/or threatened native aquatic plants along the elevation gradient.	2	2	1	3		
	4. Install gabion structures planted with amphibious aquatic plants.	3	2		4		1
C) Maintain existing & enhance conditions for other native fauna, such as native fish, frogs, lizards and invertebrates.	Actions 2 and 3 (as above)						
	5. Install bird-proof covers on bins to prevent access by wildlife.	Whole site					
	6. Improve signage and increase community engagement to discourage bird feeding and the release of pest fish or other aquatic animals (e.g. ducks, fish, turtles).	Whole site					
D) Control pest plants & animals	7. Remove Common carp by electrofishing or netting at low water levels (will require boat ramp for safe access).	3	2				1
	8. Remove pest plants and undesirable native seedlings.	1	1	1	1	1	1
E) Take opportunities to increase conservation value	Actions 2 and 3 (as above)						
	9. Assess feasibility of introducing threatened small native fish.	3	1				2
	10. Collaborate with other wetland professionals to fill knowledge gaps and increase operational capacity.	Bi-annually to intentionally share information.					

6.2 Basin descriptions, water management priorities and opportunities



Figure 12: Roy Amer Reserve Basin A water management features and ecological opportunities.

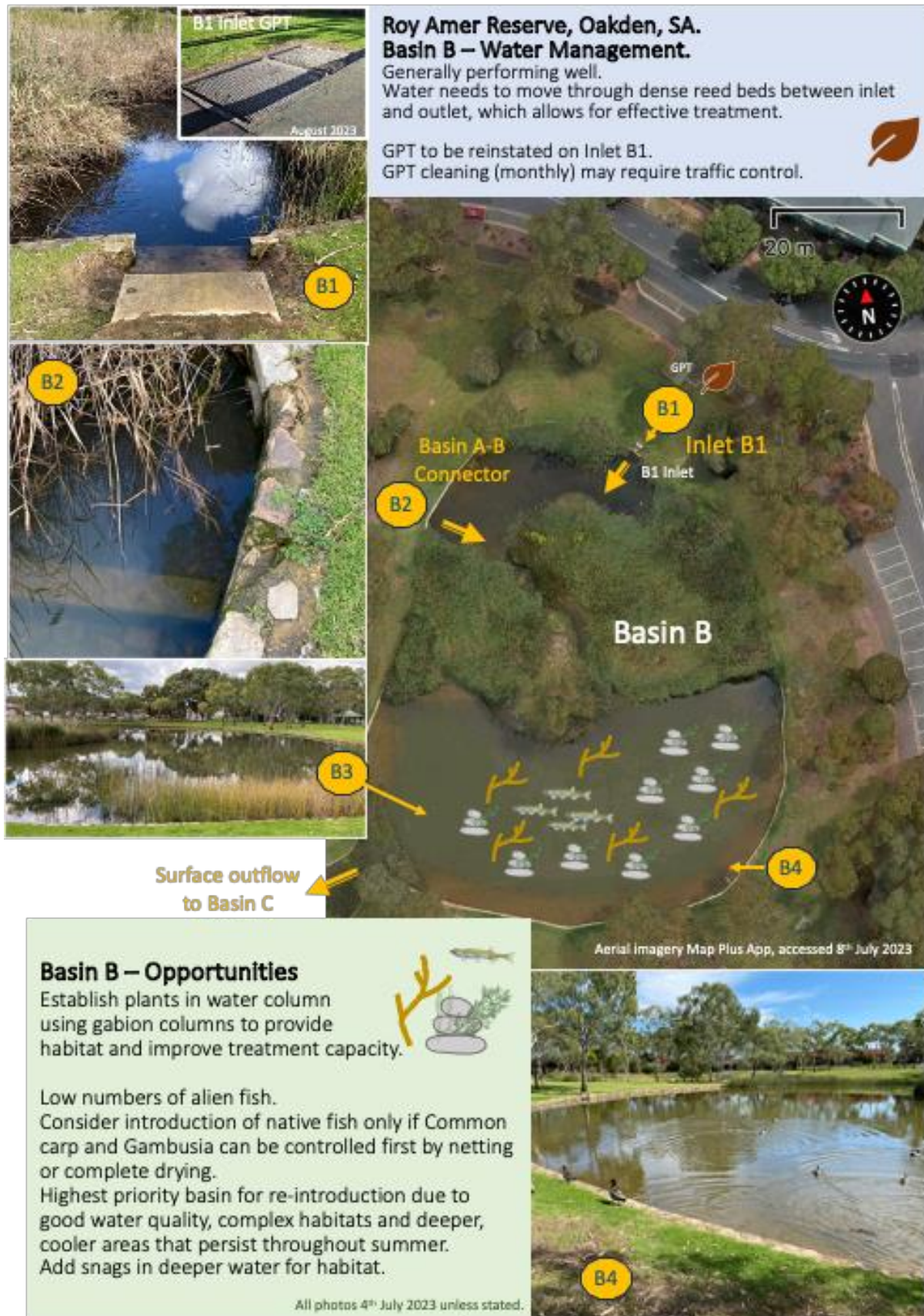


Figure 13: Roy Amer Reserve Basin B water management features and ecological opportunities.

Roy Amer Reserve, Oakden, SA.

Basin C – Water Management.

Generally performing well. No direct stormwater inputs and therefore no GPT or need to clean out inlet. Water moves through dense reed beds between the inlets and outlets in the two basins feeding Basin C (A and B) and in Basin C itself, which results in effective treatment.



Figure 14: Roy Amer Reserve Basin C water management features and ecological opportunities.

Roy Amer Reserve, Oakden, SA.

Basin D – Water Management Actions.

