



mainroads
WESTERN AUSTRALIA

Roe Highway Extension

Land Acquisition and Management Plan



Prepared for
Main Roads Western Australia
by AECOM Pty Ltd

November 2016

AECOM

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Summary

Two properties (three lots at Lake Clifton and one at Nirimba) have been chosen for the offset. These were selected based on site attributes required by the approval conditions (Table 1).

Table 1 Offset sites

Condition	Offset Attributes	Lake Clifton (ha)	Nirimba (ha)	Total (ha)
MS 1008 12-4 (1)	Land acquired	522.4	101.6	624
EPBC 2009 / 5031	Black Cockatoo Habitat	459.6	69.4	529
MS 1008 12-4 (3)(a)	Carnaby's Cockatoo Foraging Habitat	459.6	69.4	529
MS 1008 12-4 (3)(a)	Forest Red-tailed Black Cockatoo Foraging Habitat	200.1	52.5	252.6
MS 1008 12-4 (3)(b)	Black Cockatoo Breeding Habitat	167.5	69.4	235.9
MS 1008 12-4 (3)(c)	Conservation Category Wetlands	7.1	11.7	18.8
MS 1008 12-4 (3)(d)	Vegetation condition	Good to Excellent	Good to Excellent	
MS 1008 12-4 (3)(e)	Flora and fauna assemblage	Similar to Roe Highway	Similar to Roe Highway	

1.0 Introduction

1.1 Background

Main Roads Western Australia (Main Roads) proposes to construct the Roe Highway Extension which is part of the Perth Freight Link project. This document presents the offset package as required as a condition of approval.

The Project involves the construction of approximately 5 km of highway, extending Roe Highway from its current terminus at the Kwinana Freeway in Jandakot to Stock Road in Coolbellup. The proposed extension to Roe Highway is largely located within a primary regional road reserve which adjoins Beeliar Regional Park.

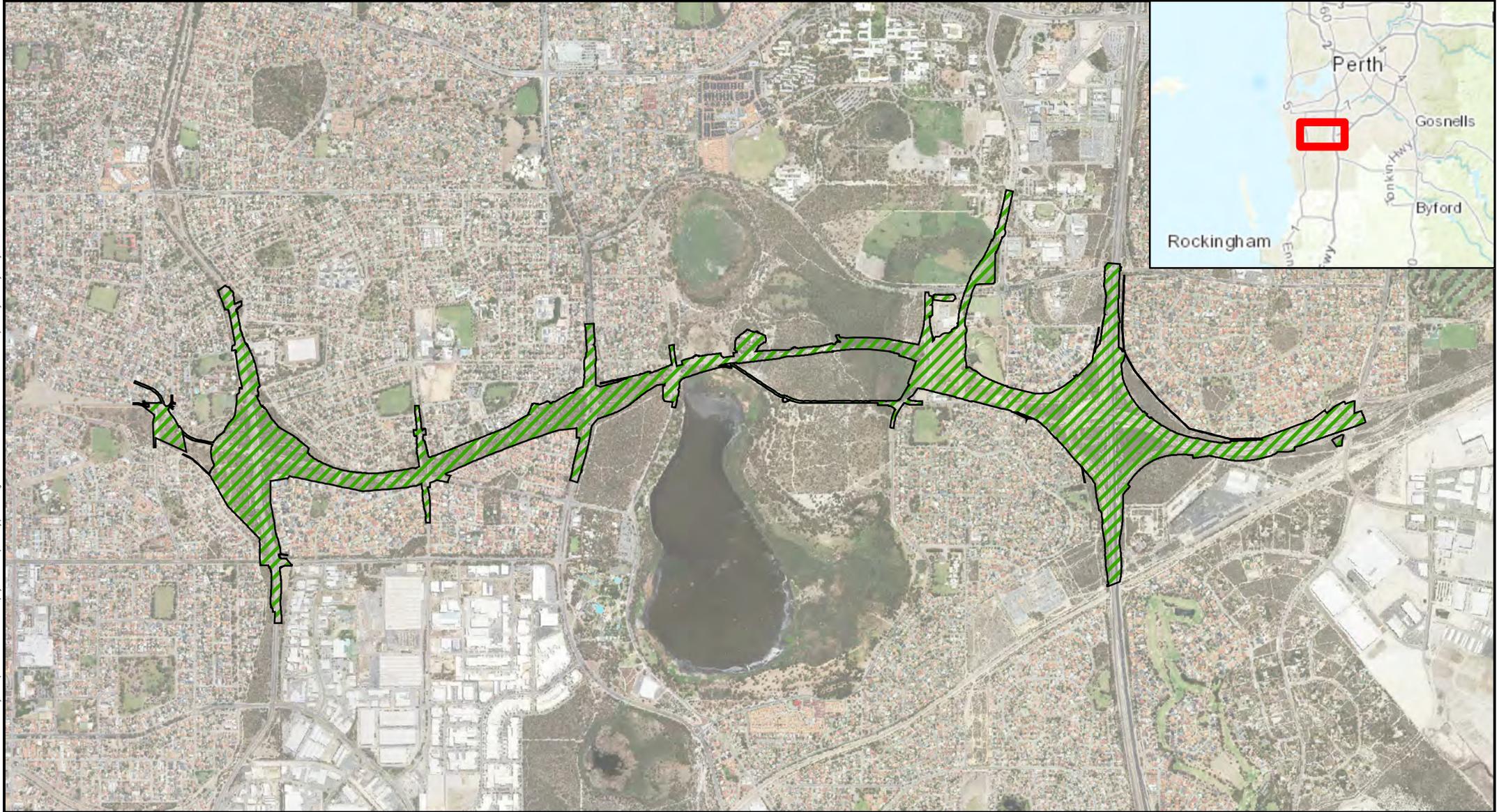
EPA Ministerial Statement 1008 was published on 2 July 2015 for the construction and operation of the extension of Roe Highway from the Kwinana Freeway in Jandakot to Stock Road in Coolbellup, pursuant to the *Environmental Protection Act 1986 (WA)* (EP Act). Due to significant residual impacts on the environment as a result of the proposal, including impacts on threatened species, priority flora, fauna habitat, migratory birds, native vegetation, wetlands, Beeliar Regional Park and Bush Forever sites Main Roads is required to provide a suitable offset in accordance with conditions 12-2 to 12-16 of Ministerial Statement 1008.

The Commonwealth Government also approved the project with conditions on 21 October 2015 under the *Environment Protection and Biodiversity Conservation Act 1999 (Comm)* (EPBC Act) in EPBC 2009/5031.

1.2 Project Location

The Roe Highway Extension is located approximately 14 kilometres south of Perth within the Swan Coastal Plain Bioregion (Figure 1). The project area is largely contained within the City of Cockburn, however, parts of the design extend northward into the City of Melville along Murdoch Drive and Kwinana Freeway. Generally, the proposed project is oriented east-west, within a road reserve that was set aside in the Metropolitan Region Scheme (MRS) in 1963. The alignment is between North and Bibra Lakes, which are part of the Eastern Chain of the Beeliar Wetlands.

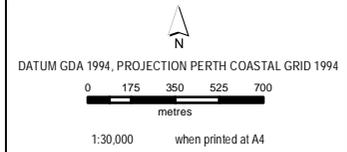
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LEGEND
 Project Location



Project Location

Main Roads

LAND ACQUISITION MANAGEMENT PLAN

Figure 1

Data sources: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeBCo, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS

1.3 Objective of document

This Land Acquisition and Management Plan (LAMP) is submitted to satisfy the requirements of Ministerial Statement 1008, Conditions 12-2 to 12-6 for the Roe Highway Extension Project and EPBC 2009/5031 Conditions 7 to 9. The requirements of these conditions are addressed in Table 2.

