



City of Melville

Booragoon Lake Reserve Strategic Management Plan

26/06/2019

Executive Summary

Booragoon Lake Reserve (Booragoon) occupies 13.5 ha within the suburb of Booragoon. As well as including a lake (Booragoon Lake), the reserve also includes areas of native bushland and parkland.

In 2019 The City of Melville (the City) appointed Ecoscape to conduct environmental surveys and, using information gathered, update the Strategic Management Plans (SMPs) for Booragoon Lake Reserve. Previous SMPs had been developed in 2004 and 2012.

The assets identified as corresponding with the reserve, and how the City is performing in relation to its measurable indices as identified in the Natural Areas Asset Management Plan (NAAMP) include:

- that Booragoon Lake is classified as a Conservation Category Basin
- it is a Bush Forever site (number 337) and forms part of a High Value Strategic Greenway
- is a nationally accredited Important Wetland meeting four of the six criteria for listing
- forms an important part of the Beeliar Regional Park
- · several community groups are active in the management of the reserve
- four largely native vegetation types are considered to occur within the reserve:
 - o Baumea articulata Rushland
 - o Melaleuca rhaphiophylla and Melaleuca teretifolia Low Woodland
 - o Eucalyptus rudis and Melaleuca rhaphiophylla Woodland (native understorey)
 - o *Eucalyptus rudis* and *Melaleuca rhaphiophylla* Woodland (rehab understorey)
- Booragoon Lake is a representative of the Wooded wetlands that support colonial waterbird nesting areas P2 Priority Ecological Community
- all four Ecological communities indices are considered to have been successfully achieved
- the vegetation condition ranged from Very Good to Degraded
- 35 native plant species, none of which are of conservation significance. When considering the information from previous management plans it appears that native species diversity has reduced since 2004.
- seven fauna habitat types occur within the reserve; Eucalypt Woodland (closed understory), Eucalypt Woodland (open understory), Fringing Melaleuca Woodland, Rushland, Wetland (open water), Revegetation and Parkland
- 34 habitat trees were recorded
- the fauna surveys included pitfall trapping, cage trapping, motion cameras, acoustic bat recorders and field observations and identified:
 - o five native mammal species (Southern Brown Bandicoot (Quenda), listed as Conservation Dependent by DBCA, and four bats), plus Common Brushtail Possums that have been observed in the reserve but were not recorded during the field survey
 - o six reptiles
 - o five amphibians
 - taking into account community observations, 121 bird species including threatened Black Cockatoo species (Carnaby's Cockatoo and Red-tailed Black Cockatoo)
- except for Native Fauna Indices relating to the Oblong Turtle Population, for which efforts are concentrated on nearby Blue Gum Lake, all others have been successful at maintaining fauna diversity and habitat.

The threats identified from the reserve, and how the City is performing in relation to its measurable indices as identified in the NAAMP, include:

- physical disturbance including informal track developments, rubbish dumping and vandalism
- fire, with none reported since 2005. The Fire Indices of preventing unplanned fires and fire impact (recovery have been successfully achieved.

- weeds; 41 weed species were identified in 2018, which appears to represent a decrease in weed diversity
 over time largely as a result of the City's weed control activities, although woody weeds appear to be
 increasing in numbers. Weed Indices are considered to be largely successful due to overall reductions in
 species diversity and abundance.
- feral animals; Feral Cats are regularly observed, Rabbits and Foxes (considered as very high priority for control) are not considered to be active in the reserve. Bees are considered a high priority for control and are regularly removed. Feral Animal Indices, except for management of Cats, have been successful.
- no evidence of plant disease have been identified
- stormwater, received via six drains, resulting in poor water quality including high soluble phosphorus and nitrogen that leads to algal blooms in the lake. Stormwater and Water Quality Indices for metals, water quality targets and physical water quality have been unsuccessful; nutrient inflow improvements have been successful.
- reticulation; the Reticulation Index of preventing reticulation from entering bushland has been successfully achieved
- no activation of Acid Sulfate Soils has been directly observed, however ASS was identified as potentially
 affecting the lake water quality

The highest priorities for management of assets and threats in the reserve are to:

- continue with current revegetation program, progressively improving the vegetation condition along the west and north sides of the lake. This program has been successful in increasing the extent of native vegetation in the reserve as well as contributing to flora diversity and improving habitat for native animals such as Quenda.
- undertake revegetation of wetland areas using sedge and rush species to improve habitat for Oblong Turtles and waterbirds; this will likely also act to improve water quality
- work with the community and utilise Melville local cat ownership rules and management guidelines to reduce the presence and impact of cats on wildlife in the reserve. Control of this species will support population of Quenda and Brushtail Possum.
- removal of sapling size Brazilian Pepper Trees from wetland fringing areas to prevent a large fruiting population establishing
- target currently small populations of very high priority weeds Arum Lily, Bridal Creeper and Madeira Vine for elimination to prevent them becoming more widely established
- consider thinning of regrowth and weedy Eucalypts in the south east corner of the bushland to reduce fire risk and allow establishment of other species
- work towards improving the water quality in the wetlands in regards to nutrients and associated low dissolved oxygen levels.

TABLE OF CONTENTS

1 Int	1 Introduction				
1.1	Background	6			
1.2	Objectives	6			
1.3	Scope	7			
2 As	sets	8			
2.1	Reserve Assets	8			
2.1.1	Bush Forever	8			
2.1.2	Ecological Linkages	8			
2.2	Site Assets	10			
2.2.1	Ecological Communities	10			
2.2.2	Wetlands	14			
2.2.3	Heritage	14			
2.2.4	Community Interest	15			
2.2.5	Reference	15			
2.3	Species	15			
2.3.1	Flora Species	15			
2.3.2	Native Fauna	16			
3 Th	reats	24			
3.1	Physical Disturbance	24			
3.2	Fire	26			
3.3	Weeds	28			
3.4	Habitat Loss	41			
3.5	Feral Animals	41			
3.6	Diseases and Pathogens	43			
3.7	Stormwater	43			
3.8	Reticulation	45			
3.9	Acid Sulfate Soils	46			
3.10	Climate Change	47			
4 Im	plementation	48			
4.1	Review of Management 2012-2019	48			
4.2	Management Objectives 2019-2024	48			
Refere	nces	55			
Appen	dix One Survey Methodology	57			
Appen	dix Two Vegetation Types	58			
Appen	dix Three Native Flora Inventory	60			
Appen	dix Four Fauna Inventory	63			
Appen	dix Five Weed Inventory	70			

Maps

Map 1: Vegetation type and quadrat location	12
Map 2: Vegetation condition	13
Map 3: Fauna habitat and sampling sites	
Map 4: Priority fauna observations, habitat trees and nest box locations	19
Map 5: Perennial weeds	
Map 6: Annual weeds	
Map 7: Tree and shrub weeds	
Map 8: Arum Lily	
Map 9: Vines	34
Map 10: Giant grasses	35
Map 11: Perennial clumping grasses	
Map 12: Annual clumping grasses	
Map 13: Perennial running grasses	
Map 14: Clumping geophytes	
Map 15: Herbs High Priority	
Map 16: Potential revegetation areas and management issues	54

1 Introduction

1.1 Background

In accordance with the City of Melville's Natural Areas Asset Management Plan (NAAMP) framework, a Strategic Reserve Plan (SRP) is required to be developed for selected reserves. These SRPs are required to be periodically updated according to the guidance provided in the NAAMP. Content discussed in detail in the NAAMP is not repeated in this SRP, it is recommended that this document is applied in conjunction with the guidance provided in the NAAMP.

Two prior management plans have been developed for Booragoon Lake Reserve (Booragoon). These are:

- Booragoon Lake Reserve Management Plan (Bennett Brook Environmental Services 2004), referred to as the 2004 Management Plan
- Booragoon Lake Reserve Strategic Management Plan (Natural Areas Consulting 2012), referred to the 2012 Management Plan.

1.2 Objectives

The objective of this SRP is to update and expand on content provided in the previous management plans. This SRP also updates the format and structure of the document to align with the standard template described in the NAAMP and used for other City SRPs.

Under the framework described in the NAAMP this SRP is required to:

- describe any environmental assets present (flora, fauna or vegetation communities, community usage and heritage)
- assess any change evident in the assets present, comparing against previous surveys and plans
- identify current potential threats to environmental assets
- identify management priorities
- identify reserve specific management strategies
- provide recommendations for implementation of reserve specific management strategies
- provide assessment of the success of previously identified goals and management strategies with consideration of the use of these as leading or lagging indicators.

Specific focus has been placed on reviewing the outcomes and effectiveness of management strategies, goals and guidelines set in the previous Strategic Management Plan (Natural Areas Consulting 2012). Where possible a quantitative assessment of the success of these management strategies, goals and guidelines has been undertaken. A summary of measurable indices table is provided at the end of each section. The understanding gained through this process will be used to shape more appropriate recommendations moving into the future.

The finalised SRP is intended to guide management activities in the reserve for the proceeding five year period.

1.3 Scope

The SRP covers the wetland and bushland areas that comprise the Booragoon Lake Reserve area which is managed by the City in partnership with Friends of Booragoon and Blue Gum Lakes (FoBBGL) and other environmental and community partners.

The reserve is 13.5 hectares in size and is located in the suburb of Booragoon. The location is shown below in **Figure 1**.



Figure 1: Reserve location

2 Assets

2.1 Reserve Assets

A strategic risk assessment and identification of significant assets to be used as measurable indices was undertaken at the time of the development of the NAAMP. The identified significant assets present at Booragoon identified during this process are discussed below. A table summarising the assessment of success of the stated goals of the NAAMP and previous management plans is provided for each asset discussed.

2.1.1 Bush Forever

Regionally significant bushland was identified under the Bush Forever Scheme following its introduction in 2000 (Government of Western Australia 2000b). The majority of the area considered to be Booragoon in this SRP is recognised as Bush Forever Site number 337.

The criteria under which Booragoon was listed are detailed in the NAAMP. A goal described in the NAAMP for all Bush Forever listed reserves is to maintain the environmental criteria which were used to list the area originally. As Bush Forever listings are not subject to a review process at this time it is expected that the listing will remain unchanged for the proposed lifespan of this SRP.

Table 1: Bush Forever Indices

Asset	Objective	Assessment of Success
Bush Forever Listing	Reserve continues to meet criteria for which it was listed (See NAAMP for specific criteria)	Successful

2.1.2 Ecological Linkages

The NAAMP identifies that ecological linkages are to be considered in terms of prioritising management of resources between reserves and determining whether or not some species can persist within the reserve long term.

The reserve intersects the following ecological linkages (Figure 2 and Figure 3):

- High Value Strategic Greenway 82, a small connection between Blue Gum and Booragoon Lakes (Waters 2011)
- Regional Ecological Linkage 50 (Perth Biodiversity Project Regional Linkages) that links the Swan River and Beeliar Regional Park (Western Australian Local Government Association 2003)
- Greenway 229 Leach Highway linking Bullcreek wetland with Piney and Booragoon Lakes, Perth Biodiversity Project Greenways (Government of Western Australia 2000a).

The bushland of Booragoon remains moderately isolated with the closest significant vegetation being Piney Lakes Reserve to the south (separated by Leach Highway) and Blue Gum Lake (separated by housing and recreational spaces) approximately 500 m to the northeast.

A history provided in the 2004 management plan indicates that the lake is natural, however the lake is considered to have increased in extent since earlier records. The surrounding area was developed for housing in the 1950s and 1960s. The lake was considered for draining and subdividing in the late 1960s and early 1970s, but was saved and had supplementary water pumped into it in the 1970s and 1980s to prevent it drying out over summer. This history indicates that the reserve and Piney Lakes Reserve have been largely isolated for over 50 years. Leach Highway, that separates these reserves, was opened in 1972.

ASSETS



Figure 2: Ecological linkages



Figure 3: NAAMP Ecological Linkages and Greenways

2.2 Site Assets

2.2.1 Ecological Communities

Vegetation types were mapped by Ecoscape in spring 2018 at a reconnaissance level (formerly known as level 1) floristic survey under the Flora and Vegetation Technical Guidance (Environmental Protection Authority 2016). This represents the most detailed level of survey undertaken at the site to date. Survey methodology is described in **Appendix One**.

Four native vegetation types were identified, one of these has been supplemented by planting native species in the understorey (rehab understorey). These are summarised below in **Table 2** with comparison to vegetation types previously described in the 2004 and 2012 management plans although vegetation type boundaries between the survey years do not align precisely.

The 2018 vegetation types are described in detail in **Appendix Two** and displayed in **Map 1**. Vegetation condition mapping is displayed in **Map 2**.