Generally performing well, although white clay used to line the basin is persistently suspended giving a milky appearance. Water needs to move through dense reed beds between the inlet and outlet, which helps treat the water, however, the fine clays may remain in suspension indefinitely.

GPTs to be reinstated on Inlets D1 and D2. Inlets to be cleaned out monthly.



Figure 15: Roy Amer Reserve Basin D water management features and ecological opportunities.

Roy Amer Reserve, Oakden, SA. Basin E – Water Management Actions.



No GPT on Inlet E1, which means that large amounts of leaves and other litter enter with stormwater. The inlet needs to be cleaned out monthly during flow season.



Basin E – Opportunities

Reeds beds are diverse and dense (Photo E1). Water Ribbons (*Cynogoten procerum*) are establishing (Photo E2) and the basin is becoming densely vegetated with a range of plants. No submerged plants.

Purple swamp hen nesting site and therefore reeds will be continually thinned allowing for more plants to establish.

All photos 4th July 2023 unless stated.



Figure 16: Roy Amer Reserve Basin E water management features and ecological opportunities.

Roy Amer Reserve, Oakden, SA.

Basin F – Water Management Actions.

Poorest quality water of all basins, even though last in sequence, due to high bird faecal matter inputs from Australian White Ibis rookery, other native waterfowl and feral pigeons. High turbidity also thought to be caused by resuspension of white clay used to line Basins D and E during construction.



GPT to be reinstated on Inlet F1 and cleaned monthly.



Figure 17: Roy Amer Reserve Basin F water management features and ecological opportunities.

6.3 Detailed Action Plan (2023-2033)

6.3.1 Action 1- Re-instate GPTs

Gross Pollutant Traps (GPTs) were installed when the wetlands were constructed on all inlets except for Inlets D1, E1 and F1. The GPTs installed were simple trash racks that aim to store captured stormwater pollutants in a dry state between storm events (Stormwater NSW 2022). The baskets from these GPTs have been removed during the ensuing years, which means that leaves, and other litter, are currently entering the wetlands directly with stormwater. These GPTs should be re-instated in the first eighteen months of this plan and others retro-fitted, where feasible (Table 6). It is more likely that the whole suite of management objectives will be achieved if this occurs as soon as possible because the wetland will have less pollutant load and water quality should start to improve.

Access and infrastructure at each inlet differ as follows, refer to Figure 12 to Figure 17 for photographs of inlets and GPTs:

- **Inlet A1**
GPT Type: Trash Rack
Notes: Adjacent concrete pad, between Acorn Parade and Victoria Drive.
Likely to require traffic control.
- **Inlet A2**
GPT Type: Trash Rack
Notes: Adjacent concrete pad, GPT life points. Next to the café on Sir Ross Smith Boulevard.
Likely to require traffic control.
- **Inlet B1**
GPT Type: Trash Rack
Notes: Adjacent concrete pad, on corner of Regent Crescent.
Likely to require traffic control.
- **Inlet D2**
GPT Type: Trash Rack
Notes: Adjacent concrete pad at end of Parkview Drive.

Inlets D1, E1 and F1 have no pre-treatment (i.e. no trash racks or litter baskets) meaning that stormwater discharges directly into Basins D, E and F from these inlets.

6.3.2 Action 2- Clean out inlets monthly after flow

Once reinstated, the GPTs will need to be cleaned out monthly after flows. Refer to the Guidelines for Maintenance of Stormwater Treatment Measures – South Australian Extract (Stormwater NSW 2022) for maintenance considerations and actions.

The peak flows are expected between May and November, but cleaning out of litter will need to occur in the other months, if flows occur. Given the predominance of hard surfaces in the catchment, it is expected that flow will occur after any rainfall of 1 mm or greater.

There is also a need to clean out silt and other litter from the inlet to Basin E on a monthly basis after flows. It does not have GPT infrastructure to reinstate and therefore the litter directly enters the basin, smothering plants near the inlet (Figure 16 – Basin E).

6.3.3 Action 3- Plant new and/or threatened native aquatic plants

Action 3 focuses the planting of riparian species onto the floodplain areas in Basin C in the first two years. This area is weedy and has not been colonised by dense native plants. There are stems of *Phragmites australis* (Common reed) and clumps of other reeds/sedges present, indicating where the water regime is drier than optimal for *Phragmites australis* and thus suitable to support amphibious or terrestrial damp plant species that prefer intermittent watering.

Adding the plant species in Table 4 to Basin C will increase the overall diversity of plants in the reserve and will provide additional habitat, enhance biodiversity and amenity values. The target ecological beneficiaries are frogs, reptiles, insects, butterflies and woodland birds (e.g. Blue wrens), but these plants are also attractive to the human eye and will improve the appearance of Basin C. It is recommended that habitat stacks of sticks and logs of various sizes are also installed for the target fauna. Basin C has been divided into four planting zones that correspond to the water regime and proximity to viewing points (Figure 19). Depending on the stormwater inputs, these plantings may require irrigation for the first two seasons after planting. Most of the area nominated in Basin C for planting in Years 1 and 2 is covered in weeds such as kikuyu and *Aster* sp. (Figure 18). These weeds will need to be removed before planting occurs. On-going removal of weeds will allow the native plants to shift along the elevation gradient into bare soil as their populations establish.

Some native plants are present in the planting area of Basin C (e.g. *Crassula helmsii*, *Juncus* spp.). These native plants will need to be identified and protected during weed removal. It is recommended that weed removal and planting is done by hand at a patch scale, rather than using herbicides, starting at the upstream end, and working down the flow path. The shrubs and spreading native plants will outcompete the weeds overtime as well, although kikuyu may grow up into the shrubs if not removed before planting. See Figure 14 – Basin C map for more details.