Table 2 Relevant condition requirements

Condition	Requirement	Report Section
	Statement 1008 – Residual impacts and risk management measures	
	<i>Land Acquisition and Management Plan</i>	
12-1	In view of the significant residual impacts to the environment, including impacts to threatened species, priority flora, fauna habitat, migratory birds, native vegetation, wetlands, Beeliar Regional Park and Bush Forever sites, as a result of implementation of the proposal, the proponent shall undertake the following requirements relating to offsets as outlined in conditions 12-2 to 12-16.	
12-2	Prior to commencement of construction, or as otherwise agreed by the CEO, the proponent shall submit a Land Acquisition and Management Plan to the requirements of the CEO.	
12-3	The proponent shall implement the Land Acquisition and Management Plan, prior to commencement, or as otherwise agreed by the CEO, until the CEO advises implementation may cease.	This plan
12-4	<p>The Land Acquisition and Management Plan shall:</p> <p>(1) identify at least 234 hectares of land to be acquired;</p> <p>(2) demonstrate that individual land parcels to be acquired are at least 100 hectares in area;</p> <p>(3) identify the environmental attributes of the land to be acquired which must contain:</p> <p>(a) at least 234 hectares of <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo) and 219 hectares of <i>Calyptorhynchus banksii naso</i> (Red-tailed Black Cockatoo) potential foraging habitat;</p> <p>(b) at least 7.5 hectares of <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo) and <i>Calyptorhynchus banksii naso</i> (Red-tailed Black Cockatoo) potential breeding habitat;</p> <p>(c) at least 7 hectares of Conservation Category Wetland areas and an appropriate buffer;</p> <p>(d) unless subject to condition 12-4(4) remnant native vegetation similar or better than the vegetation association being impacted by the proposal; and</p> <p>(e) an assemblage of fauna and flora species similar to those being impacted.</p> <p>(4) detail a Rehabilitation Plan for any areas identified in 12-4(1) that require rehabilitation measures. The Rehabilitation Plan on advice of the Department of Parks and Wildlife shall:</p> <p>(a) identify the areas to be rehabilitated;</p>	<p>Section 2.1 and 2.2 Section 3.1.1</p> <p>Section 2.0</p> <p>Section 3.1.3 Section 3.1.2</p> <p>Section 3.1.4</p> <p>Section 3.1.6</p> <p>Section 2.1.3 and 2.2.1</p> <p>Section 3.1.7</p> <p>Section 3.1.8</p>

Condition	Requirement	Report Section
	(b) outline the objectives and targets to be achieved; (c) outline timeframes and responsibilities for implementation; (d) outline the funding schedule and financial arrangements; and (e) outline monitoring, reporting and evaluation mechanisms. (5) detail the arrangements and funding for the ongoing management of the land acquired on advice from the Department of Parks and Wildlife; and (6) include monitoring and reporting requirements.	
12-5	Prior to commencement of construction, or as otherwise agreed by the CEO, the proponent shall acquire, or fully fund the acquisition of, the land identified in the approved Land Acquisition and Management Plan for the purpose of conservation.	Appendix C
	EPBC 2009/5031 – Offsetting of residual impacts	
7.	To offset the loss of black cockatoo habitat, prior to commencement, the approval holder must provide the Department with written evidence that funds have been provided to the DPAW for the acquisition of an environmental offset property. The written evidence must include a description and map clearly defining the location and boundaries of the offset property and be accompanied with the offset attributes and a shapefile	Appendix C
8.	Within 12 months of the commencement of the action, the approval holder must provide the Department with written evidence, including certificates of title, that the offset property has been transferred to the State of Western Australia for the purpose of addition to the conservation estate.	Appendix C
9.	Within 5 years of the commencement of the action, the approval holder must provide funds to DPAW to assist in the management of the offset property following the transfer of the land as described in condition 8. The funding must be adequate for DPAW to maintain the quality of black cockatoo habitat within the offset property for at least 20 years. The approval holder must consult with DPAW, in determining the amount of necessary funding to achieve the aims of this condition. Once the funding has been provided to DPAW, the approval holder must provide written evidence of this to the Department.	Section 4.2

Condition	Requirement	Report Section
	<p>Definitions (as defined in EPBC 2009/5031)</p> <p>Black Cockatoos - this includes the following threatened species and communities listed under the EPBC Act:</p> <ul style="list-style-type: none"> · Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>) · Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>) <p>Black cockatoo habitat – includes <i>Banksia attenuata</i>, <i>Banksia menziesii</i>, <i>Banksia illicifolia</i>, <i>Banksia littoralis</i>, <i>Xanthorrhoea preissii</i>, <i>Eucalyptus marginata</i>, <i>E. gomphocephala</i>, <i>Corymbia calyophylla</i> and <i>Allocasuarina fraseriana</i> trees.</p> <p>Offset property: Means a property that contains at least 523 ha of black cockatoo habitat with similar or better quality than the black cockatoo habitat being impacted by the action.</p> <p>Potential nesting trees: means those 38 trees specified in the list held by the Department and provided confidentially to the Approval Holder as part of the notification of this decision.</p>	Section 3.1.5

2.0 Offset Properties

The Lake Clifton offset area (Figure 2) was identified as a potential suitable offset site for the Roe Highway Extension project in 2014. The Lake Clifton offset area was selected as the most suitable site due to the likelihood of meeting Roe Highway Extension offset requirements.

The offset site is located next to Lake Clifton and almost entirely surrounded by Yalgorup National Park. Ecological investigations were undertaken in July 2016 to determine the quality of the site as an offset (**Appendix A**).

The Nirimba offset area (Figure 2) is located in the Shire of Murray, 59 km south of Roe Highway Extension. It is zoned as Regional Open Space. The site is immediately adjacent to the A-class Austin Bay Nature Reserve on its western and northern boundaries. The site is also bounded by the Peel-Yalgorup System Ramsar site on its northern and western sides (Figure 3).

The Nirimba offset area was included as an offset for the Roe Highway Extension due to the presence of Forrest Red-tailed Black Cockatoo foraging habitat within its boundaries.

The two offset sites together meet the statutory requirements for compliance with Statement 1008 and EPBC 2009/5031.

2.1 Description of the Lake Clifton Offset site

The Lake Clifton site comprises 522.4 ha across three contiguous lots and is surrounded by Yalgorup National Park. All properties within the offset site are zoned for rural land use as part of the Peel Region Scheme except for the south-eastern corner of the site (Lot 1000), which is zoned as Regional Open Space. Petroleum Exploration Permit EP 480 lies across the whole site, held by Empire Oil & Gas NL.

The offset site is located wholly within an Environmentally Sensitive Area (ESA), which is associated with the Peel-Yalgorup Ramsar site and the Yalgorup National Park. Yalgorup National Park represents the largest coastal reserve on the Swan Coastal Plain, and includes coastal wetlands that are part of the Peel-Yalgorup wetland system recognised as a “Wetland of International Importance” under the Ramsar convention.

There are no Bush Forever Sites in the Lake Clifton offset site.

The lots and part lots that form the Lake Clifton offset site (Figure 3) are:

- Lot 1000 Preston Beach Road, PRESTON BEACH – C/T 2515/858 (189.67 ha)
- Part Lot 2657 Old Coast Road, LAKE CLIFTON – C/T 2058/415 (154.69 ha out of 221.35 ha)
- Part Lot 3045 Old Coast Road, LAKE CLIFTON – C/T 2058/415 (178.05 ha out of 245.36 ha).