Ecoscape, 2018	Natural Area Consulting, 2012	Bennet Brook Environmental Services, 2004	Extent Summary Area (ha) % of total
Baumea articulata rushland	-	Open water/aquatic vegetation	0.33 2.51%
<i>Melaleuca rhaphiophylla</i> and <i>Melaleuca teretifolia</i> low woodland	Melaleuca woodland	Melaleuca woodland	5.30 39.96%
Eucalyptus rudis and Melaleuca rhaphiophylla	Fueshantus rudio woodland	Eucalyptus woodland	0.93
woodland (native understorey)		Transitional vegetation	7.05%
<i>Eucalyptus rudis</i> and <i>Melaleuca rhaphiophylla</i> woodland (rehab understorey)	Landscaped areas	Parkland	2.53 19.07%
Total Native Vegetation: 9.10 ha Not Vegetation: 4.17 ha			
Total Reserve Size: 13.27 ha			

Table 2: Vegetation Type Summary

Due to differing vegetation classification systems, updated survey guidance, different intensity of survey, likely change due to revegetation effort and absence of historical spatial data, direct comparison of change in vegetation type and vegetation condition extent was not possible. Assessment of indicative vegetation type and condition changes were undertaken by visually comparing overlaid mapping, the interpretation from this process is:

- the total area that is classified as native vegetation expanded slightly from 2004 to 2012 and again from 2012 to 2018. This was due to revegetation of areas previously classed as Parkland.
- the vegetation in 2004 and 2012 was, at best, mapped as being in Good condition. In 2018, Ecoscape assessed a significant portion of the *Melaleuca rhaphiophylla* and *Melaleuca teretifolia* low woodland vegetation as being in Very Good condition. High water levels for several years, having supressed weed species growing on the lake bed, may have contributed to this improvement in condition.
- vegetation condition in the inundated section of the lake (*Melaleuca rhaphiophylla* and *Melaleuca teretifolia* low woodland vegetation) was assessed as being Degraded in 2004; this had improved to Good in 2012 and was assessed as Very Good in 2018. The improvement may be due to several factors
 (including weed control or high water levels in 2018 supressing weeds.

- areas along the north eastern and south eastern edges of the lake improved from Totally Degraded in 2004 to Degraded in 2012 then to Good in 2018, this was due to weed control and revegetation works.
- the area at the western drain entrance, mapped as Completely Degraded condition in 2012 was improved to Degraded in 2018 following weed removal.

Significant Communities

Booragoon Lake is specifically listed as representative of the *Wooded wetlands that support colonial waterbird nesting areas* P2 Priority Ecological Community (PEC) (Species and Communities Branch, Department of Biodiversity, Conservaton and Attractions [DBCA] 2019). Whilst not identified as a PEC by a particular vegetation type, the vegetation at Booragoon is significant as it forms and/or supports the habitat required for waterbird nesting.

The site is not representative of any currently described Threatened Ecological Community listed for protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 and/or Western Australia *Biodiversity Conservation Act* 2016.

Assessment Against Ecological Community Indices

Whilst there is apparent slight assessor interpretation variation between surveys, there is no reduction in the number of vegetation types recorded, nor reduction in extent of areas considered as native vegetation. The condition of the vegetation adjacent to the wetland has improved since the previous assessment. Therefore the Ecological Community Indices Objectives listed in **Table 3** can be considered as successful.

Asset	Objective	Assessment of Success
Vegetation communities	Maintain diversity of vegetation types present (non quantified)	Successful
Vegetation communities	Maintain or expand area of native vegetation (non quantified)	Successful
Significant vegetation communities	Protect vegetation values which qualify listing as a conservation significant community	Successful
Vegetation condition	Maintain or improve condition of vegetation (non quantified)	Successful

Table 3: Ecological Community Indices

Map 1: Vegetation type and quadrat location



Map 2: Vegetation condition



2.2.2 Wetlands

The wetland section of Booragoon is mapped as a Conservation Category Basin (Ref 6502) (DBCA 2017). The reserve is also recognised as forming part of the Beeliar Wetlands Regional Park (CALM 2006).

Historic information provided in the 2004 Management Plan indicates the wetland has held permanent water at least since the area was urbanised, however, in the 1970s and 1980s the water levels were artificially maintained at higher levels over the summer period by supplementation with borewater. In 1989-1990 the City ceased supplementation after it was identified that, amongst other attributes, naturally fluctuating water levels were important triggers for waterbird breeding and fringing vegetation was adapted to periodic, not permanent, inundation. Since 1990 water levels have been allowed to fluctuate naturally.

Asset	Objective	Assessment of Success
Wetland community	Environmental criteria leading to listing as Conservation Category maintained	Successful
Wetland community	Wetland water levels behaving as per a natural system (insofar as is possible)	Successful

2.2.3 Heritage

The reserve is recognised as falling within the Whadjuk People Indigenous Land Use Agreement area. It is recognised that the entirety of the wetland systems of the Perth region would have been extensively used by Aboriginal people and continue to be significant to Aboriginal people.

Registered Aboriginal Site 3298 was identified as corresponding with the northern and western portion of the reserve from a search of the Aboriginal Heritage Inquiry System (Department of Planning Lands and Heritage 2019, accessed 12 April 2019). This Site type is Artefacts/Scatter, Camp that is without access or gender restrictions. Its location is shown in **Figure 4**.



Figure 4: Registered Aboriginal Site Extent (taken from Aboriginal Heritage Inquiry System)

2.2.4 Community Interest

Booragoon is identified as being a High value community site in the NAAMP. Several community, natural resource management (NRM) and research organisations are active in the management of or are users of the reserve. Groups include:

- Friends of Booragoon and Blue Gum Lakes (FoBBGL)
- South East Centre for Urban Landcare (SERCUL)
- Wirambi Landcare
- Conservation Volunteers Australia
- local residents passive recreation
- research and teaching organisations (Murdoch University, Southern Metropolitan TAFE)
- wildlife rescue and care organisations e.g. Turtle Oblonga Rescue and Rehabilitation Network, Native Arc and WA Seabird Rescue.

Community/NRM groups particularly FoBBGL and SERCUL have been very active between 2012 and 2018. Projects undertaken include:

- · significant weed control works in revegetation and bushland areas
- significant revegetation planting
- removal of rubbish
- · environmental monitoring such as compiling observations of bird species
- educational projects including botany walks and birdwatching.

Quantitative data as indicators of activity (e.g. area revegetated, hours of weed control invested, number of active participants) was not compiled however major projects are estimated to have achieved:

- 3,800 m² of revegetation planting on the north and western side of the wetland
- ongoing work involving weeding and rubbish removal.

Table 5: Community Interest Indices

Asset	Objective	Assessment of Success
Community interest in sites	Maintain or improve number and size of active community groups	Successful
Community interest in sites	Maintain or improve area to which time is being committed	Successful

2.2.5 Reference

No reference sites for long term monitoring or research have been established in Booragoon.

2.3 Species

2.3.1 Flora Species

A compilation of all previous surveys (2004-2018, using reconciled data that removed duplicates) identified 58 native plant species as being recorded in the reserve. This is approximately 29% of the total number of flora species recorded for all the natural areas of the City as described in the NAAMP.

The 2012 management plan which included records from the 2004 management plan identified 46 native species. The Ecoscape 2018 surveys identified 35 native species. A detailed summary of flora records for the reserve is provided in **Appendix Three**.

As the 2012 management plan does not separate their species records from the 2004 management plan records it is not possible to assess change from 2012 to 2018. An assessment of composite 2004-2012 species diversity verses 2018 was possible.

The assessment of the change in flora species recorded and overall species diversity suggests:

- native species diversity appears to have decreased from 2004 to 2018, likely due to:
 - o previous drier conditions that permitted greater access to wetland shore areas allowing a range of annual species to be recorded
 - o failed revegetation efforts that were newly planted (and still living) during earlier surveys
 - o new revegetation plantings that could not be identified were present in 2018 but not included in final species list.

The listed Very High Value Plant species described in the NAAMP were specifically targeted during the surveys. None were observed, nor have any been recorded during surveys for the earlier management plans.

No conservation significant species were identified during the surveys. *Banksia* species have been identified in the City as being at a high risk of local extinction. The abundance of *Banksia* species within the reserve was recorded. Future surveys should also record abundance to assess change over time.

Table 6: Banksia Species Count

Species	Count
Banksia attenuata	2
Banksia grandis	19
Banksia menziesii	12
Banksia littoralis	11
Total	44

Table 7: Native Flora Indices

Asset	Objective	Assessment of Success
Native species diversity	Maintain native species diversity	Potentially unsuccessful – overall species diversity has apparently reduced
Very High Value plant species	Maintain or increase populations of species	Not applicable – none are present or have been previously recorded
Banksia abundance	Maintain or increase Banksia abundance	No data available prior to survey to allow comparison

2.3.2 Native Fauna

The native fauna recorded in 2018 and a table comparing occurrences listed in the 2004 and 2012 management plans is provided in **Appendix Four**. The 137 native species recorded across all surveys to date represents 62% of the total species recorded for the City as described in the NAAMP. This demonstrates that the reserve is a significant location in regards to species diversity in the City. The vast majority of species recorded were birds.

As the Ecoscape 2018 survey included observations, pitfall and cage trapping, motion cameras and acoustic bat recorders, many species were identified that were not previously recorded in the reserve. Apart from species which are readily recorded through observation (e.g. birds and large mammals) direct comparison between the 2004 – 2012 surveys and the 2018 survey for changes in species diversity was not possible.

Fauna habitat types, significant fauna observations and the location of significant habitat trees were mapped as part of the assessment. These are shown in **Map 3** and **Map 4**.

Fauna Habitat

Seven fauna habitat types were described, as indicated in Table 8.

Table 8: Fauna habitat types

Fauna Habitat Type	Area present (ha) in 2018
Eucalypt Woodland (closed understorey)	0.93
Eucalypt Woodland (open understorey)	2.53
Fringing Melaleuca Woodland	5.30
Rushland	0.33
Wetland (open water)	3.76
Revegetation	0.08
Parkland	0.30

Large native habitat trees (those with a DBH of above 60 cm) were mapped, with the species and if the tree was dead or alive recorded. This is summarised below in **Table 9**. No nest boxes were recorded.

Table 9: Habitat trees

Tree species	Alive or dead	Count
Eucalyptus sp. (planted)	All alive	10
Eucalyptus rudis	All alive	22
Melaleuca preissiana	All alive	1
<i>Melaleuca</i> sp. planted	All alive	1

Map 3: Fauna habitat and sampling sites







Mammals

Five native mammal species were recorded during the field surveys. Four of these were bats identified by acoustic recording devices. It is expected that the bat species identified will all utilise the reserve for foraging, perching and roosting habitat.

Southern Brown Bandicoot, also known as Quenda, were trapped in the south eastern corner of the reserve. Quenda are listed by DBCA as Priority 5 (Conservation Dependent Species) and by the City as a Very High Value species.

Although not observed during the field surveys, Common Brushtail Possums have been recorded in tree hollows by volunteers and feral bee contractors.

Species	Habitat requirement	Considerations	
<i>Austronomus australis</i> White-striped Free-tailed Bat	Roosts in large Eucalypt trees Forages in open areas Feeds on invertebrates	Include native hollow-forming Eucalypts (e.g. Marri) in revegetation mix to provide long term continuity of habitat Leave standing dead trees erect Remove feral bee hives	
<i>Chalinolobus gouldii</i> Gould's Wattled Bat	Roosts in tree hollows but also uses bat boxes and artificial habitat Forages amongst and above vegetation Feeds on invertebrates	As above Consider installing bat boxes	
Vespadelus regulus Southern Forest Bat	Roosts in tree hollows and roofs Forages amongst vegetation Feeds on flying invertebrates	As above	
<i>Isoodon fusciventer</i> Southern Brown Bandicoot	Requires low dense vegetation for shelter Forages in leaf litter for invertebrates, fungi and plant roots and tubers	Feral animal control is important Leave hollow logs on the ground Include dense understorey plantings of native species in revegetation	
<i>Trichosurus vulpecula</i> Brush-tailed Possum	Requires hollows for nesting (but will use nest boxes or roofs) Feeds on leaves, flowers, fruits, insects, eggs, small mammals	Include native hollow-forming Eucalypts in planting mix Include diverse range of native species in mid and ground stratum revegetation	

Table 10: Considerations to improve mammal habitat

Reptiles and Amphibians

Six reptile and five amphibian species were recorded.

No reptiles or amphibians of conservation significance were recorded.

The Long-necked or Oblong Turtle (*Chelodina colliei*; not recorded in 2018 but, according to the 2012 management plan and community records, is known to occur) is an iconic species of the lake. Its high level of interest for the community is well documented. A survey of the Oblong Turtle population in the lake (one of 35 sites) was undertaken by Anthony Santoro as part of an honours project in 2017 (Santoro 2017). Santoro only recorded five individuals at Booragoon.

The findings of this and other surveys of population change in the region can be summarised as such:

- studies of wetlands of the Swan Coastal Plain suggests that populations of the Oblong Turtle are in decline across the region (Bartholomaeus 2015; Santoro 2017)
- Booragoon Lake has, and appears to have had for some time, a low abundance of turtles relative to other wetland areas in Perth. This could be a result of lack of resources, urbanisation, effects of the terrestrial environment or water quality (Bartholomaeus 2015), predation including by Yabbies (Bradsell *et al.* 2002), cats (Scott Thompson *pers. com.* 2019), foxes and dogs (Steen and Gibbs 2004) or waterbirds and

Kookaburras (juveniles), or the lack of suitable fringing vegetation or suitable wetland bank structure.