Some of the plants in Table 4 could also be planted around the edges of the other basins, however, the hard concrete walls will limit their capacity to colonise except for near the inlets and outlets. It is recommended that the plants with asterisk (*) in Table 4 are planted onto the edges of the reedbeds of Basins A, B and D in Years 4 to 10 when it is expected that the water quality will have improved from reduced inputs after GPT reinstatement. Some plants, like *Lythrum hyssopifolia* (Purple Loosestrife), are likely to self-seed and colonise suitable areas of each basin over time. This could be enhanced by distributing seed in autumn before the beginning of the main inflow season. Seed of *Cycnogeton procerum* (Water ribbons) could also be collected from plants at the outlet of Basin F and broadcast onto the water in Basins A, B, C and D. Seed cases of *Cycnogeton procerum* are photosynthetic, therefore, they will remain buoyant and float to the water's edge where they will germinate and establish. This is already happening to some extent, but most these beneficial plants are at the downstream end of the system (See Section 3.1.1).



Figure 18: The floodplain area of Basin C that is the focus for planting in Years 1 and 2. See Figure 14 for photo location and direction.

Table 4: Native plant species and notes for planting into the floodplain area of Basin C in Years 1 and 2.
Plants with * could be planted into Basins A, B and D in following years.

Species	Common Name	Zone	Number	Planting Notes
<i>Bursaria spinosa</i>	Sweet Bursaria, Christmas Bush	2	5 clumps x 3-5 plants	Shrub up to 12m tall, typically 3-5m. White clusters of flowers with sweet perfume. Drier edge. Flowers in summer. Common. Readily propagated.
<i>Callistemon seiberii</i>	River bottlebrush	1,2	3 clumps x 3-5 plants	Shrub 2-3m tall. Pale-yellow to pink flowers in Nov-Jan. Common on creek sides. Readily propagated.
<i>Centella cordifolia</i> Synonym: <i>Hydrocotyle cordifolia</i>	Heart-leaved pennywort	3	12-15	Perennial herb with creeping habit. Small purple flowers in Dec.-March. Found near freshwater swamps. Readily propagated.
* <i>Crassula helmsii</i>	Swamp crassula	3	12-15	Annual herb that can persist over autumn if conditions favourable. Grows in and around standing water. Already occurs in Basins B and C. Common. Readily propagated.
<i>Duma florentula</i> Synonym: <i>Muehlenbeckia florentula</i>	Lignum	1	5 clumps x 3-5 plants	Shrub 3-5 m tall. Open habitat with small white flowers in winter-spring, depending on moisture levels. Found on floodplains. Can withstand periods of dry each year. Common. Readily propagated.
* <i>Hydrocotyle verticillata</i>	Shield pennywort	3	12-15	Perennial herb with creeping habit. Small creamy-yellow flowers in Nov.-April. Found near freshwater swamps. Will grow into water and partially submerged. Readily propagated.
* <i>Lythrum hyssopifolia</i>	Purple Loosestrife	3, 4	25-30	Annual herb to 50cm high. Blue, red or purplish flowers. Damp areas. Seeds and colonises areas readily. Numerous records from SA, including near to Roy Amer Reserve (Yatala Prison 1989; Holden Hill 2011; Dernancourt 2017).
* <i>Marsilea drummondii</i>	Nardoo	1, 2	15	Rhizomatous fern-like herb. Grows in and around standing water. Was planted into Basins D and E but only seen in very small numbers in Basin E in autumn 2023. Common. Readily propagated.
<i>Parahebe derwentiana</i> Synonym: <i>Veronica derwentiana</i>	Derwent speedwell. White Veronica	1, 2	TBC	Shrub to 2m high. Pale-blue to pale mauve flowers. Found by streams. Rare in SA. Was recorded in Mount Lofty Ranges in 1880. Established population in River Torrens could provide source material. Readily propagated.
* <i>Persicaria decipiens</i>	Slender knotweed	2, 3	25-30	Perennial herb up to 30cm tall. Mint-like habit with spikes of purple flowers. Found on creek and wetland banks. Common. Readily propagated.
<i>Sellieria radicans</i>	Tongue plant.	2, 4	25-30	Prostrate perennial herb with small white flowers (Nov to March). Salt and drought tolerant. Margins of streams and wetlands. Often near coasts but also edges of freshwater wetlands. Common. Readily propagated.
<i>Thyridia repens</i>	Creeping Monkey flower	2, 4	25-30	Short perennial herb with obvious but small purple flowers from spring to autumn, depending on moisture levels. Found on edges of wetlands and creeks. Can form dense mats. Common. Readily propagated.



Figure 19: Planting zones for Basin C.

6.3.4 Action 4- Install gabion structures with amphibious aquatic plants

Wetland plant surveys in autumn 2023 showed that whilst the reedbeds have developed well in all basins except for Basin F (See Section 3.1), the submerged and amphibious plants have not established well, presumably due to poor light penetration (high levels of turbidity) and/or physical smothering by sediments, and this is likely to be limiting the water treatment capacity and habitat provisions.

The abundance of waterbirds, such as Australian White Ibis, Purple swamp hens and ducks, means that any young aquatic plants are likely to be pulled up before establishing. The cloudy water and large numbers of Common carp in Basin F also present challenges to plant establishment by contributing to high turbidity and physical disturbance by the mumbling behaviour of these alien fish.