2.1.1 Vegetation values

Hedde *et al.* (1980) mapped three vegetation complexes within the Lake Clifton offset properties (Table 3). All three vegetation complexes have in excess of 30% of their pre-European extent remaining.

Table 3 Heddle et al. (1980) vegetation complexes mapped within the offset site and the extent remaining using the Perth @ 3.5 million document (EPA, 2015)

Vegetation association	Description	Extent Remaining
Cottesloe Complex – Central and South	Mosaic of woodland of <i>Eucalyptus gomphocephala</i> and open forest of <i>Eucalyptus gomphocephala</i> – <i>Eucalyptus marginata</i> – <i>Corymbia calophylla</i> ; closed heath on the limestone outcrops	33%
Yoongarillup Complex	Woodland to tall woodland of <i>Eucalyptus gomphocephala</i> with <i>Agonis flexuosa</i> in the second storey. Less consistently an open forest of <i>Eucalyptus gomphocephala</i> – <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i>	38%
Quindalup	Coastal dune complex consisting mainly of two alliances – the strand and foredune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of <i>Melaleuca lanceolata</i> – <i>Callitris preissii</i> and the closed scrub of <i>Acacia rostellifera</i>	55%

The vegetation complexes of the offset sites are similar to those being impacted. Roe Highway Extension will impact four vegetation complexes:

- Cottesloe Complex Central and South
- Karrakatta Complex Central and South
- Herdsman Complex
- Bassendean Complex Central and South.

The Cottesloe complex, Central and South is found within the Lake Clifton Offset (50%). The Karrakatta complex is not found in the offset site, but the Yoongarillup Complex (30%) is composed of similar Jarrah-Marri forests and woodlands with the addition of Tuart. The Herdsman and Bassendean complexes are not present within the Lake Clifton offset. The remainder of the site is Quindalup complex (20%).

Twelve vegetation communities were mapped across the three offset lots in Lake Clifton (Appendix A). The Roe Highway project area and the Lake Clifton offset area have vegetation communities dominated by *Agonis flexuosa*, with *Banksia* species and various understory. The offset site has woodland dominated by Tuart, where the Roe Highway project area is dominated by *Banksia* communities. Tuart and *Banksia* communities are present at both sites. Jarrah communities are also present at both sites, but over a greater area in the Roe Highway project area. Marri communities are absent from the offset site. *Melaleuca* communities are present at both sites.

2.1.2 Flora assemblage

A total of 131 species from 85 genera and 48 families were recorded within the Lake Clifton offset properties during the field assessment. The total includes 110 (84%) locally native species and 21 (16%) introduced (exotic) or naturalised weed species. A number of planted species were observed however these were not identified to species level.

Diversity for the 2016 survey was lower than previously recorded, with ENV (2009) recording 179 taxa from 53 families and Weston (1998) recording 202 taxa across 65 families. The lower level of diversity in this survey is likely to be representative of the timing and effort of this survey and effort.

The Roe Highway Extension project area has been more extensively surveyed and has been subject to a number of investigations over different seasons. There were 355 flora species recorded at Roe Highway with 67 species in common with the Lake Clifton Offset site (**Appendix B**).

2.1.3 Condition

Vegetation condition within the potential offset properties varied from 'Excellent to 'Completely Degraded'. The majority was mapped as 'Excellent to Good', extending over 436 ha. The major contributing factors causing degradation are historical clearing, altered fire regimes and weed invasion.

Table 4 Vegetation Condition mapped within the Lake Clifton offset properties

Condition Rating	Area (ha)	Percentage of offset Area (%)
Excellent	25	5
Very Good	237	52
Good	174	38
Degraded	22	4.75
Completely Degraded	1	0.25

2.1.4 Fauna assemblage

A total of 115 species were recorded at the Lake Clifton offset site during either the AECOM (2016) survey or the ENV (2007) Fauna Report prepared as an Appendix to Cape Bouvard Investment's Public Environmental Review (2009). This compares with the Roe Highway Extension area where 122 species were recorded in specific site surveys.

In a comparison of the sites there are 71 species in common, which means more than half the species recorded at the individual sites are the same (**Appendix B**).

Mammals including the Southern Brown Bandicoot, common Brushtail Possum, Western Grey Kangaroo, Gould's Wattled Bat, Lesser Long-eared Bat and the Southern forest Bat are present at both Roe Highway and Lake Clifton offset site. Other species in common include 22 reptiles and turtles and 43 bird species, including the endangered Carnaby's Black Cockatoo.

2.1.5 Black Cockatoo assessment

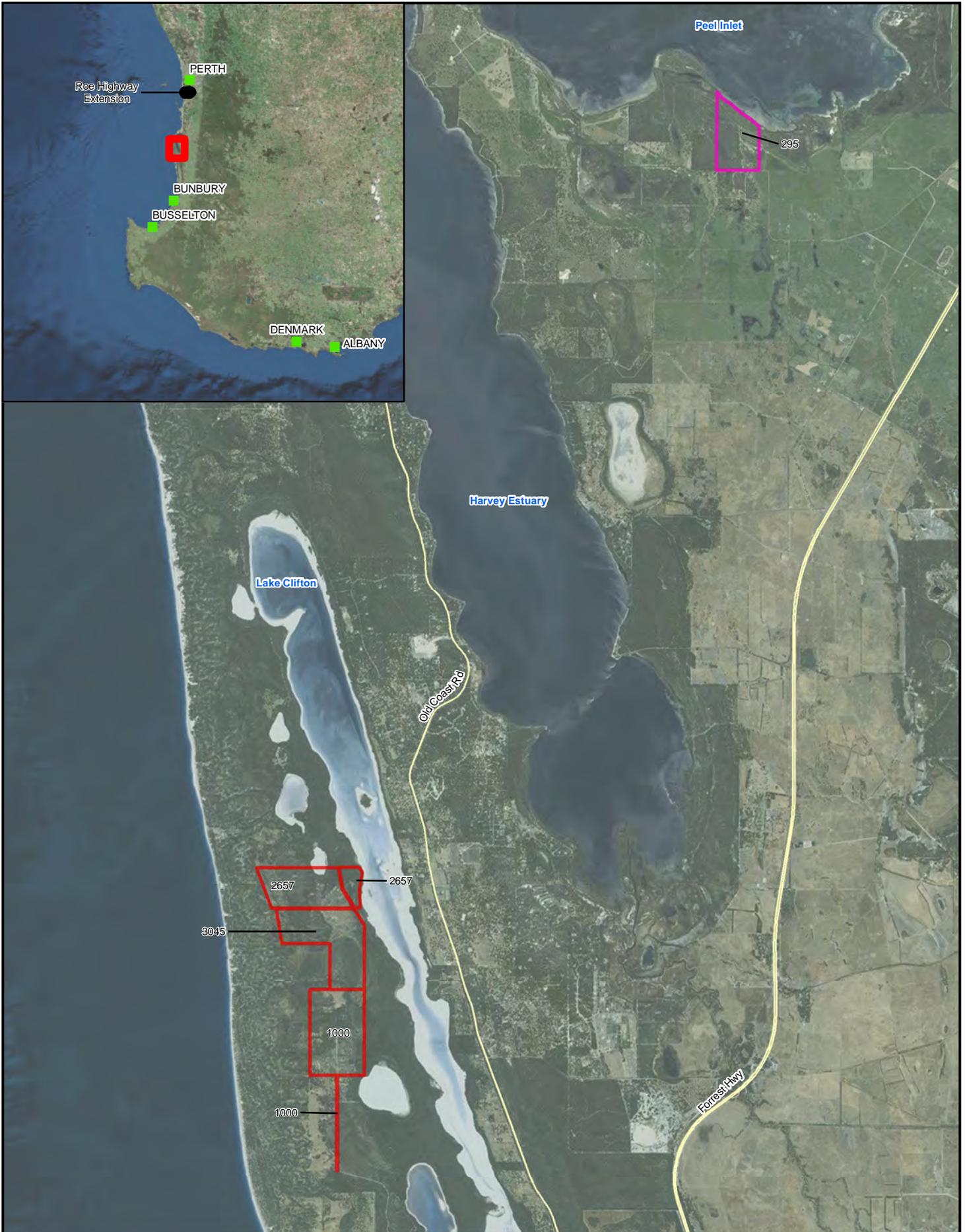
The offset area contains a significant number of mature Tuart trees. It does not contain habitats dominated by Proteaceous species but does contain moderate areas of Parrot Bush (*Banksia sessilis*) and *Banksia attenuata*, and large areas of lower value foraging species such as *Xanthorrhoea preissii* and *Hakea* spp. Carnaby's Black Cockatoo was observed foraging on Parrot Bush. There is 459.6 ha of Carnaby's Black Cockatoo foraging habitat within the offset area. In general, the Lake Clifton site contains a significant area of Carnaby's Black Cockatoo foraging habitat. There is 200.1 ha of Forest Red-tailed Black Cockatoo foraging habitat within the offset area.