- previous trapping in 2001-2002 recorded 29 individuals (Giles 2011)
- the population consists of mostly mature turtles with no juveniles being recorded
- the sex ration varied considerably between surveys, from 1:3.5 M:F (more females; Bartholomaeus 2015) to less females than males (M:F 1:0.53 and 1:0.7) (Giles 2011; Santoro 2017), although small sample size indicates that recorded ratios could be unreliable
- research suggests that populations may develop a reduction in female to male ratio as a result of females experiencing higher mortality than males due to risks associated with emerging from wetland to nest (e.g. road traffic deaths, predation by foxes and dogs) (Steen and Gibbs 2004)
- turtles (both sexes), particularly juveniles, are likely to be predated by foxes, dogs and cats.

A summary of available information suggests that Booragoon Lake does not currently provide ideal habitat for Oblong Turtles.

Species	Habitat requirement	Considerations	
	Nests in sandy wetland fringing bushland	Revegetation with sedge and rush species in wetland areas to improve	
Chelodina colliei	Feeds on fish, crustaceans and invertebrates	Protect vegetation surrounding wetland to	
Oblong Turtle	Requires habitat where prey can breed and to hunt in such as emergent sedge and rush	Consider low fences to prevent animals from wandering onto surrounding roads	
	communities	Feral animal control to reduce predation	
Reptiles (general)	Generally feed on invertebrates or other reptiles	Feral animal control	
	Requires dense vegetation, leaf litter or logs for shelter	Revegetate using native species	
	Prefers open areas for basking e.g. logs or rocks	Provide dense ground stratum cover	
Frogs (all)	Feed on invertebrates Requires dense riparian vegetation	Revegetation with sedge and rush species in wetland areas to improve habitat	

Table 11: Considerations to improve reptile and amphibian habitat

Birds

Birds are identified as a highly valued natural asset present at Booragoon Lake. A combined total of 121 species were recorded across all surveys to date, noting that community records are kept for the reserve in combination with those of the nearby Blue Gum Lake. A total of 93 bird species were recorded in in the 2004 and 2012 management plans, these observations were collected over an extended period by zoologists and community bird watchers. Ecoscape's 2018 survey and information collected over an extended period by Thea Terpstra (2016 *pers comm*) recorded 88 species. Of the species recorded in 2018, 28 were not previously recorded in 2004-2012, and 32 were recorded in 2004-2012 but not in 2018. This indicates that there is variability in species assemblages during different survey periods.

Due to the highly mobile/ migratory nature of many of these species it is expected that some difference in observed species diversity will occur. As specific data regarding intensity of survey for both survey periods (e.g. number of recording events, hours spent per event) is not available confidence in drawing conclusions regarding changes in species diversity is limited. Considering this the following observations and suggestions regarding species diversity change can be made:

- of the 32 species recorded in 2004-2012 but not recorded in 2018 the absent species were mainly wetland species
- due to the mobile and migratory nature of many wetland species the differences between 2004-2012 and 2018 species diversity is not considered to be indicative of significant change.

Booragoon Lake is considered to be a Priority Ecological Community (PEC) due to its importance as a colonial waterbird nesting site. According to the 2012 management plan Little Black Cormorants, Great Cormorants, Darters, Little Pied Cormorants and Australian White Ibis have been recorded as nesting in the

Melaleucas surrounding the lake, with Ibis now the dominant nesting species due to water levels dropping which favours waders. Ibis, Purple Swamphens and Grebes were observed to be the most abundant waterbirds in 2018.

No threatened Black Cockatoo species were recorded during the 2018 field survey, however, there are community records of Carnaby's and Forest Red-tailed Black Cockatoos. The 2012 management plan identified evidence of foraging in the *Banksia littoralis* stand by Carnaby's Cockatoo. As there is no suitable nesting habitat and few foraging species, neither species are likely to be dependent on the resources available at Booragoon and would only be occasional visitors.

Species	Habitat requirement	Considerations
Black Cockatoos	Nest in hollows in large trees Feed on primarily on <i>Banksia,</i> <i>Hakea</i> and Eucalypt species	Unlikely to breed in urban bushland Include <i>Banksia</i> , <i>Hakea</i> and Eucalypt species in revegetation mix to provide foraging habitat
Wetland Birds (general)	Feed on mainly on submerged and riparian plant species, invertebrates, small fish and amphibians Require emergent and riparian vegetation for feeding and nesting	Revegetation with sedge and rush species in wetland areas to improve habitat and prey availability Feral animal control to reduce predation
Bushland Birds (general)	Mixed feeding strategies including insects, small reptiles, nectar and grains Require diverse mixture of shrub species to provide a range of feeding and nesting opportunities	Include a diverse range of shrub species in revegetation species lists Feral animal control to reduce predation with a particular focus on reducing the impact of cats

Table 12: Considerations to improve bird habitat

Invertebrates:

No recent surveys have been undertaken for invertebrates in the reserve. In 2011 Brucciani (Brucciani & Kemp 2011) conducted an assessment of Booragoon Lake that included investigating macroinvertebrates. She found that Booragoon Lake had low species richness, with the relatively high abundance of Cladocera and Copepoda indicating increasing salinity and Chironomidea larvae indicating eutrophic waters.

Table 13: Considerations to improve invertebrate habitat

Species	Habitat requirement	Considerations
Invertebrates	Varied	Continue to remove feral bee hives

Table 14: Native Fauna Indices

Asset	Objective	Assessment of Success	
Mammal species	Maintain species diversity and manage habitat to allow ongoing use of reserve by bat species	Successful – bat species continue to be recorded in the reserve	
Mammal species	Maintain Quenda population	Successful- species recorded in the reserve	
Amphibian Species	Maintain species diversity and manage habitat	Successful – frogs continue to be recorded in the reserve	
Reptile species	Maintain species diversity and manage habitat	Successful	
Oblong Turtle population (Chelodina colliei)	Maintain stable population of Oblong Turtle	Likely unsuccessful – population shows characteristics consistent with that of a population in decline (noting that the population at Booragoon has been small throughout the period that management plans have been in place)	
Oblong Turtle population (Chelodina colliei)	Improve wetland habitat to support population	Not applicable – efforts to improve habitat for turtles is concentrated on nearby Blue Gum Lake that supports more suitable habitat	
Bird population diversity	Maintain species diversity of wetland birds	Likely successful – species diversity does not appear to have significantly changed	
Bird population diversity	Maintain species diversity of bushland birds	Likely successful – species diversity does not appear to have significantly changed	
Bird habitat	Maintain or improve bird habitats	Successful – habitat extent and diversity has been improved by revegetation activities	

3 Threats

The ten most significant threats to natural areas in the City are identified in the NAAMP. The presence, extent and impact of these threats are described below. A table summarising the success of mitigation of these threats considering the stated Objectives of the NAAMP and previous management plans is provided for each threat discussed.

3.1 Physical Disturbance

Physical disturbance observations are summarised below in **Table 15**. The locations of identified issues are displayed in **Figure 5**.

Physical Disturbance	Ecoscape, 2018	Natural Area Consulting, 2012
Informal track development	40 m over one track on eastern side of	None
	lake	
Disturbance for likely	Point 6 at end of informal track site	
propagation of prohibited	inactive	None
substances		
	Small amount of wind/water	Minimal litter close to pathways.
Rubbish dumping	transported along Leach Highway	Small amount of wind dispersed paper
	road verge and around storm water	litter within vegetation.
	drain at western edge	No garden waste dumping observed but
		considered to have historically occurred.
Tree poisoning		
Illegal Clearing	None	None
Firewood collection		
Vandalism	Small amount on signago	Small amount on signage
Variaalistii		Little disturbance in native vegetation

Table 15: Physical Disturbance Summary



Figure 5: Physical disturbances

It is noted that rubbish removal and control of vandalism is continually undertaken by City staff and community groups. No specific data is available to assess the investment in time devoted to these activities across different time periods. As such the assessment of success in controlling these issues can only be based on what was observed at the times of survey. It is acknowledged that ongoing effort is required to maintain the low levels of rubbish and vandalism observed.

Threat	Objective	Result
Physical disturbance	To reduce or remove informal tracks and disturbance	Unsuccessful- new track has been established and small plant growing set up has been present
Rubbish dumping	Maintain low level of rubbish from around drains and roads	Successful – ongoing work required
Tree poisoning Illegal Clearing Firewood collection	No occurrences	Successful
Vandalism	Maintain at low level	Successful

Table 16: Physical Disturbance Indices

3.2 Fire

The reserve is considered to be a bushfire prone area according the Department of Fire and Emergency Services (DFES 2019, accessed 17 April 2019). Vegetation of over 1 ha is generally mapped as being bushfire prone. As the southern edge of the reserve is adjacent to a major highway the potential for accidental fire ignition (e.g. as a result of discarded cigarette butts from motorists) is increased.



Figure 6: Bushfire Prone Areas (DFES 2019)

The NAAMP identifies that negative impacts of fire are often observed in small urban bushland remnants such as Booragoon Lake. It is also identified that large (effecting more than 50% of the reserve) or frequent fires (frequency < eight years) may trigger local extinctions of fire vulnerable species. The fire history for recent years is summarised in **Table 17** and shown on **Figure 7**.

Table 17: Fire History Summary

Year	Fire Impact
2005	0.8 ha in southeast portion (reported in 2012 management plan), a hot canopy fire causing
2003	significant damage to vegetation
2005-2018	No reported fires



Figure 7: Fire history

Scorching on tree trunks as a result of the February 2005 fire is still evident. Dense Bracken Fern (*Pteridium esculentum*), which has been observed to be a disturbance opportunist, corresponds with the burnt area and is likely to be a result of the fire. A grove of dense eucalypt regrowth primarily from non-native species (suspect **Eucalyptus grandis*) and native Flooded Gum (*Eucalyptus rudis*) has occurred in the fire affected area (see **Map 7**). In this location densely growing Eucalypts are resulting in a high accumulation of bark, leaves and dead branches which is increasing future fire risk. Removal or thinning of non-native species may be required.

Table 18: Fire Indices

Threat	Objective	Result
Frequent, high intensity or large fires	Prevent unplanned fires	Successful – no unplanned fires have occurred since 2005
Vegetation assets reduced by fire impact	Fire impacted vegetation being on a recover trajectory	Successful – the dense Bracken Fern that has resulted from the fire provides habitat for fauna including Quenda. One dense Eucalypt grove may require removal or thinning

3.3 Weeds

Sixty eight weed species have been identified as occurring in the reserve across all surveys to date. The 2012 management plan identified 55 species whereas, during the 2018 survey, 41 species were recorded. However, only 28 species were recorded in common between the two management plans. This variation is likely to be due to a number of factors including:

- greater access to wetland areas during earlier surveys that were conducted during drier seasons
- different seasonal conditions (wetter in 2018) and season of survey (spring in 2018 and summer in 2012) favouring different weed suites
- targeted weed control efforts that have removed some species from the reserve
- new introductions.

A full comparison of weed species diversity is provided in Appendix Five.

Weed species are classified into impact classes under the NAAMP; significant species recorded in 2012 and 2018 are compared below in **Table 19**. *Asparagus asparagoides*, *Zantedeschia aethiopica* and *Moraea flaccida* are Declared Pest plants listed under the *Biosecurity and Agriculture Protection Act 2007*, however, all are in the exempt category so no legislated control actions are required.

Table 19: Significant Weed Occurrence Comparison

Impact	Species	2012	2018
	Bridal Creeper Asparagus asparagoides	X	X
	Arum Lily Zantedeschia aethiopica	X	X
	One Leaf Cape Tulip <i>Moraea flaccida</i>	X	
Very High	Madeira Vine Anredera cordifolia	X	X
	African Love Grass Eragrostis curvula	X	
	Brazilian Pepper Schinus terebinthifolius	X	X
	Perennial Clumping Grasses		
	Ehrharta calycina	X	X
	Paspalum dilatatum /urvillei	X	X
	Annual Clumping Grasses	6 species (Avena barbata, Bromus diandrus, Ehrharta longiflora, Hordeum leporinum, Lagurus ovatus, Poa annua)	5 species (Aira cupaniana, Avena barbata, Bromus diandrus, Ehrharta longiflora, Hordeum leporinum)
	Perennial Running Grasses		
High	Cynodon dactylon	X	X
i ngn	Cenchrus clandestinus	X	X
	Clumping Geophyte	4 species (Chasmanthe floribunda, Freesia alba x leichtlinii, Nothoscordum gracile, Watsonia meriana)	1 species (Chasmanthe floribunda)
	Giant Grasses		
	Cortaderia selloana	X	X

Impact	Species	2012	2018
	Trees and Shrubs	7 species (Acacia podalyriifolia, Ficus carica, Homalanthus novo- guineensis, Melaleuca quinquenervia, Ricinus communis, Schinus terebinthifolius, Washingtonia filifera)	10 species (Acacia baileyana, Acacia iteaphylla, Brachychiton populneus, Casuarina cunninghamii, Eucalyptus sp., Ficus carica, Melaleuca quinquenervia, Phoenix dactylifera, Schinus terebinthifolius, Washingtonia filifera)
Medium and Low	All other species	29 species	17 species
Significant in reserve	Fumaria or Whiteflower Fumitory Fumaria capreolata	X	x

Although the species *Fumaria capreolata* (Fumaria or Whiteflower Fumitory) was is not listed in the NAAMP as being a significant species it was identified as being a significant weed species in the context of this reserve. In disturbed wetland areas this species can form dense mats which smother native seedlings, annuals and revegetation plantings. It is generally restricted to disturbed, moist areas and has limited impact in good condition bushland. This species was mapped individually to allow targeted control.