To overcome these challenges and successfully establish aquatic plants in the water column, it is recommended that gabion columns or baskets filled with growing medium and planted with suitable species are placed into Basin F (first as a trial). The concept is to construct these gabion structures in a pyramid shape to a height that corresponds to ~10-15 cm below typical high-water level. This elevation should equate to the elevation at which the plants near the outlet of Basin F are growing (Photo 4; Figure 17).

The gabion pyramids need to be relatively small in area at the top (<1 m²) to discourage waterfowl from nesting on them, and it may also be beneficial to install metal spikes to also discourage roosting by birds

whilst plant establish. This will be easier to manage and more visually pleasing than bird netting, although methods may need to be adapted depending on the degree of herbivory or damage by birds.

A pyramid shape will allow the top surface to be restricted to $<1 \text{ m}^2$ and the rock base below high water level to gradually increase in width to $<1 \text{ m}^2$ allowing plants growing on the sides good access to light and a range of water depths to establish in.

Given that the size of these structures is likely to be limited to minimise the likelihood of waterbirds nesting on them, there will need to be multiple pyramids to provide the plant biomass necessary to consume significant quantities of nutrients. It is recommended that two to three clusters of three to five gabion pyramids are installed into Basin F (in the locations shown on the Basin F map in Figure 17) as a trial in autumn 2024 before the water levels begin to rise with autumn rains. It is expected that the retaining wall on Basin F will be replaced in the 2023/24 summer, and this would be a good operational opportunity to also install the gabion pyramids. Ideally, the new retaining wall would also be made of gabion, rather than cemented rocks, to provide habitat for invertebrates and biofilms. Biofilms are also expected to form on the gabion pyramids, and this will increase water purification capacity as well as providing food for invertebrates.

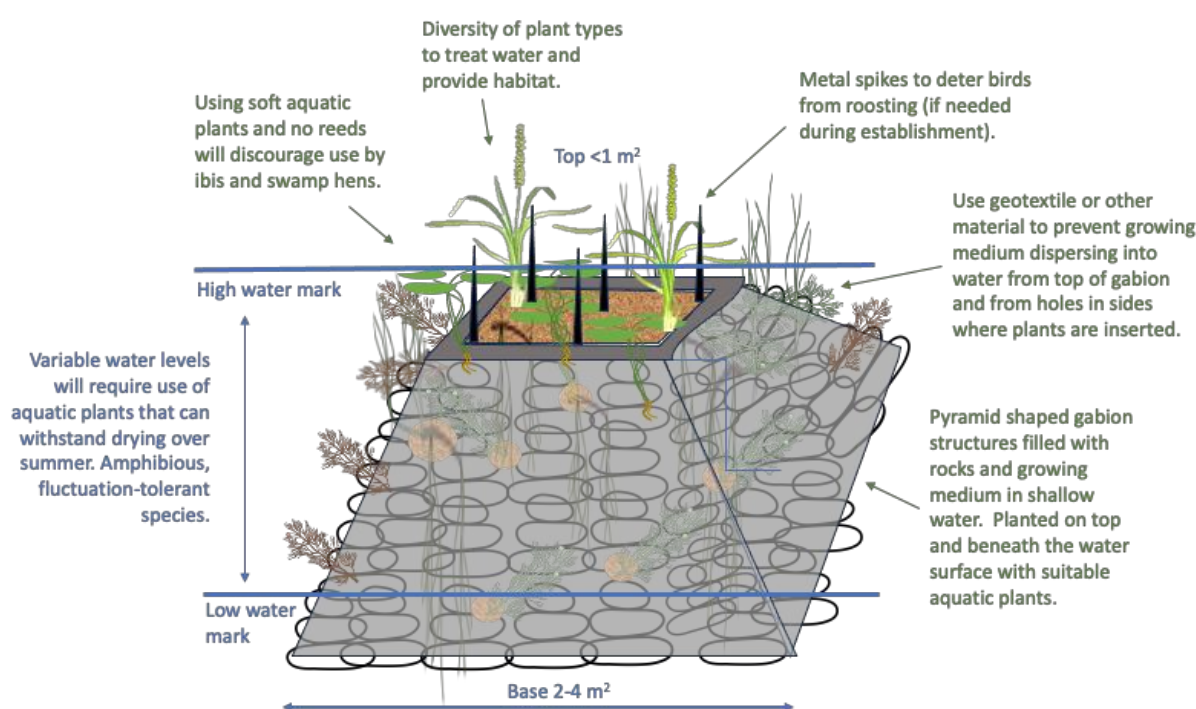


Figure 20: Gabion pyramids planted with submerged and amphibious plants are designed to increase water treatment capacity.

The plants shown in Table 5 are recommended for planting into the gabion structures based on their capacity to tolerate variable water levels. *Cyanogeton procerum* is colonising the outlet of Basin F already and is presumably unattractive to the resident waterbirds or able to withstand some level of damage. The other plants in Table 5 are not currently present in the wetland system. Once the first generation of gabion pyramids have been installed, modified (if necessary) and successfully growing plants, then more can be installed into Basin F and potentially into Basins A, B and D, in accordance with the concept diagrams in Figure 12 to Figure 17.

Other threatened native plants could be planted into new gabion pyramids or added to existing ones. Examples include *Ottelia ovalifolia* and *Villarsia reniformis*, both of which are very attractive flowering aquatic plants that are now much less common in South Australia than they were. It is recommended that these less common plants are sourced, planted and maintained in collaboration with botanists from the Seed Conservation Centre (<https://www.botanicgardens.sa.gov.au/science-conservation/seed-conservation-centre>).

Table 5: Native aquatic plants for gabion pyramids to be trialled in Basin F.