A Black Cockatoo breeding habitat assessment to quantify potential breeding habitat within the offset area was undertaken. In total, the offset site contains approximately 167.5 ha of Black Cockatoo breeding habitat, with approximately 119 potentially suitable breeding trees. Table 5 provides further detail on the breeding habitat assessment.

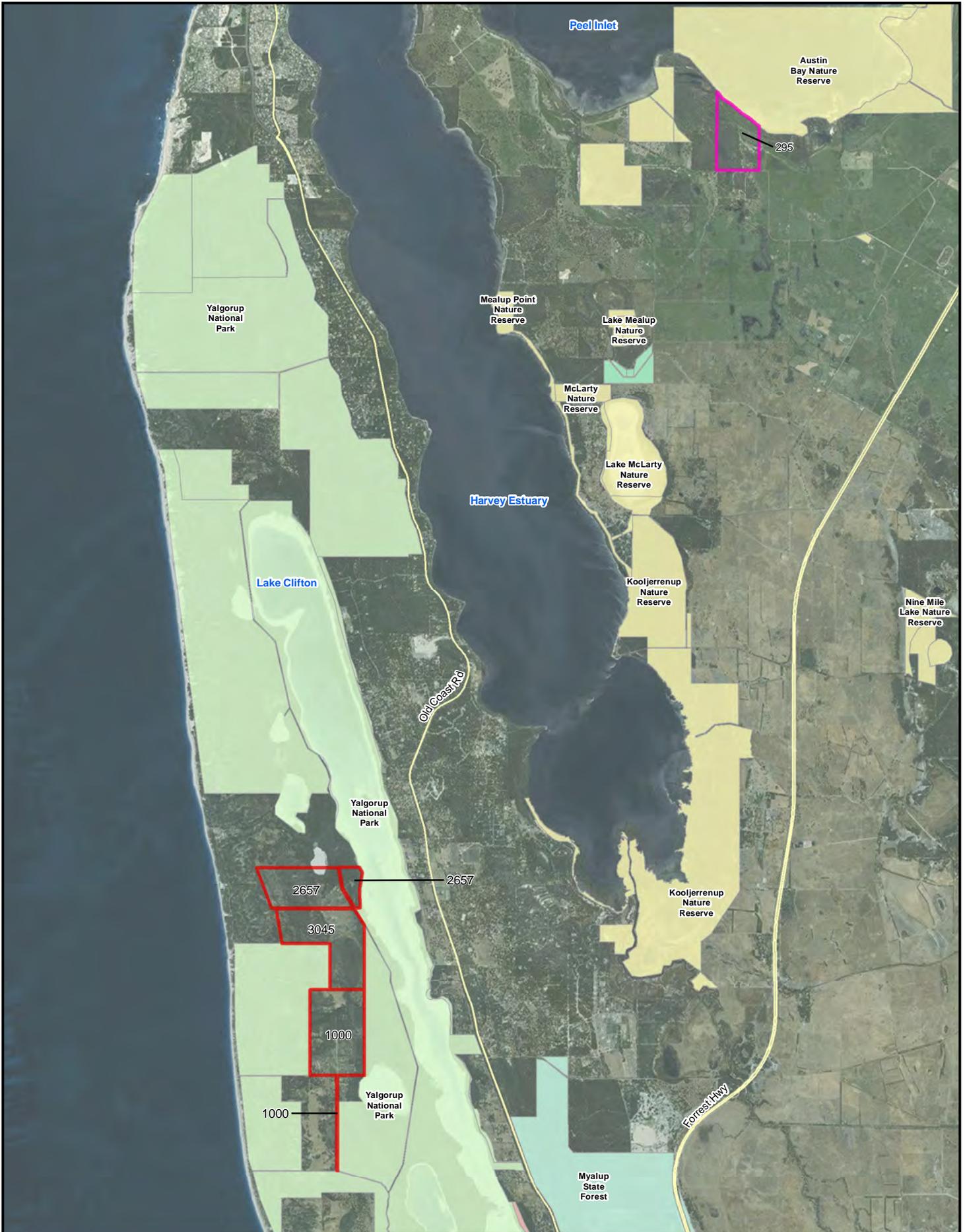
There is a confirmed Carnaby's Black Cockatoo breeding location within 12 km of the site and there is also a confirmed Carnaby's Black Cockatoo roosting site within 700 m of the southernmost point of the lots surveyed.

Table 5 Black Cockatoo habitat at Clifton Lake offset site

Habitat type	Carnaby's Black Cockatoo potential foraging habitat	Forest Red-tailed Black Cockatoo potential foraging habitat	Black Cockatoo potential breeding habitat	Black Cockatoo habitat (as per EPBC 2009/5031)
Area (ha)	459.6	200.1	167.5	459.6



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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 770 1,540 2,310 3,080
 metres

1:100,000 when printed at A4

LEGEND

- Nirimba
- Lake Clifton

DPaw Managed Land & Waters

- 5(1)(g) Reserve
- Crown Freehold - Dept Interest
- National Park
- Nature Reserve
- State Forest

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Offset locations and proximity to DPaw managed parks and reserves

MAIN ROADS

LAND ACQUISITION MANAGEMENT PLAN

Figure 3

2.1.6 Wetlands at Lake Clifton property

The offset site intersects with one Conservation Category Wetland (CCW), UFI 3096. Wetland details are in Table 6. Vegetation within the wetland boundary is considered in 'Very Good' to 'Excellent' condition. The geomorphic wetlands boundary mapping was considered accurate for depicting wetlands and associated riparian vegetation within the offset area.

The 5.1 ha impact of Roe Swamp CCW vegetation will be offset with a minimum of 7 ha of CCW comprising wetland system elements including water, riparian vegetation and adjacent *Agonis flexuosa* / *Eucalyptus gomphocephala* woodland. The majority of wetland vegetation is mapped as 'Excellent' with some fringing vegetation considered 'Very Good'.

A total of 7.1 ha of suitable CCW wetland in UFI 3096 is located within the Lake Clifton offset area.