A 30 m grid survey was undertaken for weeds in the reserve following the methodology outlined in the NAAMP. This is the first survey undertaken at the reserve using this method; future surveys will use the same grid points. Broad observations regarding weed population change are as follows:

- apparent eradication of One Leaf Cape Tulip (Moraea flaccida), Caster Oil (Ricinus communis), Silver Wattle (Acacia podalyriifolia), Freesia (Freesia alba x leichtlinii), Inkweed (Phytolacca octandra) and Watsonia (Watsonia meriana) that were recorded in 2012 but not in 2018 (note; not all absent species listed)
- apparent introduction of a number of tree, shrub and cycad species (Acacia baileyana, Acacia iteaphylla, Brachychiton populneus, Casuarina cunninghamii, Eucalyptus sp. (suspect Eucalyptus grandis hybrid), Phoenix dactylifera), although it is more likely that these were not recorded but were present during earlier surveys
- apparent significant reduction in the areas where Edible Fig (*Ficus carica*) and Brazilian Pepper (*Schinus terebinthifolius*) were recorded, likely due to removal efforts.

Threat	Objective	Result
Very High Impact weed species	Reduce number of species and abundance	Successful – reduction from eight to seven very high impact species No comparable data to identify if abundance has changed
High Impact weed species	Reduce number of species and abundance	 Variable: reduction in the number of clumping geophyte species increase in the number of trees and shrubs apparent reduction in the areas of occurrence of Edible Fig and Brazilian Pepper no comparable data to identify if abundance has changed
Medium and Low Impact Species	Reduce number of species and abundance	Successful – apparent reduction in the number of species. No comparable data to identify if abundance has changed

Table 20: Weed Indices

Map 5: Perennial weeds



Map 6: Annual weeds



Map 7: Tree and shrub weeds



Map 8: Arum Lily



Map 9: Vines



Map 10: Giant grasses



Map 11: Perennial clumping grasses



Map 12: Annual clumping grasses



Map 13: Perennial running grasses



Map 14: Clumping geophytes



Map 15: Herbs High Priority



3.4 Habitat Loss

The NAAMP identifies habitat loss and fragmentation as a significant threat to the long-term viability of some species in urban areas.

Habitat loss can be assessed using total weed density, bare ground cover and soil disturbance. As these are some of the key factors which influence vegetation condition mapping, an assessment of change in mapped vegetation condition can be used as a proxy to assess potential habitat loss. Vegetation condition mapping is displayed in **Map 3** and condition extents of vegetation summarised in **Table 21**.

Vegetation Condition (Keighery, 1994)	Extent (ha)	% of Total Area
Very Good	5.64	42.47
Good	1.24	9.37
Degraded	2.22	16.74
Parkland/infrastructure/revegetation/open water	4.17	31.41

Table 21 : Vegetation Condition Summary

As data for vegetation condition extents for the 2004 and 2012 management plans is not available, quantitative comparison of change in vegetation condition extents was not possible. Assessment of vegetation condition changes were undertaken by visually comparing overlaid mapping. The conclusions that can be drawn from this assessment are:

- overall vegetation condition has improved with wetland areas previously assessed as being in Good condition now largely considered to be in Very Good condition (note this may be due to several years of high-water level supressing weeds)
- no Completely Degraded vegetation recorded
- vegetation formerly recorded as Degraded condition on the east of the lake now partly in Good condition
- vegetation along the north side of the lake improved from Degraded to Good condition following revegetation.

At a reserve wide scale the trend has been observed to be an improvement in vegetation condition from 2012 to 2018.

The NAAMP suggests management of habitat loss and fragmentation through a revegetation plan which aims to:

- increase the size of meta populations
- introduce redundancy by encouraging the establishment of plant and animals with limited distribution and abundance
- increase the extent of core habitat by increasing the extent of better condition vegetation.

Table 22: Habitat Loss Indices

Threat	Objective	Result
Habitat loss	Prevent loss of habitat at a reserve scale	Successful – overall amount of habitat increased and condition improved

3.5 Feral Animals

The NAAMP identifies three species as Very High Impact introduced animals: Feral Cat, European Wild Rabbit and Fox.

Two species are listed as High Impact introduced animals: European Bee and One-spot Livebearer (a fish).

Active control programs for the above listed terrestrial species are undertaken on an ongoing basis by contractors for the City under the City's Management of Feral Animals guidelines. A summary of species observations and control results for the period 2012- 2018 is provided in **Table 23**.

Priority (NAAMP)	Feral Animal Species	2012-2018 Records	Ecoscape, 2018 Records	
Vary High	Feral Cat	Not listed in 2012 management plan	Recorded	
	Fox	Listed in 2012 management plan	No evidence	
	Rabbit	Listed in 2012 management plan	No evidence	
		Listed in 2012 management plan	Recorded	
High	European Bee	48 hives controlled- 29 of these in the period 2012-2015 and 17 from 2015-2018.		
	One-spot Livebearer	No information available	No information available	
	Black Rat	Not listed in 2012 management plan	Recorded	
	House Mouse	Not listed in 2012 management plan	Not recorded but likely to be present	
Non Priority	Mallard Duck	Not listed in 2012 management plan	Recorded	
	Laughing Kookaburra	Listed in 2012 management plan	Recorded	
	Laughing Turtle Dove	Listed in 2012 management plan	Recorded	
	Spotted Dove	Listed in 2012 management plan	Recorded	
	Rainbow Lorikeet	Listed in 2012 management plan	Recorded	

Table 23: Feral Animal Activity

Review of available occurrence records for the period and previous management plans indicates:

- feral cats have been frequently observed during site visits by fauna specialists from 2012-2018. Cats
 observed by Ecoscape zoologists are considered to be roaming domestic animals rather than feral. The
 City is investigating options to reduce the incidence of roaming cats including education of local residents.
- evidence of bird deaths believed to be caused by cats was observed by Ecoscape in 2018. It is
 considered probable that cats are having the greatest impact on native species of any feral animal in the
 reserve.
- foxes and rabbits are not considered to be active in the area (City of Melville *pers. comm.*); no evidence of their presence was recorded in 2012-2018.
- bee hive control has been undertaken on an ongoing basis, however, due to the mobile nature of bee colonies it is not considered that total removal is possible. Hive numbers appear to be showing a decreasing trend from 2012-2018. Hives will require regular ongoing control.
- the number of hives being controlled per year appears to be showing a decreasing trend. The number treated can only fall to a certain floor level which represents the number of new hives being established then controlled each year.
- the 2004 and 2012 management plans recommended control of introduced waterfowl including Geese (not recorded) and Mallard ducks (recorded) when they exceeded a population of four individuals.
- as observed in the 2012 management plan, Rainbow Lorikeet numbers were high during the 2018 surveys.

Specific information such as number of hours spent searching for and trapping Very High and High priority species is not available to undertake a quantitative assessment of the success of the control programs undertaken to target these species. Assessment of success was undertaken based on presence or absence at the time of surveys or trapping events.

Table 24: Feral Animal Indices

Threat	Objective	Result
Feral Cat	Manage within guidelines to reduce	Unsuccessful – activity shows no evidence of
	presence	being reduced
Fox	Exclude from area	Successful
Rabbit	Exclude from area	Successful
European Bee	Manage within guidelines to reduce	Successful – control is ongoing
	presence	Successial – control is origoing
	Exclude from area. If population of a	
Feral Waterfowl	feral waterfowl species exceeds four	Successful
	individuals removal is triggered	

3.6 Diseases and Pathogens

According to the NAAMP, no introduced diseases or pathogens, including *Phytophthora* dieback, have been identified from Booragoon Lake. No evidence of plant diseases warranting investigation were identified in 2018.

Table 25: Disease and Pathogen Indices

Threat	Objective	Result	
Dieback	Prevent any infestations becoming	Successful – no evidence suggesting	
	established	disease presence	

3.7 Stormwater

Booragoon, which is part of the Bull Creek catchment area, receives stormwater flows from the surrounding road, urban and garden catchments through six drains, shown in **Figure 8**.

The south western drain entrance has been upgraded to include a retention basin, rock riffles and a vegetated channel. Weed control work and revegetation has occurred in the area surrounding the basin. The drainage basin in the north east is functional although weeds are abundant. The drain located on Leach Highway has the potential to be the source of significant pollution if there is a fuel, oil or chemical spill, including as a result a motor vehicle accident. A valve is present on this drain to allow it to be closed if required. The remaining drains flow directly into the lake with minimal sedimentation or nutrient stripping.



Figure 8 Stormwater drain locations (Natural Areas Consulting 2012)

Water quality sampling is undertaken at the reserve on an annual basis by SERCUL in partnership with the Department of Water and Environmental Regulation (DWER) and the City. The 2019 sampling report provides a summary of and a comparison to the previous 11 years of data (2007-2018) (SERCUL 2019). The key results from this report and how this compares to ANZECC guidelines (ANZECC and ARMCANZ 2000) are summarised below in **Table 26**. For detailed results please refer to the SERCUL 2019 report.

Water Quality Parameter Type	Sub	Summary of Results (SERCUL, 2019)	
	Aluminium	Concentrations of total and soluble aluminium have exceeded ANZECC 95% protection guideline for protection of biota over the past 11 years.	
	Chromium	Level below relevant guideline values for recent years.	
	Copper	Below relevant guideline values.	
		Total iron concentrations were generally one of the highest out of Melville Bull Creek catchment sites sampled over the 11 year monitoring period.	
Metals	Iron	1 otal iron concentrations exceeded guideline value for every event of the 2018 sampling period. Soluble iron concentration has also exceeded the NHMRC recreation for aesthetic value.	
		Particularly high total iron concentrations are potentially a result of acid sulphate soil oxidation decreasing pH and mobilising metals.	
	Mercury	Not measured. According to the 2004 management plan, levels since measurement began (1972) have exceeded guidelines (up to 2002).	
	Lood	Below relevant guideline values for 2018.	
		Exceedance of guidelines recorded in historical data.	
	Zinc	Below relevant guideline values.	
		Exceeded trigger values on almost all sampling occasions.	
Nutrients	Total nitrogen	The annual maximum concentrations of TN recorded from 2012 to 2018 (excluding one recording in 2017) were significantly lower (although variable) than those recorded from 2007 to 2011, but still significantly exceed ANZECC guidelines. Spring concentrations are often higher than those recorded in autumn, possibly as a result of nutrient accumulation over rainy periods or large waterbird populations in spring.	
		Exceeded trigger values on almost all sampling occasions.	
	Total phosphorus	TP has increased significantly over the monitoring period and exceed ANZECC guidelines. Spring concentrations are often higher than those recorded in autumn, possibly as a result of nutrient accumulation over rainy periods or large waterbird populations in spring.	
		Regularly recorded as significantly outside acceptable range for wetlands (significantly outside defined as pH <5). Only slightly below guidelines in 2017-2018.	
	рН	Oxidation of acid sulphate soils may be the cause of low pH levels (see Section 3.9). Higher water levels observed in winter and spring of 2017 and 2018 reducing exposure of acid sulphate soils may be the reason for slightly higher pH levels for this period.	
Physical	<u> </u>	DO concentrations very low and below ANZECC acceptable ranges.	
	Dissolved oxygen	Particularly low DO has been recorded throughout the monitoring period and are thought to be a result of excessively high organic loads and interaction with groundwater. Increasing nitrogen and phosphorus concentrations 2012-2017 correlate with the decline in DO, suggesting a possible link between eutrophication and low DO saturation.	
William	Total suspended solids	Concentrations exceeding the DWER interim guideline (6 mg/L) on approximately 60% of sampling occasions, but not in the August-October	

Table 26: Water Quality Monitoring Results

Water Quality Parameter Type	Sub	Summary of Results (SERCUL, 2019)
		2018.
	Conductivity	Generally above ANZECC acceptable ranges, but 2018 values were lower than previously recorded.