Species	Common Name	Planting Notes
<i>Cycnogeton procerum</i> Synonym: <i>Triglochin procerum</i>	Water ribbons	Top surface of gabion. Semi-emergent.
<i>Hydrocotyle verticillata</i>	Shield pennywort	Top third of gabion. Withstands submersion.
<i>Myriophyllum verrucosum</i>	Red water milfoil	Bottom third of gabion. Submerged.
<i>Persicaria decipiens</i>	Slender knotweed	Top surface of gabion. Emergent.
<i>Potamogeton tricarlinatus</i>	Floating pondweed	Top third of gabion. Floating leaves.
<i>Potamogeton pectinatus</i>	Sago pondweed	Bottom third of gabion. Submerged.

6.3.5 Action 5- Install wildlife-proof covers on bins



Figure 21: Australian White Ibis foraging in a bin at Roy Amer Reserve, April 2023.

Australian white ibis have colonised the island in Basin F. These native birds prefer to eat worms and other soil- and ground-dwelling organisms, but they are very adaptable and will exploit food resources that they have access to. As discussed in Section 3.2, the objectives are to maintain the population (i.e. prevent further increases in number) and improve water quality, thus the birds' access to food needs to be restricted.

Bins throughout the reserve are currently being used by these birds (Figure 21).

It is recommended that the bins are replaced or modified to prevent access by ibis.

This can be done by Council staff based on examples from other regional and national Councils.

The bins shown in Figure 22 from Sydney Botanic Gardens and St. Kilda Playground, South Australia appear to be effective and preventing entrance by birds. Australian White Ibis were observed to be foraging for natural foods in garden beds in Sydney Botanic Gardens in July 2023 and especially in areas with deep mulch. Increasing the depth of the mulch cover in the garden beds in the reserve may benefit the ibis and promote more natural feeding.



Figure 22: Bird-proof bins at St. Kilda playground, South Australia (left) and Sydney Botanic Gardens, NSW (right).

6.3.6 Action 6- Discourage bird feeding and release of animals

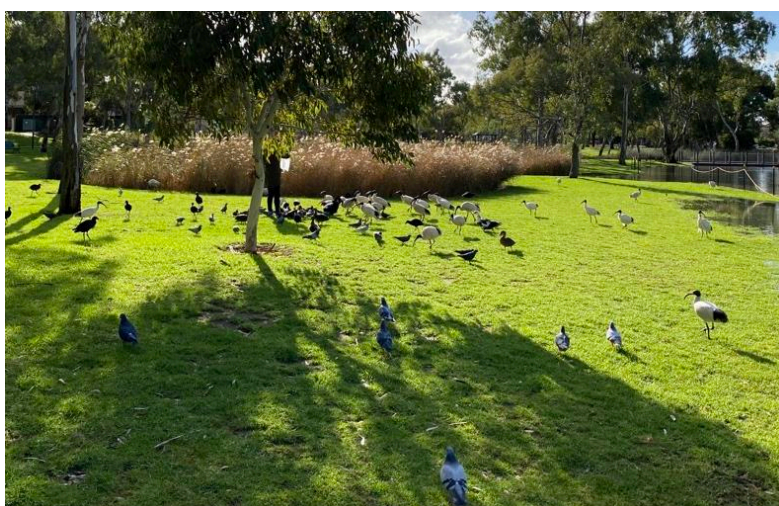


Figure 23: Community member feeding birds bread at Roy Amer Reserve, autumn 2023.

As well as accessing rubbish bins, Australian white ibis and other birds are receiving food directly from members of the public.

On each of three visits in autumn 2023, people were observed to feed birds bread and other food scraps (Figure 23).

The birds at Roy Amer Reserve are so well conditioned to being fed by people that they flock towards people who walk near the wetland areas.

Signs in the reserve focus on not feeding ducks bread because it is not their natural diet. It is recommended that the signs be replaced with very clear messages that feeding birds leads to greater numbers of birds, unnatural behaviours and increased nutrient loads to the water bodies, which in turn adds to the poor visual amenity and odours.

Signs should be only part of a more intensive community engagement program that seeks to inform the community about the undesirable outcomes of feeding birds and the conservation value of birds like Australian white ibis that have moved into urban areas due to the loss of wetland habitats in other parts of South Australia. In addition, the community need to be better informed of the consequences of releasing Common carp, turtles and domestic waterfowl. Nature Glenelg Trust have designed signs with Green Australia to educate community members about these issues that could be used in Roy Amer Reserve.

6.3.7 Action 7 – Control Common carp and other pest fish

It is standard practice in managed SA River Murray wetlands to implement a complete drying of the wetland once every 2 years for a minimum of 4 weeks to extirpate Common carp. Managing fish populations in stormwater wetlands, however, is highly constrained by having little control over water levels or options for diverting water away from a wetland to implement a complete drawdown. In addition to the lack of water level control, managers of urban wetlands are confounded by Common carp being illegally released into wetlands by community members who wish to fish for them.

Management options for controlling Common carp:

- Complete drying every 2-3 years for minimum 4 weeks
- Rotenone poison – not recommended because of risk of poisoning other fauna
- Netting (passive capture) and /or electrofishing (active capture, most efficient)
- Engaging with community to prevent releases.

Eastern gambusia are also present in Basin F. Once established, these fish are unlikely to be controlled unless complete drying is possible, although numbers can be reduced with strategic netting and electrofishing.