Table 6 Wetland occurring within the Offset Area

Unique Feature Identifier	Extent within Offset Area	Vegetation Present, Condition and Additional Comments
3096	7.1 ha	The area represents part of the wetland system including water, riparian vegetation and adjacent <i>Agonis flexuosa</i> / <i>Eucalyptus gomphocephala</i> woodland.

2.1.7 Summary of environmental values

Table 7 Summary of environmental values at Lake Clifton offset site

Environmental Value	Area (ha)
Carnaby's Cockatoo potential foraging habitat	459.6
Forest Red-tailed Black Cockatoo potential foraging habitat	200.1
Black Cockatoo potential breeding habitat	167.5
Black Cockatoo Habitat (as per EPBC 2009/5031)	459.6
Conservation Category Wetlands	7.1

2.2 Description of Nirimba offset site

The Nirimba offset site (Figure 3) comprises one of three lots adjacent to DPaW managed land with the A-class Austin Bay Nature Reserve on its northern boundary.

The Nirimba offset site comprises:

- Lot 295 Carrabungup Road, Nirimba – 101.6 ha.

A Level 1 flora and fauna survey will be undertaken in spring 2016 in accordance with the Technical guide – Flora and Vegetation Surveys for Environmental Impact Assessment and Guidance Statement 56. This will include detailed flora, vegetation, fauna habitat and vegetation condition mapping. It will also include a detailed black cockatoo foraging and breeding habitat assessment. The survey report will be provided to OEPA on its completion in 2017.

2.2.1 Vegetation Values

The site is almost entirely covered in remnant vegetation. Approximately 15 ha of the site has been degraded. This has been previously parkland cleared for rural land use. Vegetation mapping identified two vegetation complexes across the site:

- The majority of the site lies within the Vasse Complex, which is dominated by a mixture of *Melaleuca* closed scrub, fringing woodland of *Eucalyptus rudis* and *Melaleuca* species, and open forest of Tuart-Jarraah-Marri.

- A small area in the southern portion of the site is classified as Southern River Complex, which includes open woodland of Marri-Jarrah-*Banksia* fringed by woodland containing *Eucalyptus rudis*-*Melaleuca raphiophylla* along the streams.

Roe Highway Extension will impact four vegetation complexes:

- Cottesloe Complex Central and South
- Karrakatta Complex Central and South
- Herdsman Complex
- Bassendean Complex Central and South.

The Vasse complex is similar to the Herdsman complex and both complexes are associated with wetlands and are heavily dominated by *Eucalyptus rudis* and *Melaleuca spp.* The Southern River complex is similar to the Bassendean Complex with a similar assemblage of Marri, Jarrah and Banksia woodlands.

The remnant vegetation was mapped as good to excellent condition, with approximately half in very good to excellent condition. The entire site is classified as an ESA and most of it is also categorised as a Swan Bioplan Peel Regionally Significant Natural Area.

2.2.2 Black Cockatoo Assessment

The offset site contains potential habitat for Carnaby's Cockatoo and the Forest Red-tailed Black-Cockatoo. The Black Cockatoo Foraging Habitat Assessment was informed by the Flora and Vegetation Assessment and on-ground observations made during the field survey. Vegetation communities were also used to assess the potential for the offset to provide breeding habitat. Table 8 sets out the areas of each black cockatoo habitat type.

Table 8 Black Cockatoo Habitat at Nirimba offset site

Lot	Forest Red-tailed Black Cockatoo potential foraging habitat (ha)	Carnaby's Black Cockatoo potential foraging habitat (ha)	Black Cockatoo potential breeding habitat (ha)	Black Cockatoo habitat (as per EPBC 2009/5031)
295	52.5	69.4	69.4	69.4

2.2.3 Wetlands

Table 9 lists the wetlands located within Nirimba Lot 295 and the area of each evaluation category. This site is considered to provide a valuable wetland offset, given its proximity to the Peel-Yalgorup System Ramsar site.

Table 9 Geomorphic Wetlands at the Nirimba offset site

UFI	Wetland Name	Classification	Evaluation	Area (ha)
3,116	unknown	Sumpland	Conservation	2.3
2,995	unknown	Sumpland	Conservation	9.4
Total				11.7

2.2.4 Summary of environmental values

Table 10 Summary of environmental values at the Nirimba offset site

Environmental Value	Area (ha)
Carnaby's Cockatoo potential foraging habitat	69.4
Forest Red-tailed Black Cockatoo potential foraging habitat	52.5
Black Cockatoo potential breeding habitat	69.4
Black Cockatoo Habitat (as per EPBC 2009/5031)	69.4
Conservation Category Wetlands	11.7

3.0 Suitability of offset package

3.1 Suitability of offset package

The offset package meets the requirements of MS 1008 and EPBC 2009/5031. Table 11 below lists how the requirements have been met.

Table 11 Offset package

Requirement	Lake Clifton (ha)	Nirimba (ha)	Total (ha)	MS1008	EPBC 2009/50331
Land acquired	522.4	101.6	624	Compliant	
Black Cockatoo Habitat	459.6	69.4	529	-	Compliant
Carnabys Cockatoo Foraging Habitat	459.6	69.4	529	Compliant	-
Forest Red-tailed Black Cockatoo Foraging Habitat	200.1	52.5	252.6	Compliant	-
Black Cockatoo Breeding Habitat	167.5	69.4	236.9	Compliant	-
CCW	7.1	11.7	18.8	Compliant	-
Vegetation condition	Good to Excellent	Good to Excellent		Compliant	-
Flora and fauna assemblage	Similar to Roe Highway	Similar to Roe Highway		Compliant	-

3.1.1 Area of land to be acquired (MS 1008)

The offset package lots comprise a total area of 624 ha, including 522.4 ha at Lake Clifton and 101.6 ha at Nimimba. This substantially exceeds the 234 ha required in Statement 1008 condition 12-4 (1) and meets the requirement of EPBC 2009/5031. The individual land parcels are contiguous with existing nature reserves and national park, reducing the likelihood of edge effects with each lot larger than 100 ha.

3.1.2 Forest Red-tailed Black cockatoo potential foraging habitat (MS 1008)

The offset of 219 ha of foraging habitat for the Forest Red-tailed Black Cockatoo is exceeded by the provision of a total of 252.6 ha of potential foraging habitat (Figure 3) including:

- 200.1 ha at the Lake Clifton offset site
- 52.5 ha at the Nimimba offset site.

3.1.3 Carnaby's Black Cockatoo potential foraging habitat (MS 1008)

The offset for Carnaby's Black Cockatoo potential foraging habitat (234 ha) is exceeded by providing total offsets of 529 ha, including:

- 459.6 ha at Lake Clifton (Figure 4)
- 69.4 ha at Nimimba offset site.