The SERCUL 2019 report concluded that based on the above findings, Booragoon Lake and Blue Gum Lake are considered to have the poorest water quality in the Bull Creek main drain catchment and should therefore be the focus of management responses to improve the quality of the sites. It was also stated that particularly high total iron concentrations at Booragoon Lake, possibly as a result of acid sulphate soil oxidation mobilising metals, may be more likely to result in damage to biota and cause iron flocs compromising water quality and aesthetic.

The recommendations provided by SERCUL to improve water quality in the lake are summarised below:

- continue replacing grass surrounding the lake with native species to prevent further ingress of grass into the lake and help filter runoff
- continue to remove and control other invasive species that contribute to organic loads into the lake, replacing them with native species
- revegetate all drainage outlets
- periodically remove excess sediment and litter from north-east drainage basin
- investigate use of Phoslock (or similar) to control/remove phosphorus
- consider increasing the lake pH; this may also reduce mobilisation of metals from sediment
- · consider adding analysis for arsenic, mercury and nickel to future monitoring
- consider speciation testing for zinc and copper
- add macroinvertebrate testing to provide an indication of eutrophic status and species richness.

Assessment Against Stormwater and Water Quality Indices

Table 27: Stormwater and Water Quality Indices

Threat	Objective	Result	
Metals	Meet ANZECC trigger values 95% protection level for all metals	Unsuccessful – at least wo metals regularly exceed trigger values (aluminium, iron). Four metals (chromium, copper, lead, zinc) not exceeded. Mercury not measured but historically exceeded guidelines.	
Nutrients	Meet ANZECC trigger values and Local Water Quality Improvement Plan target of 1.0mg/L	Unsuccessful – total nitrogen and total phosphorus levels regularly exceeding targets	
Nutrients	Reduce inflow of nutrients through improvement to revegetated basins	Successful – recommended works to improve function of stormwater basins undertaken	
Physical Characteristics	Meet ANZECC trigger values 95% protection level	Unsuccessful – all four measured criteria outside of acceptable range (pH, dissolved oxygen, suspended solids, conductivity) Conductivity in 2018 was lower than previously recorded.	

3.8 Reticulation

No reticulation is present in areas that may affect bushland. Areas of reticulated grass in parkland are sufficiently buffered from bushland and wetland areas that additional water is not applied to bushland.

The City identified issues of overspray on the western side of the Reserve (adjacent to Aldridge Road), which was removed during 2018.

Table 28: Reticulation Indices

Threat	Objective	Result
Alteration of surface water flows	Prevent overspray / leakage from reticulation entering bushland Monitor reticulation to ensure overspray does not occur	Successful – no overspray effects observed

3.9 Acid Sulfate Soils

Assessment of the DWER Acid Sulphate Soils (ASS) Risk Map (Department of Water and Environmental Regulation 2019) shows Booragoon has a high to moderate risk of having ASS (**Figure 9**).



Figure 9: Acid Sulphate Soils Mapping

The listing of the area as high to moderate risk requires that potential soil disturbance is considered for all proposed works in the mapped area. The NAAMP identifies that disturbance of or exposure to oxygen of the ASS has potential to cause significant environmental impacts and could lead to listing of the area as a contaminated site.

If any soil disturbing works or excavations are planned for the area a specific ASS investigation and management plan would likely be required to mitigate risks.

Threat	Objective	Result
Activation of ASS	Prevent disturbance of ASS. Any soil disturbing activates should undertake a risk assessment prior to commencement	Successful – no activation of ASS observed.

Table 29: Acid Sulphate Indices

3.10 Climate Change

As described in the NAAMP climate change models predict reduced rainfall amounts and increased storm events, and a range of other impacts which are largely out of the direct control of the City of Melville. Currently no directly attributable impacts of climate change have been observed in the reserve. The general trend in water level drops, although not apparent in 2018, are likely to be a result of climate change (decreasing rainfall) affecting groundwater levels and runoff, however, borewater extraction is also likely to play a significant role.

4 Implementation

4.1 Review of Management 2012-2019

Review of previous management objectives and an assessment of success was undertaken where possible using indices described at the end of each section. Several stated objectives could not be assessed due to an unavailability of data against which to undertake an assessment. A summary of the assessment of success of measurable indices for management objectives is provided below in **Table 30**.

Asset or Threat		Successful Indices	Unsuccessful Indices	Indeterminate or Un-assessable
	Bush Forever Listing	1	0	0
	Ecological Linkages	0	0	1
	Ecological Communities	4	0	0
	Wetlands	2	0	0
Assets	Heritage	0	0	1
	Community Interest	2	0	0
	Reference	0	0	1
	Native Flora	0	1	2
	Native Fauna	7	1	1
Physical Disturbance Fire Weeds	Physical Disturbance	3	1	0
	2	0	0	
	Weeds	2	0	1
	Habitat Loss	1	0	0
Threate	Feral Animals	4	1	0
Threats	Diseases and Pathogens	1	0	0
	Stormwater	1	3	0
Reticulation Acid Sulfate	Reticulation	1	0	0
	Acid Sulfate Soils	1	0	0
	Climate Change	0	0	1
Total	·	32	7	8

Table 30: Summary of Indices 2012-2019

4.2 Management Objectives 2019-2024

The following section describes management objectives and implementation recommendations for the reserve for 2019-2024. Objectives are discussed in terms of lagging indicators for assets and leading indicators for threats. These types of indicators are described in the NAAMP as:

- Lagging indicators (assets) indicate whether strategic objectives are being met, can only be measured once actions have been implemented.
- Leading indicators (threats) indicate whether guidelines and procedures are effective in meeting objectives, can be measured at any time during implementation.

The objectives for management of reserve assets are described in framework in the NAAMP and are summarised below in **Table 31-Table 34**. Locations potential revegetation areas have been identified are indicated on **Map 16**.

Table 31: Tiered Objectives for Assets and Associated Lagging Indicators

Objective	Lagging Indicator	Applicable When
Enhance	Increase in either extent density abundance 	Assets can be enhanced for reasonable cost or where enhancement may reduce operational costs
Maintain	No decrease in extent density abundance 	Asset can be maintained or when there is insufficient knowledge or resources currently available to enhance
Confirm	Decrease number of assets for which information is limited or none available	Potential to be present but currently unknown
Monitor	No measurable indicator	Assets that cannot be managed by action within the City or where asset is not considered critical

Table 32: Asset Management Objectives and Recommendations 2019-2024

Section Reference	Asset	Sub head	Objective (Leading or Lagging Indicator)	Implementation Recommendations	Priority
2.1.1	Bush Forever Listing		Monitor – no change to Bush Forever system expected	No action required.	Low
				Prevent high intensity or frequent fires (See section 3.2).	
				Prevent introduction of dieback or other pathogens to the reserve.	
				Continue weed control efforts, these should be focused on supporting revegetation efforts.	
		Vegetation type diversity	Maintain or Enhance – four vegetation types are currently described	Revegetation on the north and north eastern side of the reserve should continue, as these works progress and mature the vegetation type <i>Eucalyptus rudis</i> and <i>Melaleuca rhaphiophylla</i> woodland (rehab understorey) will reduce in size and be replaced by <i>Eucalyptus rudis</i> and <i>Melaleuca rhaphiophylla</i> woodland (native understorey).	High
2.2.1	Factorial			Emergent <i>Baumea articulata</i> rushland vegetation type is smallest vegetation type in extent and likely the most susceptible to disturbance. This vegetation type was identified as providing important habitat for waterbirds. In the event a reduction in extent or decline in condition is observed planting of rushes may be required to maintain vegetation type. This vegetation type is expected to be seasonally impacted during extended periods of low water level.	
	Communities		Maintain or Enhance – expand area of native vegetation	Continue with revegetation program and support projects by other partners. Areas to target for revegetation or infill planting are shown in Map 16 .	
		Extent of native vegetation		The major opportunities to increase native vegetation extent in degraded condition / parkland vegetation in the south east corner.	High
				Native species lists for each vegetation type are provided in Appendix Three ; these should guide selection of species to be used in revegetation programs.	
		Condition of native vegetation	Maintain or Enhance – improve condition of native vegetation	Continue with revegetation and weed program and support projects by other partners. Weed species and control priorities are discussed in section 3.3 below.	High
		Significant communities	Maintain or Enhance – improve overall condition of native vegetation	Continue ongoing weed control and undertake revegetation where possible. Whilst no specific vegetation is of conservation significance, the recognition of the reserve as being a significant bird breeding habitat is of importance, and any measures that improve the wetland vegetation that supports this habitat could only be beneficial.	High
2.2.2	Wetlands	Conservation Category Wetland listing	Maintain or Enhance – environmental criteria leading to listing as Conservation Category	No specific action required, values leading to listing will be maintained through actions undertaken to address other aspects.	Low
2.2.3	Heritage	Registered Aboriginal Site 3298	Monitor – remain aware to new heritage discoveries or changes to conditions. Any works causing significant disturbance in mapped area should be discussed with Department of Lands Planning and Heritage	City staff and community groups are to continue to be made aware of the presence of Registered Aboriginal Site. Any major works in mapped area should be discussed with Department of Lands, Planning and Heritage and appropriate permits gained prior to work commencing	Moderate
				49	

Section Reference	Asset	Sub head	Objective (Leading or Lagging Indicator)	Implementation Recommendations	Priority
2.2.4	Community Interest		Maintain or Enhance – improve number or size of active community groups and area being actively managed	Provide support to and maintain relationships with community partners.	High
2.2.5	Reference		Monitor – no change expected	No action required.	NA
2.3.1	Native Flora	Species diversity	Maintain or Enhance – increase native species diversity	The majority of actions are the same as for 2.2.1 Ecological Communities. Revegetation species lists should consider a range of suitable local species outside that which are known to currently occur in the reserve. Revegetation planting is the key opportunity to increase species diversity. Due to the isolated nature of the reserve natural regeneration capacity to increase diversity is very low.	High
		Very High Value plant species	Monitor – none of these species are currently known from the reserve	No action required.	NA
		Mammal species	_	Action to maintain Ecological Communities (section 2.2.1) will address most requirements to maintain or enhance habitat which will support fauna diversity. Specific Habitat requirements for species and species groups are discussed in Section 2.3.2. Actions	
		Amphibian species	Maintain – continue to protect	specific to fauna are:	
2.3.2 Native Fau	Native Fauna	Reptile species	species diversity and manage habitat to allow ongoing use of	 feral animal control as discussed in section 3.5 below water quality measures as discussed in section 3.7 below to support amphibians and nesting waterbirds 	High
		Bird species Bird species	reserve by species	 dense revegetation planting around lake edge to provide shelter for Oblong Turtles (noting that Blue Gum Lake is higher priority for intervention as it has more suitable habitat) consider low fencing along Leach Highway edge to discourage Oblong Turtles and Southern Brown Bandicoot from crossing the road. 	

The objectives for management of threats are described in framework in the NAAMP and are summarised below in **Table 33**.

Table 33: Tiered Objectives for Assets and Associated Leading Indicators

Objective	Leading Indicator	Applicable When
Prevent	Prevent introduction or occurrence of	Threat not currently present in an area
Eliminate	Reduce extent, density or abundance working towards eventual complete removal	Elimination is feasible Impact has potential to be high
Contain	Stop, restrict or reduce rate of spread or frequency of occurrence	Elimination is not feasible Impact has potential to be high
Manage	Limit negative impacts on assets	Threat is believed to be already at or near maximum impact
None	No measurable indicator	Threat is absent from reserve and will not be accidentally introduced or naturally develop