It is recommended that Common carp be controlled in Basin F by boat electrofishing and/or netting when water levels are low undertaken in the warmer months. Basin F is the priority due to the high numbers of fish in this basin, the lack of aquatic plants in the water column and the poor water quality. Basin F does not completely dry in autumn, although water levels tend to drop to a maximum depth of 10-15 cm and the outlet shelf becomes exposed (Figure 2). Electrofishing at low water levels may be feasible, however, a boat ramp will need to be installed to allow safe access. One option for completely drying Basin F would be to pump out water remaining in late summer into one of the other basins (Basin A or B). Common Carp would be removed during the drying process to ensure that fish are not left stranded and cause community concern. Turtles can be relocated to adjoining wetlands during the drying program. This would extirpate the feral fish and consolidate the sediments. It would also provide an opportunity to access the wetland floor for installing the gabion pyramids (Action 3). Complete drawdown would be effective at removing Common carp, but annual harvesting would be required if they re-establish.

6.3.8 Action 8- Remove pest plants and woody native seedlings

The wetlands are relatively free of weeds, although terrestrial weeds are present on the margins of Basins A, B and E. Basin C has the most annual and perennial weeds, but this issue will be addressed by implementing Action 3 to establish native plants on the floodplain area. Street tree seedlings (e.g. Acer) were observed in Basins A, B and E and these should be removed by hand or by cutting and swabbing in a careful manner that avoids non-target plants being poisoned. Other winter weeds, such as Aster sp. and thistles, were observed throughout the wetland system in areas that had been wet and had dried out enough over summer for terrestrial weeds to establish. These areas are generally easy to access around the concrete walls. The woody weed seedlings and Burr clover are the highest priority for removal. Other annual weeds will boom and bust according to seasonal weather patterns and are likely to reinfest.

River red gums (*Eucalyptus camaldulensis*), Bottlebrush (*Callistemon rugulosus*) and Tea tree (*Melaleuca lanceolata*) seedlings were also observed in Basins A, B, C and E. Some of these seedlings may be in desirable locations and can be left to establish. Others are very close to the concrete edges, which they may damage as they grow, and these should be removed. The saplings near the bridge in Basin C need to be assessed for safety when full grown.

In some cases, the River red gum seedlings are establishing in clusters within dense reed beds. The combined effects of high rates of evapotranspiration and sediment accumulation around their roots are likely to make areas that River red gums establish become shallower over time and small islands may form around them. This may encourage nesting by water birds and may not be desirable in all basins. Strategic removal of River red gum seedlings is needed to prevent adverse outcomes.

6.3.9 Action 9 - Investigate opportunities for small native fish

Of all the basins at Roy Amer Reserve, Basin B is the most suitable in terms of habitat, water depth and water quality for the introduction of small-bodied, threatened native fish. Big-headed gudgeons were released in 1993, but do not appear to have persisted presumably due to the lack of aquatic vegetation and high rates of predation. Pest fish control would need to be effectively achieved and the habitat enhanced before native fish were introduced. For example, submerged aquatic vegetation could be planted using the gabion structures, which would provide additional shelter, logs could be installed as snags and water quality improved by reinstating the GPT and regularly cleaning it. At this stage, the fish populations could be resampled and the feasibility of introducing threatened fish assessed. The introduction of native fish species could be done in collaboration with the Green Adelaide Urban Wetlands Threatened Fish Plan, which is being developed by Green Adelaide, Councils, land managers and Nature Glenelg Trust.

6.3.10 Action 10- Collaborate, fill knowledge gaps and increase operational capacity

The management of constructed wetlands is a complex and challenging exercise that requires adaptive learning and application of new knowledge. The City of Port Adelaide Enfield contains a number of constructed wetlands, some of which were among the first built on the Adelaide Plains. Collaboration with other managers, scientists, researchers and community members will help to fill knowledge gaps and assist all parties to learn how to best manage common problems, such as Common carp control and establishing submerged aquatic plants to optimise water treatment.

Key organisations that Port Adelaide Enfield staff could collaborate with include:

- Green Adelaide – especially the Waste and Wildlife program looking at problems such as Australian white ibis accessing food waste
- Seed Conservation Centre, Adelaide Botanic gardens – for assistance in, and knowledge about, growing less common plant species
- Other Local Governments – for example, Marion City Council have a dedicated water resources officer to manage their wetlands, like Oaklands Wetlands, which has similar management issues.

7 Monitoring and Adaptive Management

The monitoring program to support the adaptive management of Roy Amer Reserve Wetlands includes:

- Management Performance Monitoring – to evaluate whether the actions in Table 6 have been implemented on-time and on-budget. The monitoring required for assessing each action is shown in Table 6.
- Wetland Condition Monitoring – to evaluate the ecological and water quality condition against the management objectives. Monitoring methods and triggers at the whole of reserve scale are shown in Table 7.
- Targeted Trials - to test management options, such as installing gabion pyramids to support establishment of submerged and amphibious plants in the water column.

Photopoints can be established following Department for Environment and Water methods, https://cdn.environment.sa.gov.au/landscape/docs/ep/eplb_photopoint_monitoring_factsheet.pdf, to assist with capturing changes over time.

A Stormwater Treatment Measures Register could also be developed for the existing infrastructure and updated as actions are implemented including the following information at a minimum.

Most of the information needs listed below are provided in this plan as at September 2023, but these could be transferred to an asset register for ease of access:

- A description of the measure or asset;
- A geo-referenced location;
- The catchment area for this measure;
- Measure owner;
- Operational start date of the measure;
- Capital costs of the measure;
- Photographs of the measure;
- The physical condition and effectiveness of the measures; and
- Any financial data to assist with decision making (e.g. whole of life estimates, maintenance schedules, quantities, present value of measure, identification of surplus/obsolete measures and decisions to upgrade or decommission the measure).

The monitoring requirements will be reviewed and updated, as needed.

8 Review

The management actions detailed above will be successively implemented over a ten-year period with adaptations likely to be made to the schedule in Table 6 due to stormwater inflow patterns and the results of trials (e.g. gabion installation and planting trials).