3.1.4 Black Cockatoo Potential Breeding habitat (MS 1008)

The offset requirement of 7.5 ha of Black Cockatoo potential breeding habitat is exceeded by the provision of 236.9 ha of potential breeding habitat (Figure 5) comprising:

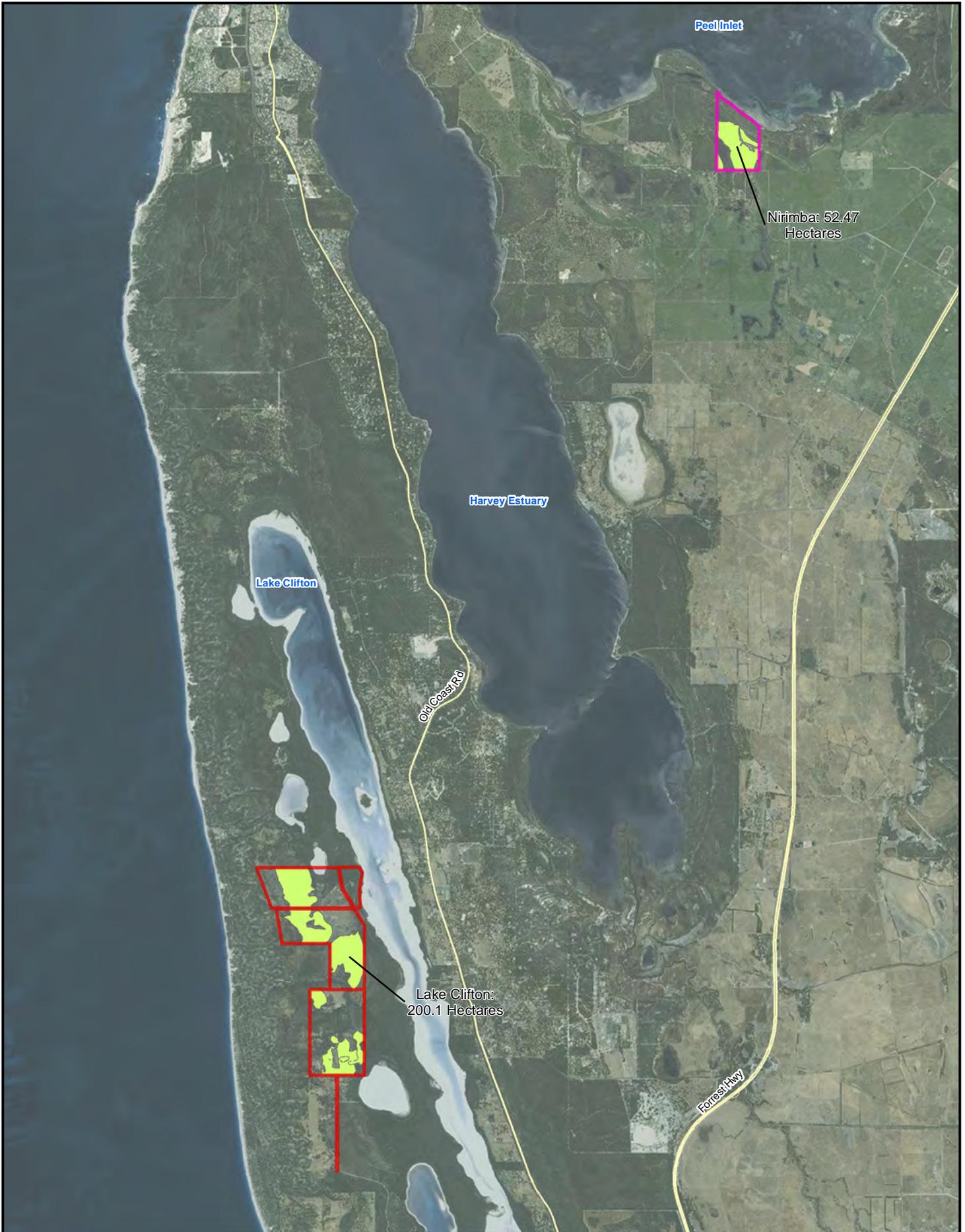
- 167.5 ha provided on Lake Clifton offset site
- 69.4 ha habitat on the Nimimba offset site.

3.1.5 Total Black Cockatoo habitat (EPBC 2009/5031)

The EPBC 2009/5031 decision states that the offset property is to consist of a property that contains at least 523 ha of black cockatoo habitat with similar or better quality than the habitat being impacted. Black cockatoo habitat is defined as including *Banksia attenuata*, *Banksia menziesii*, *Banksia illicifolia*, *Banksia littoralis*, *Xanthorrhoea preissii*, *Eucalyptus marginata*, *E. gomphocephala*, *Corymbia calyophylla* and *Allocasuarina fraseriana* trees. The offset package lots comprise Black Cockatoo habitat across a total area of approximately 529 ha, comprising 459.6 ha at Lake Clifton and 69.4 ha at Nirimba. This meets the requirement of EPBC 2009/5031.

3.1.6 Wetlands (MS 1008)

An offset of 11.7 ha of Conservation Category Wetland (Figure 7) is located on the Nirimba offset site and 7.1 ha of CCW is located on the Lake Clifton offset site for a total of 18.8 ha.



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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 770 1,540 2,310 3,080
 metres

1:100,000 when printed at A4

LEGEND

- Nirimba
- Lake Clifton
- Red-tailed Black Cockatoo Foraging Habitat (252.57 Ha)

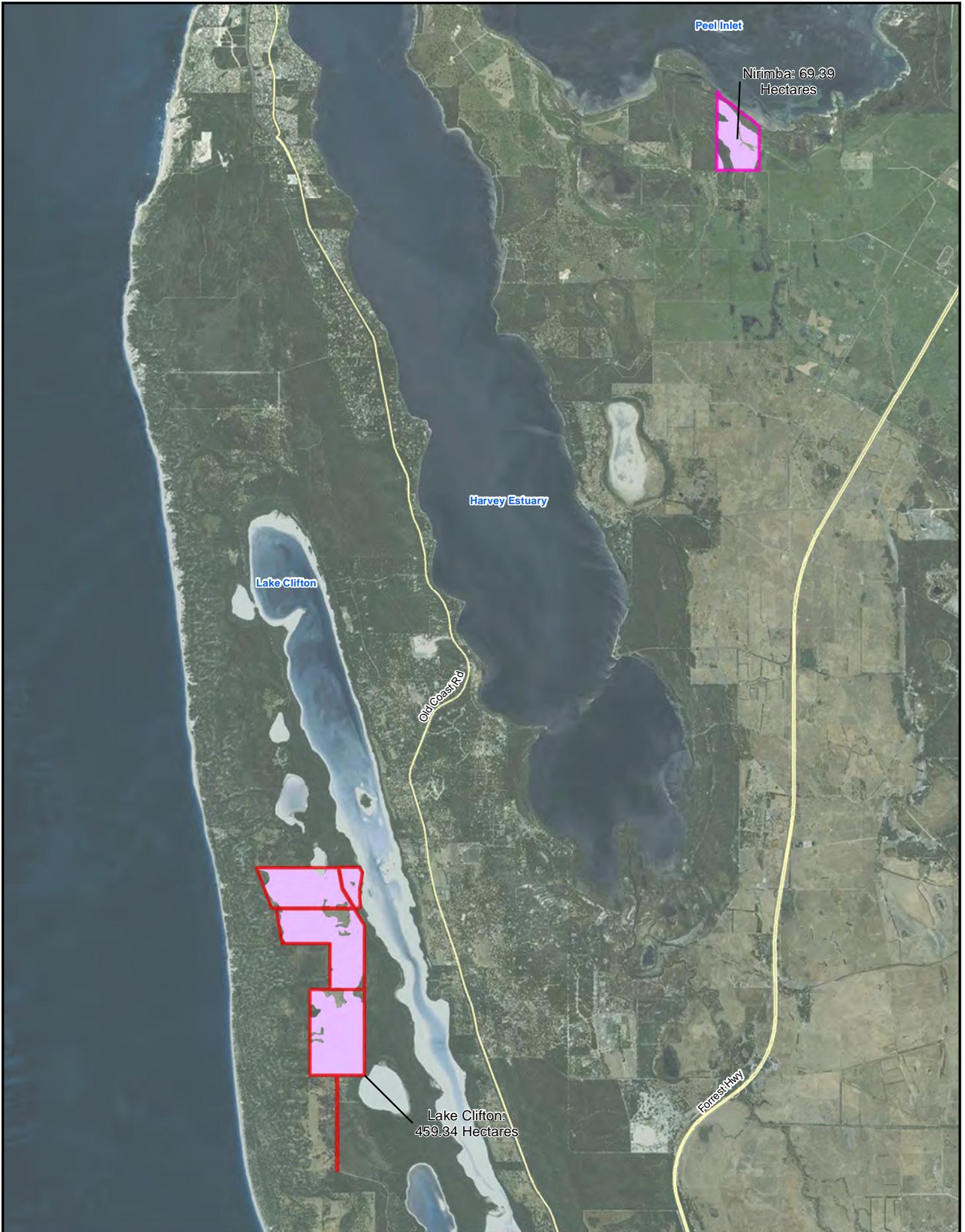
Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Red-tailed Black Cockatoo Foraging Habitat