Table 34: Threat Management Objectives and Recommendations 2019-2024

MARANANTI -

Section Reference	Threat	Sub head	Objective (Leading or Lagging Indicator)	Implementation Recommendations	Priority
3.1		Informal tracks	Eliminate – reduce number and extent of informal tracks in bushland	Informal track appears to be naturally regenerating. Consider placing of some branch material at beginning of track to discourage access while regenerating. Remove growing equipment and materials associated with propagation of illegal substances. Notify ranger and community watch of activity and monitor the area.	Moderate
	Physical Disturbance	Rubbish Dumping	Manage – continue ongoing rubbish removal program. Maintain rubbish occurrence at low levels currently recorded, target no large occurrences of garden waste or household rubbish dumping	Continue rubbish removal program by the City. Target rubbish accumulation along Leach Highway verge to limit water borne plastic wastes entering the wetland during flows. Encourage community rubbish collection programs. Remove any major garden or other rubbish dumping locations to discourage further dumping. Dumping of garden wastes, in particular lawn clippings has been recorded in the past at this reserve.	Moderate
		Tree poisoning Illegal Clearing Firewood collection	Prevent – no occurrences	Continue to work with community and residents to promote values of natural areas.	Low
		Vandalism	Manage – maintain current low levels of graffiti on signage only	Continue removal of graffiti under City parks maintenance program. Main signage and information board at beginning of boardwalk appears to be the major target for graffiti activity.	Low
3.2	Fire	Prevent – manage the reserve so as to prevent any large (>50% of reserve burnt) or overly frequent (frequency <8 years) fires occurring		Manage the reserve in accordance with guidance provided in the City Bushfire Management Guidelines (City of Melville 2014). Ensure that the verge and parkland immediately adjacent to Leach Highway is maintained as low grass to reduce the chance of accidental ignition from cigarette butts disposed of by motorists. Monitor the density of Eucalypt species regrowing in the 2005 fire area. These groves are dense and are producing significant levels of accumulating litter. Consideration may need to be given to thinning this area in the future to reduce fuel loads. A planted Eucalypt species is abundant in this area and can be targeted for removal immediately to reduce fuel load.	High
3.3	Weeds	Very High Impact weed species	Eliminate- Arum Lily, Bridal Creeper, Brazilian Pepper, Madeira Vine, Contain- Perennial Veldt Grass (<i>Ehrharta calycina), Paspalum dilatatum</i>	All weed species are to be controlled following guidance in the Environmental Weed Management Guidelines (City of Melville 2013). Arum Lily, Bridal Creeper and Madeira vine were all recorded as occurring in low abundance (less than 10 plants). These species should be targeted for eradication as a priority. As all species are known to resprout from underground tubers, ongoing follow up control will be required to remove them. Brazilian Pepper trees are scattered around wetland edge, plants are currently at sapling size where they are just becoming large enough to produce fruit. Removal should occur as a priority to prevent additional seed being dispersed in the reserve. Other plants are likely to be growing further into the inundated section of the wetland, periods of low water levels should be used to access further in and remove this species. Perennial clumping grass <i>Paspalum dilatatum</i> (or closely related species <i>Paspalum urvillei</i>) is only occurring in small numbers at the drain entrance at the southwestern end of the lake. This population can be targeted to contain it to its current extent with a longer term goal of removing it. Perennial Veldt Grass (<i>Ehrharta calycina</i>) is sparsely occurring in dryland areas in the eastern edge of the reserve, it should be controlled in areas of rehabilitation. Due to the dense venetation its potential for spread is limited.	High

Section Reference	Threat	Sub head	Objective (Leading or Lagging Indicator)	Implementation Recommendations	Priority
	High Impact weed species		Eliminate- Clumping Geophytes, Giant Grasses (Pampas Grass) Contain-Annual Clumping Grasses Perennial Running Grasses (Kikuyu and Couch)	Clumping geophytes are limited to a very small population of African Flag and scattered Gladiolus in the south east corner. These small populations can be removed to prevent spread. Pampas Grass population is restricted to two individuals, these are currently small in size and can be removed before they set seed and increase in size. Annual clumping grasses occur at low to moderate density in almost all areas of the reserve. Control of these species should be undertaken with a focus on containing them to existing areas and preventing increase in better condition bushland or in areas undergoing revegetation. Perennial running grasses are widespread in shaded and moister sections of the reserve. They have been removed from areas undergoing revegetation. Control should be undertaken with a focus on containing them to existing areas and preventing increase in better condition bushland. Control should be undertaken with a focus on containing them to existing increase in better condition bushland. Control will also be required prior to undertaking further revegetation. Trees and shrubs weeds are very common and widespread in the reserve and have a high potential to impact the reserve. Priorities for control should be the removal of species in the following order:	High
				 Ficus sp. Acacia species Scattered Casuarina cunninghamiana Dense groves of Eucalyptus sp. planted growing along the southern and eastern edge of the lake Palms All other tree and shrub weeds. 	
		Medium and Low Impact weed species	Contain- species Fumaria (<i>Fumaria capreolata</i>) Manage- reduce impact on bushland or revegetation projects when possible	Although Fumaria is not identified in the NAAMP as a high priority species, within this reserve its impact was observed to be significant. It is recommended that this species is to be considered a high priority for control. Control should focus on areas undergoing revegetation or those being prepared for revegetation. For all other species only target these species as resources allows, control should focus on protection of revegetation works.	Low
3.4	Habitat Loss		Manage – prevent habitat loss at reserve scale	Continue revegetation to enhance habitat quality. If the lake dries significantly consider using the opportunity to revegetate in areas that are usually inundated with additional rush species. Continue weed control to improve habitat quality. Prevent fires as discussed in section 3.2.	Moderate
		Feral cats	Manage – reduce numbers (within guidelines)	Consider education (e.g. newsletters, targeted information leaflet drop) of local residents regarding the significance of the damage that domestic cats can do to wildlife, and the significance of the reserve especially for waterbirds. Improvements in habitat quality to allow native animals to better protect themselves. Consider targeted cat trapping program for removal of stray animals from area. Investigate regulatory options to prevent cat presence in the reserve.	High
3.5	Feral Animals	Fox and Rabbit	Manage – exclude from area (prevent reintroduction)	Continue monitoring for presence and control if required. Foxes are considered likely to move into the reserve on occasion from adjacent Piney Lakes.	Low
		European Bee	Manage – reduce presence (within guidelines)	Continue monitoring and removal of bee hives under existing bee control plan, appears to have been successful to date.	Moderate
		Feral Waterfowl	Prevent – exclude from the area if more than four individuals observed	Conduct regular population census counts of Mallards to determine if action is required to reduce numbers; remove birds if more than four are counted at any one time. Ensure Geese do not become established at the Lake.	Low
3.6	Diseases and Pathogens	iseases and athogens Prevent – ensure infestations of diseases and pathogens do not become established		Continually assess general vegetation health to determine if problem diseases or pathogens are potentially present; seek professional advice if sudden poor plant health or deaths occur in patches.	Moderate
		Stormwater	Manage – ensure stormwater inflows into the lake are as clean as possible	Improve or maintain water quality through ongoing improvements to filtering of stormwater as it enters the lake at outlets (reed beds, retention sites etc.). Ensure drains are not blocked by excessive grass growth.	High
3.7	Stormwater	Metals	Manage – ensure stormwater inflows into the lake are as clean as possible	 Follow City of Melville Stormwater Management Guidelines (expected completion 2019). Consider more detailed investigation regarding relationship between pH levels, potential acid sulfate soils activation and metals in sediment concentrations. Develop more detailed management strategy for these metals based on above investigation. Consider testing for arsenic, mercury and nickel, and speciation testing for zinc and copper, to future monitoring. 	Moderate

uilel.

Section Reference	Threat	Sub head	Objective (Leading or Lagging Indicator)	Implementation Recommendations	Priority	
				Follow City of Melville Stormwater Management Guidelines (expected completion 2019).		
				Maintain community and parks and gardens team training and awareness programs regarding use of fertiliser.		
			Manage – reduce nutrient addition to	Consider undertaking further works to redesign outlets into lake to incorporate nutrient stripping plants and having loosely arranged rocky bases to increase oxygenation.		
		Nutrients	the lake	Improve nutrient load by reducing net imports into the lake by filtering sediments from stormwater drains.	High	
				Revegetation of drain areas to increase reed beds at drains.		
				Consider investigating methods of nutrient export e.g. Phoslok.		
				Consider macroinvertebrate testing to provide an indication of eutrophic status and species richness.		
				Improve nutrient load by reducing net imports into the lake by filtering sediments from stormwater drains.		
		Physical characteristics	Manage – ensure stormwater inflows into the lake are as clean as possible	SERCUL 2019 report identified that oxidation of acid sulfate soils may be the cause of low pH levels, an investigation into the Presence of acid sulfate soils is recommended. See heading 3.9 for details.	High	
				Increasing nitrogen and phosphorus concentrations 2012-2017 correlate with the decline in DO, suggesting a possible link between eutrophication and low DO saturation. Recommendations stated above to address nutrient issues will likely assist.		
				Consider the instillation of hard rock riffles at the stormwater entrance points to increase oxygenation of incoming water flows.		
3.8	Reticulation		Manage – prevent overspray/leakage from reticulation entering bushland	Continue current management.	Low	
			Prevent- Prevent physical disturbance of ASS. Any soil	All works in the area mapped as being at risk of acid sulfate soils should be managed following Treatment and Management of Soil and Water in Acid Sulfate Soil Landscape guidelines (Government of Western Australia & Department of Environment Regulation 2015).		
3.9 Acid Sulfate	Acid Sulfate Soils	Acid Sulfate Soils Activation of ASS	S disturbing activates should undertake a risk assessment prior to commencement	An investigation into the presence of acid sulfate soils should be undertaken in the wetland areas, this assessment will provide information that will assist in interpretation of low pH values recorded in water testing program. Investigation should follow Identification and Investigation of Acid Sulfate soils and acidic landscapes guidelines (Government of Western Australia and Department of Environmental Regulation 2015).	Moderate	
3.10	Climate Change		Manage- continue to manage climate change impacts	Continue environmental monitoring programs to identify long term changes in reserve	Low	



Map 16: Potential revegetation areas and management issues

References

ANZECC and ARMCANZ 2000, National water quality management strategy Paper No. 4: Australian and New Zealand guidelines for fresh and marine water quality., Australian & New Zealand Environment & Conservation Council, Agriculture & Resource Management Council of Australia & New Zealand, Canberra., Canberra.

Australian Government. Environment Protection and Biodiversity Conservation Act 1999.

- Bartholomaeus, C.J. 2015. Understanding the decline of an urban turtle species; the critical role of combining ecological and social research. PhD Thesis School of Veterinary and Life Sciences, Murdoch University.
- Bennett Brook Environmental Services. 2004. Booragoon Lake Reserve Management Plan. City of Melville.
- Bradsell, P., Prince, J., Kuchling, G., & Knott, B. 2002. Aggressive interactions between freshwater turtle, *Chelodina oblonga*, hatchlings and freshwater crayfish, *Cherax* spp.: implications for the conservation of the critically endangered western swamp turtle *Pseudemydura umbrina*. *Wildlife Research*, vol. 29, no. 3, pp. 295-301
- Brucciani, B. & Kemp, A. 2011. Assessing the Health of Beeliar Regional Park Wetlands, Western Australia. The University of Notra Dame Australia.
- CALM. 2006. Beeliar Regional Park Final Management Plan.
- City of Melville. 2013. Environmental Weed Management Guidelines.
- City of Melville. 2014. Bushfire Management Guidelines.
- Department of Biodiversity Conservation and Attractions. 2017. *Geomorphic Wetlands, Swan Coastal Plain (DPAW-017)*. Available from: <u>https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain</u>.
- Department of Fire and Emergency Services. 2019. *Map of Bush Fire Prone Areas*. Available from: <u>https://maps.slip.wa.gov.au/landgate/bushfireprone/</u>.
- Department of Planning Lands and Heritage. 2019. *Aboriginal Heritage Inquiry System*. Available from: <u>https://maps.daa.wa.gov.au/ahis/</u>.
- Department of Water and Environmental Regulation. 2019. *Acid Sulphate Soils Risk Map (Spatial Dataset DWER-055)*. Available from:
- Environmental Protection Authority. 2016. *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment*. Available from: <u>http://www.epa.wa.gov.au/policies-guidance/technical-guidance-flora-and-vegetation-surveys-environmental-impact-assessment</u>.
- Giles, J. 2011, Assessment of turtle behaviour and management recommedations for the maintenance of the turtle population under a seasonal hydrologic regime, City of Melville.
- Government of Western Australia 2000a. Bush Forever Keeping the Bush in the City. Volume 1: Policies, Principles and Processes Perth, Western Australia, Western Australian Planning Commission.
- Government of Western Australia 2000b. Bush Forever Keeping the Bush in the City. Volume 2: Directory of Bush Forever Sites Perth, Western Australia, Western Australian Planning Commission.

.....

Government of Western Australia. Biosecurity and Agriculture Management Act 2007.

Government of Western Australia. Biodiversity Conservation Act 2016.

- Government of Western Australia & Department of Environment Regulation 2015, *Treatment and management of soil and water in acid sulfate soil landscapes*.
- Government of Western Australia and Department of Environmental Regulation. 2015. Identification and investigation of acid sulfate

soils and acidic landscapes.

A THOMAS

Natural Areas Consulting. 2012. Booragoon Lake Reserve Strategic Management Plan. City of Melville.

- Santoro, A. 2017. The impact of urbanisation on the south-western snake-necked turtle (Chelodina colliei). Honours Thesis School of Veterinary and Life Sciences, Murdoch University.
- SERCUL. 2019. Water and sediment quality in the Bull Creek catchment and City of Melville lakes 2018.
- Species and Communities Branch Department of Biodiversity Conservation and Attractions. 2019. *Priority Ecological Communities for Western Australia Version 28; 17 January 2019.* Available from: <u>https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Priority%20ecological%20communities%20list%20_Jan%202019.pdf</u>.

Steen and Gibbs. 2004. Effects of roads on the structures of freshwater turtle populations.

- Waters, A. 2011, *City of Melville Strategic Natural Areas Asset Management Plan 2011*, City of Melville, Western Australia.
- Western Australian Local Government Association 2003. Regional Ecological Linkages for the Perth Metropolitan Region.