It is expected that the outcomes of these actions will take at least 3 years to be apparent and for some actions the outcomes will be observed after 5 years or more.

A review of the management objectives and progress towards the action plan will be undertaken after five years (i.e. in 2028). Pending the results of that review, the action plan will continue to be implemented for the ten-year planning period, until 2033, when it will be more comprehensively reviewed.

Table 6: Detailed ten-year Roy Amer Reserve Wetland Management Action Plan (2023-2028).

Action	Basin	Task	Methods	Timeframe	Monitoring	Responsibility & Budget
1. Re-instate GPTs to control incoming pollutants.	A, B, D, F	1.1. Inspect all GPTs and determine what materials and repairs are needed to reinstate 1.2. Reinstall GPTs 1.3. Test operations and repair, as necessary	Refer to – Guidelines for the maintenance of stormwater treatment measures (October 2022) South Australian Extract Traffic control may be required	Jan to May 2024.	Successful reinstatement.	Drainage Team \$20,000 (Capital)
2. Clean out silt and other matter from inlets monthly after flow.	A, B, D, E, F	2.1. Remove silt, leaf litter and other detritus monthly after flows 2.2. Dispose of material	Refer to Water Sensitive SA <i>Inspection and Maintenance Guidelines - Wetlands</i> (Internal draft June 2023)	Monthly after flow.	Record volumes of material removed.	Drainage Team
3. Plant new and/or threatened native aquatic plants along the elevation gradient.	C	3.1. Identify native plants and protect during weed removal 3.2. Remove weeds, install habitat stacks and plant native plants (Table 4) patch-by-patch starting at the upstream end in late summer – in the four planting zones in Figure 12. 3.3. Irrigate if needed before flows start or if water levels do not reach the upper plants 3.4. Follow up weeding by hand until plants establish	<ul style="list-style-type: none"> Hand-weeding where possible to avoid use of herbicides. Plant tube stock firmly into soil to prevent removal by birds or water. Top of root ball to be level with surface soil when planted Habitat stacks are randomly piles of sticks and logs of varying size to support lizards and frogs. 	Jan to May 2024 & 2025.	Regular check of plant survival, weed growth and need for supplementary watering during establishment. Use photopoints.	Parks & Gardens \$15,000 (Operational)
	A, B, D	3.5. Plant species marked in Table 4 into damp areas of other basins 3.6. Distribute seed to upstream sites	<ul style="list-style-type: none"> As above Seed collection and dispersal can be done when seed is mature or in autumn with stored seed 	Jan to May 2028-2033.	Regular check of plant survival and weed growth.	
4. Install gabion structures planted with amphibious aquatic plants.	Trial in F	4.1. Design gabion pyramids structures 4.2. Install 2-3 clusters of 3-5 gabion pyramids as a trial when water levels are low with bird-detererring spikes 4.3. Source most tolerant plants and plant into gabion structures as being built 4.4. Irrigate if necessary before flows commence	<ul style="list-style-type: none"> Methods will need to be determined as built Plant stock should be firmly embedded into gabion to prevent removal by birds or water 	Jan to May 2024 & 2025	Regular check of plant survival and water level variation relative to height of gabions and plants. Assess effectiveness before installing more gabion pyramids.	Parks & Gardens \$10,000 per gabion, including design (Capital)

Action	Basin	Task	Methods	Timeframe	Monitoring	Responsibility & Budget
		4.5. Install bird netting on half of the pyramids during plant establishment to determine effectiveness, if needed.				
	A, B, D, F	4.6. If trial is successful, install 20 or more gabion pyramids in Basin F 4.7. Install into Basins A, B and D to fill gaps, as needed.	<ul style="list-style-type: none"> As above 	Jan to May 2026 to 2033.	Regular check of plant survival compared to water level variation. Assess need to replant.	As above.
5. Install covers on bins to prevent access by wildlife.	Whole reserve	5.1. Design or source ibis-proof lids for bins throughout reserve 5.2. Install ibis-proof lids	To be constructed by Council based on bins used at Sydney Botanic Gardens.	Sept 2023 to Feb 2024	Confirm whether ibis can access rubbish. Engage community to assist in observations.	Waste Management Team \$15,000 (Capital)
6. Improve signage and engage with community to discourage bird feeding and releasing animals.	Whole reserve	6.1. Remove existing signs 6.2. Design or source signs with strong messaging 6.3. Install in strategic locations (near entry paths and the bridge) and at heights that attract attention 6.4. Collaborate with Green Adelaide to develop a regional community engagement program focussed on Australian White ibis	Use key messages in this plan (Section 3) as basis for community engagement program focussed on not feeding birds and allowing them to forage naturally.	Throughout 10-year plan period.	Include monitoring of bird behaviour in citizen science, especially 'mobbing' people for food.	Environment Team \$20,000 (Operational)
7. Remove Common carp by electrofishing or netting.	F	7.1. Explore fish removal options and confirm minimum size for electrofishing boat 7.2. Assess safety of boat access at low water levels 7.3. Install boat tyre ramps, if needed 7.4. Pump out Basin F, if practicable, to completely dry for 2-4 weeks 7.5. Remove and euthanise fish by electrofishing and/or netting at lowest achievable water levels	Follow protocols provided by Nature Glenelg Trust or another licenced contractor.	Time to coincide with reconstruction of retaining wall around Basin F. Summer 2023/24 and then bi-annually.	Resurvey fish populations using electrofishing and/or netting to determine changes in population size every 2-5 years.	Parks & Gardens \$10,000 (Operational) Every 2 years.
8. Remove pest plants and undesirable native seedlings	A, B A, B, C, E	As above, if successfully achieved in Basin F. 8.1. Identify pest plants and undesirable native woody seedlings	<ul style="list-style-type: none"> Hand-weeding where possible to avoid use of herbicides. 	As required.	Bi-annual rapid plant surveys of all basins with a focus on areas from where	Parks & Gardens