MAIN ROADS

LAND ACQUISITION MANAGEMENT PLAN

Figure
4



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LEGEND

- Nirimba
- Lake Clifton
- Carnaby Foraging Habitat (528.73 Ha)

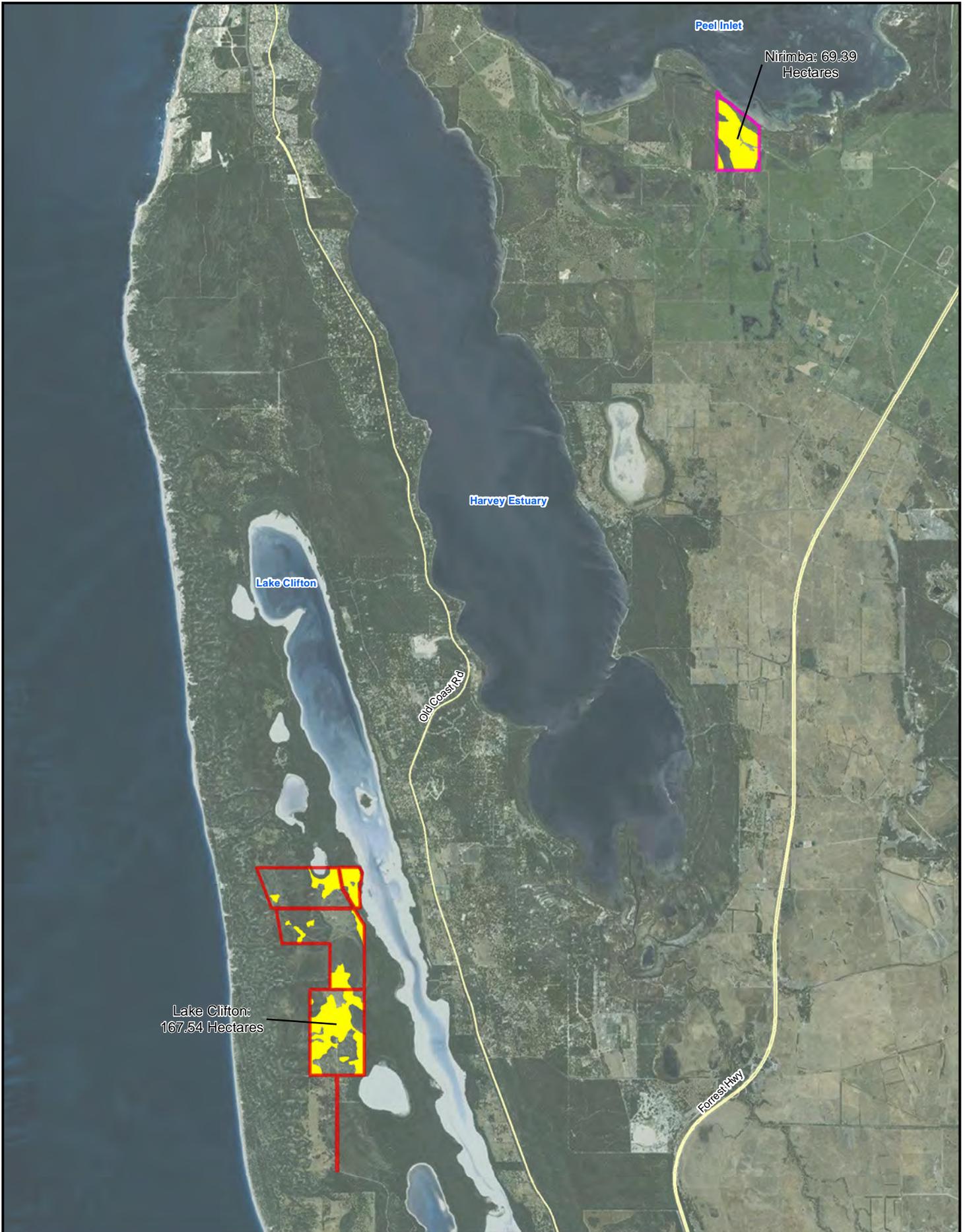
Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Carnaby's Black Cockatoo Foraging Habitat

MAIN ROADS

LAND ACQUISITION MANAGEMENT PLAN

Figure
5



<p>PROJECT ID 60100953 CREATED BY DGF APPROVED BY LK LAST MODIFIED 14 SEP 2016</p>	<p>AECOM www.aecom.com</p>	<p>LEGEND</p> <ul style="list-style-type: none"> Nirimba Lake Clifton Black Cockatoo Breeding Habitat (236.93 Ha) 	<p>Black Cockatoo Breeding Habitat</p> <hr/> <p>MAIN ROADS</p> <p><i>LAND ACQUISITION MANAGEMENT PLAN</i></p>
<p>DATUM GDA 1994, PROJECTION MGA ZONE 50</p> <p>0 770 1,540 2,310 3,080</p> <p>metres</p> <p>1:100,000 when printed at A4</p>		<p><small>Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community</small></p>	<p>Figure</p> <p>6</p>



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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 770 1,540 2,310 3,080
 metres

1:100,000 when printed at A4

LEGEND

- Nirimba
- Lake Clifton
- Black Cockatoo Habitat (528.73 Ha)

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Black Cockatoo Habitat

MAIN ROADS

LAND ACQUISITION MANAGEMENT PLAN

Figure
7



<p>PROJECT ID 60100953 CREATED BY DGF APPROVED BY LK LAST MODIFIED 14 SEP 2016</p> <p>AECOM www.aecom.com</p> <p>DATUM GDA 1994, PROJECTION MGA ZONE 50</p> <p>0 770 1,540 2,310 3,080 metres</p> <p>1:100,000 when printed at A4</p>	<p>LEGEND</p> <ul style="list-style-type: none"> Nirimba Lake Clifton Conservation Category Wetland (18.83 Ha) <p><small>Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community</small></p>	<p>Conservation Category Wetland</p> <hr/> <p>MAIN ROADS</p> <p>LAND ACQUISITION MANAGEMENT PLAN</p> <p style="text-align: right;">Figure 8</p>
---	--	--

3.1.7 Flora Assemblages

The flora assemblages of the offset sites are similar to those being impacted. Roe Highway Extension will impact four vegetation complexes:

- Cottesloe Complex Central and South
- Karrakatta Complex Central and South
- Herdsman Complex
- Bassendean Complex Central and South.

These complexes or similar vegetation complexes are found within the offset package.