APPENDIX ONE SURVEY METHODOLOGY

Vegetation:

Vegetation types were mapped by Ecoscape in spring 2018 at a reconnaissance level (formerly known as level 1) floristic survey under the *Flora and Vegetation Technical Guidance* (Environmental Protection Authority 2016). This consisted of establishing one unmarked relevé per identified vegetation type.

The following information was collected from within each relevé:

- observer
- date
- site number
- GPS location (GDA94) of the northwest corner
- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the relevé
- soil type and colour
- topography
- list of flora species recorded with the total cover within the relevé for each species
- vegetation condition.

Flora:

A list of native flora was compiled per identified vegetation community. This list comprises of records from the relevé used to describe the vegetation type and an opportunistic list of collections undertaken as the surveyor traversed the survey area.

Weeds:

Significant weeds as identified in the NAAMP were mapped in the reserve. Weed populations were mapped using a 30m grid point system following the methodology described in the NAAMP. In addition point locations were recorded when appropriate for distinct weed points.

Fauna:

Two trap lines were installed distributed amongst identified habitat types. These were installed for four nights. Trap lines consisted of:

- 20 L bucket and 50 cm PVC pipe traps: these are dug into the ground and act as pitfall traps. A 10 m long, 30 cm high fence is passed across the top of the pit to direct fauna into it. One per trap line.
- Faser-type funnel traps: similar to yabbie traps, these are placed at the ends of each fence to capture fauna that do not readily fall into pit traps. All funnel traps are covered by industrial insulation shades to reduce the likelihood of animals suffering from overheating. Two per trap line.
- Elliott traps: aluminium box traps baited with 'universal bait' to attract and capture smaller mammals and re-baited daily. All Elliott traps are covered by industrial insulation shades to reduce the likelihood of animals suffering from overheating. One per trap line.
- Cage traps: larger wire-frame box traps, also baited with 'universal bait', to capture medium-sized mammals. All Cage traps are covered by Hessian shades to reduce the likelihood of animals suffering from overheating. Two per survey area.
- Two motion sensing infrared cameras were set for five nights in the reserve.

Opportunistic searches were also undertaken which involves turning surface debris, raking leaf litter/ spoil heaps and observation of active fauna.

An ultrasonic bat recorder was also deployed for four nights to survey for bats.

Bird surveys were undertaken in all habitat types. These searches consisted of one half hour observation period at dawn and one at dusk for each habitat type.

APPENDIX TWO VEGETATION TYPES

Table 35: Vegetation type summary

Mapping Unit	Vegetation Type	Relevé	Representative Photograph	Area (ha) and Extent (%) of Reserve
<i>Eucalyptus rudis</i> and <i>Melaleuca</i> <i>rhaphiophylla</i> Woodland (rehab understorey) ErMrLW	<i>Eucalyptus rudis, Melaleuca rhaphiophylla</i> low woodland over <i>Acacia saligna subsp. lindleyi,</i> <i>Viminaria juncea, Jacksonia furcellata</i> tall open shrubland	BOR01		2.53 19.07%
<i>Eucalyptus rudis</i> and <i>Melaleuca</i> <i>rhaphiophylla</i> Woodland (native understorey) ErMrLOF	Eucalyptus rudis, Melaleuca rhaphiophylla low open forest over Pteridium esculentum, Fumaria capreolata, Ehrharta longiflora low closed fernland	BOR02		0.93 7.05%

Mapping Unit	Vegetation Type	Relevé	Representative Photograph	Area (ha) and Extent (%) of Reserve
<i>Melaleuca rhaphiophylla</i> and <i>Melaleuca teretifolia</i> Low Woodland MtMrLW	<i>Melaleuca teretifolia, Melaleuca rhaphiophylla</i> low woodland over <i>Lemna disperma, Cenchrus</i> <i>clandestinus</i> low open forbland/grassland	BOR03		5.30 39.96%
<i>Baumea articulata</i> Rushland BaTR	<i>Melaleuca teretifolia, Melaleuca rhaphiophylla</i> tall sparse shrubland over <i>Baumea articulata</i> tall rushland	No relevé (not accessible)	No image area not accessable	0.33 2.51%

APPENDIX THREE NATIVE FLORA INVENTORY

Table 36: Native flora species diversity comparison

Native Species Records	2004-2012	2018
	Surveys	Survey
Acacia pulchella	X	X
Acacia saligna subsp. lindleyi	X	X
Acacia stenoptera		X
Adenanthos cygnorum subsp. cygnorum	X	
Allocasuarina humilis		X
Alternanthera nodiflora	X	
Astartea scoparia	X	X
Banksia attenuata	X	
Banksia grandis		X
Banksia littoralis	X	X
Banksia menziesii	X	X
Baumea articulata	X	X
Baumea juncea	X	
Baumea preissii	X	
Bolboschoenus caldwellii	X	
Bossiaea eriocarpa		X
Burchardia congesta	X	
Cassytha racemosa	X	
Centella asiatica	X	X
Dianella revoluta	X	
Dodonaea sp.	X	
Eucalyptus rudis subsp. rudis	X	X
Gastrolobium ebracteolatum	X	
Haemodorum spicatum	X	
Hakea prostrata	X	X
Hakea varia		X
Hardenbergia comptoniana	X	X
Hypocalymma robustum		X
Isolepis congrua		X
Jacksonia furcellata	X	X
Jacksonia sternbergiana	X	X
Juncus pallidus	X	X
Kennedia prostrata	X	X
Kunzea glabrescens		X
Lemna disperma	X	X
Lepidosperma longitudinale	X	X
Leucopogon propinquus	X	
Lobelia anceps	X	
Macrozamia fraseri	X	x
Melaleuca preissiana	X	X
Melaleuca rhaphiophylla	X	X

Native Species Records	2004-2012 Surveys	2018 Survey
Melaleuca teretifolia	X	X
Microtis media	X	
Nuytsia floribunda	X	
Patersonia juncea	X	
Persicaria decipiens	X	
Pimelea rosea subsp. rosea	X	
Pteridium esculentum	X	X
Schoenoplectus validus	X	
Scholtzia teretifolia		X
Sowerbaea laxiflora	X	
Synaphea spinulosa subsp. spinulosa		X
Tricoryne elatior	X	
Typha domingensis	X	
Typha orientalis	X	X
Viminaria juncea		X
Xanthorrhoea preissii	X	X
Xanthosia huegelii		X

Table 37: Native species per vegetation type

Native species by vegetation type (Ecoscape 2018 survey)	<i>Eucalyptus rudis, Melaleuca</i> <i>rhaphiophylla</i> Woodland (rehab understorey)	<i>Eucalyptus rudis, Melaleuca</i> <i>rhaphiophylla</i> Woodland (native understorey)	<i>Melaleuca rhaphiophylla,</i> <i>Melaleuca teretifolia</i> Low Woodland	<i>Baumea articulat</i> a Rushland
Acacia pulchella		Х		
Acacia saligna subsp. lindleyi	Х	Х		
Acacia stenoptera		Х		
Allocasuarina humilis		Х		
Astartea scoparia		Х		
Banksia grandis		Х		
Banksia littoralis	Х	Х		
Banksia sp.	Х			
Baumea articulata			Х	Х
Bossiaea eriocarpa		Х		
Cassytha sp.		Х	Х	
Centella asiatica		X		
Eucalyptus rudis subsp. rudis	x	x		
Hakea prostrata		X		
Hakea varia		X		

61

Native species by vegetation type (Ecoscape 2018 survey)	<i>Eucalyptus rudis, Melaleuca</i> <i>rhaphiophylla</i> Woodland (rehab understorey)	<i>Eucalyptus rudis, Melaleuca</i> <i>rhaphiophyll</i> a Woodland (native understorey)	<i>Melaleuca rhaphiophylla,</i> <i>Melaleuca teretifolia</i> Low Woodland	<i>Baumea articulata</i> Rushland
Hardenbergia comptoniana	Х	X		
Hypocalymma robustum		Х		
Isolepis congrua		Х		
Jacksonia furcellata	Х	Х		
Jacksonia sternbergiana		Х		
Juncus pallidus			Х	
Kennedia prostrata		х		
Kunzea glabrescens		Х		
Lemna disperma			Х	
Lepidosperma longitudinale	Х			
Macrozamia fraseri	Х	Х		
Melaleuca leucadendra	Х			
Melaleuca preissiana	х	х		
Melaleuca rhaphiophylla	Х	Х	Х	Х
Melaleuca teretifolia		Х	Х	Х
Pteridium esculentum	Х			
Scholtzia teretifolia			Х	
Senecio sp.		X		
Synaphea spinulosa subsp. spinulosa				
Viminaria juncea	Х	Х		
Xanthorrhoea preissii		X		
Xanthosia huegelii				

APPENDIX FOUR FAUNA INVENTORY

Table 38: Mammal records

Invasive	Species	Common name	2004-2012 Survey	2018 Survey
	Austronomus australis	White-striped Free-tailed Bat		X
	Chalinolobus gouldii	Gould's Wattled Bat		X
*	Felis catus	Cat	Х	X
	Isoodon obesulus subsp. fusciventer	Quenda/Southern Brown Bandicoot		Х
	Nyctophilus sp.	Unidentified Long-eared Bat		Х
*	Oryctolagus cuniculus	Rabbit	х	
*	Rattus rattus	Black Rat		Х
	Vespadelus regulus	Southern Forest Bat		X
*	Vulpes vulpes	Fox	Х	

Table 39: Likelihood of High Priority mammal occurrence

Species	Common name	Likelihood
Macropodidae		
Macropus irma	Western Brush Wallaby	U
Macropus fuliginosus	Western Grey Kangaroo	U
Muridae	·	·
Rattus fuscipes	Bush Rat	U
Peramelidae		
Isoodon obesulus fusciventer	Southern Brown Bandicoot	Recorded
Phalangeridae	·	·
Trichosurus vulpecula	Common Brushtail Possum	Recorded*
Tarsipedidae		
Tarsipes rostratus	Honey Possum	U
Vespertilionidae	·	·
Chalinolobus gouldii	Gould's Wattled Bat	Recorded
Chalinolobus morio	Chocolate Wattled Bat	Р
Falsistrellus mackenziei	Western False Pipistrelle	U
Nyctophilus geoffroyi	Lesser Long-eared Bat	Р
Nyctophilus gouldii	Gould's Long-eared Bat	U
Nyctophilus major	Greater Long-eared Bat	U
Vespadelus regulus	Southern Forest Bat	Recorded

L- Likely P- Possible

U- Unlikely

* Common Brushtail Possums have been sighted by volunteers and feral bee contractors but were not observed during the field surveys,

Table 40: Reptile records

Species	Common name	2004-2012 Survey	2018 Survey
Acritoscincus trilineatus	Western Three-lined Skink	X	Х
Chelodina colliei	Long-necked or Oblong Turtle	Х	
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink		Х
Cryptoblepharus virgatus	Fence Skink	Х	
Egernia kingii	King's Skink		Х
Hemiergis quadrilineata	Two-toed Earless Skink		Х

Table 41: Likelihood of High Priority reptile occurrence

Species	Common name	Likelihood
Agamidae	1	1
Ctenophorus adelaidensis	Ctenophorus adelaidensis	U
Pogona minor minor	Pogona minor minor	Р
Elapidae		
Demansia psammophis	Demansia psammophis	U
Neelaps bimaculatus	Neelaps bimaculatus	Р
Neelaps calonotus	Neelaps calonotus	Р
Notechis scutatus	Notechis scutatus	Р
Parasuta gouldii	Parasuta gouldii	Р
Pseudonaja affinis	Pseudonaja affinis	L
Gekkonidae		
Christinus marmoratus	Marbled Gecko	L
Pygopodidae		·
Aprasia repens	Worm Lizard	Р
Delma fraseri	Fraser's Legless Lizard	Р
Delma grayii	Gray's Legless Lizard	Р
Lialis burtonis	Burton's Snake-Lizard	Р
Pletholax gracilis	Keeled Legless Lizard	Р
Scincidae	•	
Lerista lineata	Lined Skink	Р
Lissolepis luctuosa	Mourning Skink	U
Typhlopidae	•	·
Ramphotyphlops australis	Southern Blind Snake	L
Ramphotyphlops waitii	Common Beaked Blind Snake	U
Varanidae		
Varanus gouldii	Gould's Sand Goanna	U

L- Likely P- Possible U- Unlikely

Table 42: Amphibian records

Invasive	Species	Common name	2004-2012 Survey	2018 Survey
	Crinia glauerti	Clicking Frog	Х	Х
	Heleioporus eyrei	Moaning Frog	X	X
	Limnodynastes dorsalis	Western Banjo Frog	Х	Х
	Litoria adelaidensis	Slender Tree Frog		Х
	Litoria moorei	Motorbike Frog		Х