Action	Basin	Task	Methods	Timeframe	Monitoring	Responsibility & Budget
		8.2. Remove winter weeds before they set seed 8.3. Remove native woody seedlings from problem areas before damage is caused or islands form			plants were previously removed.	
9. Introduce threatened native fish, if feasible.	B	9.1. Resurvey fish populations to confirm that pest fish have been controlled 9.2. Assess habitats and refine introduction actions 9.3. Install gabion structures, snags and/or additional aquatic plants to increase habitat value 9.4. Release starter population of fish in spring/summer in collaboration with Green Adelaide's Urban Wetlands threatened fish plan 9.5. Train PAE staff in management requirements, triggers etc 9.6. Survey to assess survivability. 9.7. Release more fish if required	Follow protocols provided by Nature Glenelg Trust or another licenced contractor.	Feb 2028 to May 2033.	Resurvey timing and methods will depend on habitat conditions and the type of fish released.	Environment Team (Project Scope and Feasibility Study required).
10. Collaborate, fill knowledge gaps and increase operational capacity.	Whole reserve	10.1. Collaborate with City of Marion and City of Charles Sturt Wetland Managers to share new knowledge and experiences associated with on-going wetland management 10.2. Collaborate with Green Adelaide regarding Urban Wetland Threatened Fish Plan 10.3. Contact Green Adelaide regarding updates and involvement in Wildlife and Waste project 10.4. Explore and engage in collaboration opportunities with Green Adelaide, Seed Conservation Centre, Water Sensitive SA, other Local Governments, Universities and other professionals.		Throughout 10-year plan period.	Communications log Meeting minutes Field trip notes	Environment Team

Table 7. Monitoring plan and management triggers for Roy Amer Reserve Wetlands (2023-2033).

Core indicators	Requirement	Methods	Where and when
Hydrology	The hydrology of these wetlands is primarily driven by stormwater inflows patterns and rates of evapotranspiration, rather than being under management control. Objective: observe seasonal duration and depth of water levels. Assess how the different basins respond to inflows and where areas of permanent water remain in the driest periods.	Photopoints.	Quarterly collection of photos at nominated photopoints that will also be used to observe changes in vegetation and habitats over time.
Waterbirds	Assess changes in wetland use for feeding and breeding by different species of birds and link to management changes; bird nesting to be recorded opportunistically. Trigger: presence/absence of species of conservation significance, significant increase in number of Australian White Ibis, landscape scale decisions, breeding needs	Citizen science bird observations.	Currently waterbird monitoring is conducted by citizen scientists with occasional surveys by bird experts (as was conducted during the development of this plan). Annual counting of Australian White Ibis in Autumn to determine whether the numbers have been maintained at 2023 levels.
Plant types and cover	Changes in type, extent, diversity and abundance of vegetation over time. Trigger: reed and pest plant growth may need control by hand-pulling; plants may be to be replaced in areas with poor plant uptake	Photopoints, identify to species, where possible.	The vegetation survey results in Table 1, shown as relative abundance, provide a simple baseline for on-going qualitative assessment of plant types and cover that can be repeated every 3-5 years. Specific monitoring of the gabion structures should be undertaken quarterly or even monthly during hot dry periods to assess how well the plants establish in field conditions.
Fish populations	Changes in type, extent, diversity and abundance of native vs alien fish species as a result of management actions (e.g. netting, electrofishing).	Netting and electrofishing undertaken by permitted experts using standardised techniques.	Annual or biennial, depending on alien fish removal actions, preferably at low water levels to detect changes in population demographics.

Core indicators	Requirement	Methods	Where and when
Turtle and yabbie populations	Changes in population size; introduction of new animals	Undertaken during alien fish removal activities.	As above.
Water Quality	<p>Improve understanding of how water quality changes across the different basins and through time.</p> <p>Testing for turbidity will provide data for evaluating water quality improvements due to management actions.</p>	<p>Calibrated hand-held multi-parameter meter, during fish surveys.</p> <p>Turbidity tubes for broad scale readings.</p>	<p>Surface water salinity and other water quality parameters are routinely measured during fish sampling or alien fish removal.</p> <p>Quarterly sampling of water at the inlet and outlet of each basin with turbidity tubes (could be undertaken by school students/citizens).</p>
Photopoints	<p>Changes in wetland condition and recording of variable hydrological conditions in different basins.</p> <p>Trigger: decline in basin condition over several years; may need changes in management.</p>	<p>SA Department of Environment and Water methods (same location and direction); photopoints can be permanently marked with posts and directional sight posts (1.6m high) as part of citizen science program.</p>	<p>Annually at key sites shown in Figures 12 to 17, or at other sites established to evaluate given actions.</p> <p>If incorporated into a citizen science program, then photos will be captured at a range of times and locations within the reserve, as determined by reserve users.</p>
Operations log	Evidence of whether actions were implemented as scheduled, and whether they achieved the management objectives.	Meeting minutes.	Actions recorded against the monitoring plan shown in Table 6.
Targeted trials	Evidence of whether the gabion pyramids are an effective solution to establishing aquatic plants in constructed wetlands with high turbidity and herbivory/damage by birds.	Presence/absence and percentage cover of plants installed in the gabion pyramids.	Monthly during establishment, if possible, but at least annually when water levels drop, if accessible.

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