Table 43: Bird records and comparison to previous surveys

Invasive	Species	Common name	2004-2012 Survey and Community Records	2018 Ecoscape Survey	2018 Ecoscape and Community Records
	Acanthiza apicalis	Inland Thornbill	*		
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	*		
	Acanthiza inornata	Western Thornbill	*		*
	Acanthorhynchus superciliosus	Western Spinebill	*		
	Accipiter cirrocephalus	Collared Sparrowhawk	*		*
	Accipiter fasciatus	Brown Goshawk	*		*
	Acrocephalus australis	Australian Reed Warbler			*
	Acrocephalus stentoreus	Clamorous Reed-warbler	*		
	Actitis hypoleucos	Common Sandpiper	*		
	Anas castanea	Chestnut Teal	*		
	Anas gracilis	Grey Teal	*	*	*
*	Anas platyrhynchos	Mallard	*		
	Anas rhynchotis	Australasian Shoveler	*		*
	Anas superciliosa	Pacific Black Duck	*	*	*
	Anhinga melanogaster	Darter	*		
	Anhinga novaehollandiae	Australiasian Darter			*
	Anthochaera carunculata	Red Wattlebird	*	*	*
	Anthochaera lunulata	Western Wattlebird	*		*
	Ardea alba modesta	Eastern Great Egret	*		*
	Ardea garzetta	Little Egret	*		
	Ardea intermedia	Intermediate Egret			*
	Ardea novaehollandiae	White-faced Heron	*		
	Ardea pacifica	White-necked Heron	*		*
	Aythya australis	Hardhead Duck	*	*	*
	Barnardius zonarius	Australian Ringneck-28	*		*
	Biziura lobata	Musk Duck	*		
	Bubulcus ibis	Cattle Egret			*
	Cacatua pastinator	Western Corella			*
	Cacatua roseicapilla	Galah	*	*	*
1. Hur	Cacatua sanguinea	Little Corella			*
	Cacatua tenuirostris	Long-billed Corella			*

			2004-2012	2049	2018
Invasive	Snecies	Common name	Survey and	2018 Ecoscane	Ecoscape and
IIIVasive			Community	Survey	Community
			Records		Records
	Calyptorhynchus banksii	Red-tailed Black Cockatoo			*
	Calyptorhynchus baudinii	Baudin's Black Cockatoo			*
	Calyptorhynchus latirostris	Carnaby's Black Cockatoo	*		*
	Charadrius melanops	Black-fronted Dotterel	*		
	Chenonetta jubata	Australian Wood Duck	*	*	*
	Chrysococcyx lucidus	Shining Bronze-cuckoo	*		
	Circus approximans	Swamp Harrier	*		*
	Cladorhynchus leucocephalus	Banded Stilt			*
*	Columba livia	Feral Pigeon	*		
	Coracina novaehollandiae	Black-faced Cuckoo Shrike	*		*
	Corvus coronoides	Australian Raven	*	*	*
	Cracticus tibicen	Australian Magpie		*	*
	Cracticus torquatus	Grey Butcherbird	*		*
	Cuculus pallidus	Pallid Cuckoo	*		
	Cygnus atratus	Black Swan	*	*	*
*	Dacelo novaeguineae	Laughing Kookaburra	*	*	*
	Dendrocygna arcuata	Wandering Whistling-duck	*		
	Dicaeum hirundinaceum	Mistletoe Bird	*		*
	Egretta garzetta	Little Egret			*
	Egretta novaehollandiae	White-faced Heron			*
	Elanus axillaris	Black-shouldered Kite	*		*
	Elseyornis melanops	Black-fronted Dotterel			*
	Eolophus roseicapilla	Pink & Grey Galah	*		*
	Falco berigora	Brown Falcon	*		
	Falco cenchroides	Nankeen Kestrel	*		*
	Falco longipennis	Australian Hobby	*		*
	Fulica atra	Eurasian Coot	*	*	*
	Gallinula tenebrosa	Dusky Moorhen	*	*	*
	Gallirallus philippensis	Buff-banded Rail	*		
	Gavicalis virescens	Singing Honeyeater			*
	Gerygone fusca	Western Gerygone	*		*
	Grallina cyanoleuca	Magpie Lark	*		*
	Gymnorhina tibicen	Australian Magpie	*		*
	Haliastur sphenurus	Whistling Kite	*		*
	Himantopus himantopus	Black-winged Stilt	*		*
	Hirundo neoxena	Welcome Swallow	*		*
	Hirundo nigricans	Tree Martin	*		
	Larus novaehollandiae	Silver Gull	*		
	Lichenostomus virescens	Singing Honeyeater	*		
	Lichmera indistincta	Brown Honeyeater	*	*	*
ALL.	Lophoictinia isura	Square-tailed Kite			*

			2004-2012	2019	2018
Invasive	Species	Common name	Survey and	Ecoscape	Ecoscape and
invacivo	opecie		Community	Survey	Community
	Malaaada		Records	*	Records
	maiacornyncnus membranaceus	Pink-eared Duck			Â
	Malurus splendens	Splendid Fairv-wren		*	*
	Manorina flavigula	Yellow-throated Miner	*		
	Merops ornatus	Rainbow Bee-eater	*		*
	Microcarbo melanoleucos	Little Pied Cormorant		*	*
	Nycticorax caledonicus	Nankeen Night Heron	*	*	*
	Ocyphaps lophotes	Crested Pigeon			*
	Oxyura australis	Blue-billed Duck	*	*	*
	Pachycephala rufiventris	Rufous Whistler	*		*
	Pardalotus punctatus	Spotted Pardalote			*
	Pardalotus striatus	Striated Pardalote	*	*	*
	Pelecanus conspicillatus	Australian Pelican	*		*
	Petrochelidon nigricans	Tree Martin			*
	Phalacrocorax carbo	Great Cormorant	*		
	Phalacrocorax	Little Pied Cormorant	*		
	melanoleucos				
	Phalacrocorax sulcirostris	Little Black Cormorant	*	*	*
	Phalacrocorax varius	Pied Cormorant	*		
	Phylidonyris nigra	White-cheeked Honeyeater	*		*
	Phylidonyris novaehollandiae	New Holland Honeyeater	*		*
	Platalea flavipes	Yellow-billed Spoonbill	*		*
	Plegadis falcinellus	Glossy Ibis			*
	Podiceps cristatus	Great Crested Grebe	*		
	Poliocephalus poliocephalus	Hoary-headed Grebe	*	*	*
	Porphyrio porphyrio	Purple Swamphen	*	*	*
	Porzana fluminea	Australian Spotted Crake	*		
	Porzana pusilla	Baillon's Crake	*		
	Porzana tabuensis	Spotless Crake	*		
	Purpureicephalus spurius	Red-capped Parrot	*		*
	Recurvirostra novaehollandiae	Red-necked Avocet	*		*
	Rhipidura albiscapa	Grey Fantail		*	*
	Rhipidura fuliginosa	Grey Fantail	*		*
	Rhipidura leucophrys	Willie Wagtail	*		*
	Smircornis brevirostris	Weebill	*	*	*
*	Spilopelia chinensis	Spotted Dove	1	*	*
	Spilopelia senegalensis	Laughing Turtle-Dove	1		*
	Strepera versicolor	Grey Currawong	1		*
the second	Streptopelia chinensis	Spotted Turtle-Dove	*		
14 1.16	Streptopelia senegalensis	Laughing Turtle-Dove	*		

Invasive	Species	Common name	2004-2012 Survey and Community Records	2018 Ecoscape Survey	2018 Ecoscape and Community Records
	Tachybaptus	Australasian Grebe	*	*	*
	novaehollandiae				
	Tadorna tadornoides	Australian Shelduck	*		*
	Threskiornis moluccus	Australian White Ibis	*	*	*
	Threskiornis spinicollis	Straw-necked Ibis	*		*
	Todiramphus sanctus	Sacred Kingfisher	*		*
*	Trichoglossus haematodus	Rainbow Lorikeet	*		
*	Trichoglossus moluccanus	Rainbow Lorikeet		*	*
	Tringa glareola	Wood Sandpiper			*
	Tringa nebularia	Common Greenshank	*		*
	Vanellus miles	Masked Lapwing	*		
	Zosterops lateralis	Silvereye	*	*	*

Table 44: Likelihood of High Priority bird occurrence

Species	Common name	Likelihood
Acanthizida		
Acanthiza apicalis	Inland Thornbill	P
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Р
Acanthiza inornata	Western Thornbill	Recorded
Smicrornis brevirostris	Weebill	Recorded
Anatidae		·
Biziura lobata	Musk Duck	P
Malacorhynchus membranaceus	Pink-eared Duck	Recorded
Anas rhynchotis	Australasian Shoveler	Recorded
Anas superciliosa	Pacific Black Duck	Recorded
Aythya australis	Hardhead	Recorded
Oxyura australis	Blue-billed Duck	Recorded
Apodidae		
Apus pacificus	Fork-tailed Swift	U
Ardeidae		
Ardea alba	Eastern Great Egret	P
Ardea ibis	Cattle Egret	P
Nycticorax caledonicus	Nankeen Night-Heron	Recorded
Cacatuidae		
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	Recorded
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	U
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Recorded
Climacteridae		·
Climacteris rufa	Rufous Treecreeper	U
Columbidae		
Phaps chalcoptera	Common Bronzewing	L

Species	Common name	Likelihood			
Halcyonidae					
Todiramphus sanctus	Sacred Kingfisher	Recorded			
Hirundinidae		•			
Hirundo nigricans	Tree Martin	Recorded			
Maluridae		•			
Malurus splendens	Splendid Fairy-wren	Recorded			
Meliphagidae					
Acanthorhynchus superciliosus	Western Spinebill	Р			
Anthochaera lunulata	Western Wattlebird	L			
Phylidonyris novaehollandiae	New Holland Honeyeater	Recorded			
Meropidae		·			
Merops ornatus	Rainbow Bee-eater	Recorded			
Pachycephalidae		·			
Colluricincla harmonica	Grey Shrike-thrush	Р			
Pardalotidae		·			
Pardalotus striatus	Striated Pardalote	Recorded			
Petroicida		·			
Petroica boodang	Scarlet Robin	Р			
Psittacidae		·			
Platycercus zonarius	Australian Ringneck	L			
Purpureicephalus spurius	Red-capped Parrot	Recorded			
Rallidae					
Gallinula tenebrosa	Dusky Moorhen	Recorded			
Strigidae					
Ninox connivens	Barking Owl	U			
Turnicidae	·				
Turnix varia	Painted Button-quail	U			

L- Likely P- Possible U- Unlikely

A Martin

Table 45: Likelihood of High Priority invertebrate occurrence

Species	Common name	Likelihood
Petaluridae		
Petalura hesperia	Western Petalura	U

APPENDIX FIVE WEED INVENTORY

Table 46: Weed inventory

Weeds	2012	2018
Acacia baileyana		X
Acacia iteaphylla		X
Acacia podalyriifolia	X	
Aira cupaniana		X
Anredera cordifolia	X	Х
Arctotheca calendula	X	Х
Asparagus asparagoides	X	X
Avena barbata	X	X
Brachychiton populneus		X
Brassica tournefortii		X
Bromus diandrus	X	X
Cardamine hirsuta		X
Carpobrotus edulis	X	
Casuarina cunninghamiana		X
Cenchrus clandestinus	X	X
Chasmanthe floribunda	X	Х
Commelina benghalensis	X	
Conyza bonariensis	X	Х
Cortaderia selloana	Х	Х
Cynodon dactylon	X	Х
Cyperus eragrostis	X	
Cyperus rotundus	X	
Cyperus tenuiflorus	X	Х
Eclipta prostrata+		
Ehrharta calycina	X	Х
Ehrharta longiflora	X	Х
Eragrostis curvula	X	
Erodium moschatum		X
Eucalyptus sp. planted		Х
Euphorbia peplus	X	X
Euphorbia terracina	X	
Ficus carica	X	Х
Freesia alba x leichtlinii	X	
Fumaria capreolata	X	Х
Gladiolus caryophyllaceus	X	
Homalanthus novo-guineensis	X	
Hordeum leporinum	X	Х
Hypochaeris glabra	X	X
Lactuca serriola	X	X
Lagurus ovatus	X	
Lysimachia arvensis	X	X
Melaleuca quinquenervia	X	X
Moraea flaccida	X	
Nothoscordum gracile	Х	
Oenothera drummondii	X	
Orobanche minor		X
Oxalis pes-caprae	Х	
Parthenocissus tricuspidata	X	
Paspalum urvillei	Х	X

Weeds	2012	2018
Pelargonium capitatum	X	Х
Persicaria lapathifolia	X	
Phoenix dactylifera		X
Phytolacca octandra	X	
Poa annua	X	
Raphanus raphanistrum	x	
Ricinus communis	x	
Schinus terebinthifolius	X	X
Solanum nigrum	X	X
Sonchus oleraceus	x	X
Stellaria media	X	X
Stenotaphrum secundatum	x	
Taraxacum officinale		X
Tradescantia albiflora	X	
Tropaeolum majus	x	X
Vellereophyton dealbatum	X	
Washingtonia filifera	x	x
Watsonia meriana	X	
Zantedeschia aethiopica	Х	х

+ reported by the City of Melville