Table 12 Vegetation complexes

Roe Highway Extension Complex	Lake Clifton site	Nirimba site
Cottesloe Complex Central and South - Mosaic of woodland of Tuart and open forest of Tuart-Jarra-Marri; closed heath on the limestone outcrops.	Contains Cottesloe Complex Central and South Yoongarillup Complex also contains similar species	Not present
Karrakatta Complex Central and South - Predominantly open forest of <i>Eucalyptus marginata</i> - <i>Eucalyptus calophylla</i> and woodland of <i>Eucalyptus marginata</i> - <i>Banksia</i> species	Yoongarillup Complex contains similar species and has a strong affinity with the Karrakatta Complex Central and South Contains Cottesloe Complex Central and South, which is similar as both complexes support Tuart-Jarra-Marri forests and woodlands	Not present
Herdsman Complex - Sedgelands and fringing woodlands of <i>Eucalyptus rudis</i> - <i>Melaleuca</i> species	Not present	Contains Vasse complex. This is a similar complex to the Herdsman complex. Both complexes are associated with wetlands and are heavily dominated by <i>Eucalyptus rudis</i> and <i>Melaleuca spp</i>
Bassendean Complex Central and South - Vegetation ranges from woodland of <i>Eucalyptus marginata</i> – <i>Allocasuarina fraseriana</i> – <i>Banksia</i> species to low woodland of <i>Melaleuca</i> species, and sedgelands.	Not present	Contains Southern River complex, which has a similar assemblage of species. Both sites contain Marri, Jarrah, <i>Banksia</i> woodlands

3.1.8 Rehabilitation

No rehabilitation is proposed to be undertaken at the offset locations, as the offset requirements have been met by existing habitat. A rehabilitation plan has therefore not been prepared.

4.0 Funding and Governance

4.1 State Requirements

Main Roads is required to acquire or fully fund the acquisition of the offset properties prior to commencement of construction. All properties included in this plan have been acquired by DPaW and Main Roads has then transferred funds to DPaW for the cost of acquisition (**Appendix C**). Note that the publicly available LAMP document does not contain the commercial information regarding the funds transfers.

Condition 12-4(5) of Statement 1008 requires that this LAMP details the arrangements and funding for the ongoing management of the land acquired, on advice of DPaW. Main Roads and DPaW have agreed that the ongoing management of the land acquired will include, but not limited to, the following actions:

Lake Clifton Offset Site

Actions:

- Removal of internal fences
- Installation of new fencing, including some areas of cable fencing
- Initial and ongoing (7 years) control of declared weeds in particular Cotton Bush (*Gomphocarpus fruticosus*)
- Installation of new firebreaks
- Maintenance of existing firebreaks
- Fauna survey for quenda along Lake Clifton boundary
- Cat baiting program
- Signage for cat baiting program
- Rationalisation, closure and the rehabilitation of tracks that are no longer required.

Lot 295 Nirimba Offset Site

Actions:

- Removal of internal fences
- Upgrade of boundary fences (not cable fencing)
- Installation of new firebreaks
- Maintenance of existing firebreaks
- Monitoring and trapping for pigs
- Initial and ongoing (4 years) control of Watsonia, Arum Lily and Tagasaste
- Dieback assessment mapping.

This agreement, including costs for the listed actions, will be formalised through a Memorandum of Understanding (MoU) between the two departments. The MoU will be in accordance with DPaW's Corporate Guideline for proponent management contributions to the management of offset sites.

DPaW will prepare an operational works plan that:

- identifies the tasks and activities required to complete the offset requirements as outlined above
- allocates the funds provided by Main Roads to agreed tasks and activities over an agreed timeframe.

Subject to the conditions of the MoU, Main Roads will pay the agreed cost for ongoing management of the land in a single payment within six months of construction commencing.

Main Roads will provide the MoU and evidence of the funds transfer to the CEO of the OEPA once agreement has been reached and funds have been transferred.

4.2 Commonwealth Requirements

In order to meet the conditions of EPBC 2009/5031, Condition 7, Main Roads must provide the DoEE with written evidence that funds have been provided to the DPAW for the acquisition of an environmental offset property. The written evidence must include a description and map clearly defining the location and boundaries of the offset property and be accompanied with the offset attributes and a shapefile. This Land Acquisition Management Plan provides a detailed description and maps of the offset property.

Condition 8 requires that Main Roads provide certificates of title within 12 months of the commencement of the action to demonstrate that the offset property has been added to the conservation estate. The acquisition has been completed and the certificates of title have been included – see Appendix C.

Condition 9 of EPBC 2009/5031 requires that evidence will be provided to DoEE within five years that sufficient funds have been provided to DPaW to maintain the quality of the Black Cockatoo habitat for an agreed timeframe. Main Roads will provide DoEE with the final MoU between Main Roads and DPaW and evidence of the transfer of funds within this timeframe.

4.3 Monitoring and reporting requirements

Condition 12-4 (6) Monitoring and reporting requirements are required to demonstrate that the funding arrangements made for the ongoing management of the offset sites (Condition 12-4 (5)) is sufficient to maintain the attributes of the offset sites. EPBC 2009/5031 Condition 9 states that the funding must be adequate for DPAW to maintain the quality of black cockatoo habitat within the offset property for at least 20 years.

Main Roads and DPaW will reach an agreement on management costs through a Memorandum of Understanding (MoU) and this evidence will be sent to DoEE and the CEO of the OEPA.

Main Roads will report annually on the work activities completed by DPaW under the MoU in the annual compliance report for activities undertaken from 2 July of the previous year to 1 July of the reporting year.

5.0 Offset Summary

To meet the criteria for suitability as an offset the site must meet the criteria set out in Table 13.

Table 13 Condition Requirements

Condition	Requirement	How	Evidence / Section
12-4 (1) MS1008	identify at least 234 hectares of land to be acquired	Total lots in offset package comprise 624 ha.	Section 3.1.1
12-4 (2) MS1008	demonstrate that individual land parcels to be acquired are at least 100 hectares in area	All land parcels are larger than 100 ha.	Section 3.1.1
12-4 (3)(a) MS1008	at least 234 hectares of <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo) and 219 hectares of <i>Calyptorhynchus banksii naso</i> (Red-tailed Black Cockatoo) potential foraging habitat	The offset package comprises 529 ha of Carnaby's Black Cockatoo foraging habitat and 252.6 ha of Red-tailed Black Cockatoo foraging habitat.	Section 3.1.3 Section 3.1.2
12-4 (3)(b) MS1008	at least 7.5 hectares of <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo) and <i>Calyptorhynchus banksii naso</i> (Red-tailed Black Cockatoo) potential breeding habitat	The offset package contains 236.9 ha of Black Cockatoo breeding habitat.	Section 3.1.4
12-4 (3)(c) MS1008	at least 7 hectares of Conservation Category Wetland areas and an appropriate buffer	A total of 18.8 ha of CCW is located within the offset package.	Section 3.1.6
12-4 (3)(d) MS1008	unless subject to condition 12-4(4) remnant native vegetation similar or better than the vegetation association being impacted by the proposal	The offset is in similar or better condition than the vegetation association impacted by the proposal.	Section 2.1.3 and 2.2.1
12-4 (3)(e) MS1008	an assemblage of fauna and flora species similar to those being impacted	Assemblage of flora and fauna is similar.	Section 3.1.7
12-4 (4) MS1008	detail a Rehabilitation Plan for any areas identified in 12-4(1) that require rehabilitation measures	Rehabilitation not required as the quality and extent of selected offset areas are suitable	See section 3.1.8
12-4 (4)(a) MS1008	The Rehabilitation Plan on advice of the Department of Parks and Wildlife shall: (a) identify the areas to be rehabilitated		
12-4 (4)(b) MS1008	The Rehabilitation Plan on advice of the Department of Parks and Wildlife shall: (b) outline the objectives and targets to be achieved;		

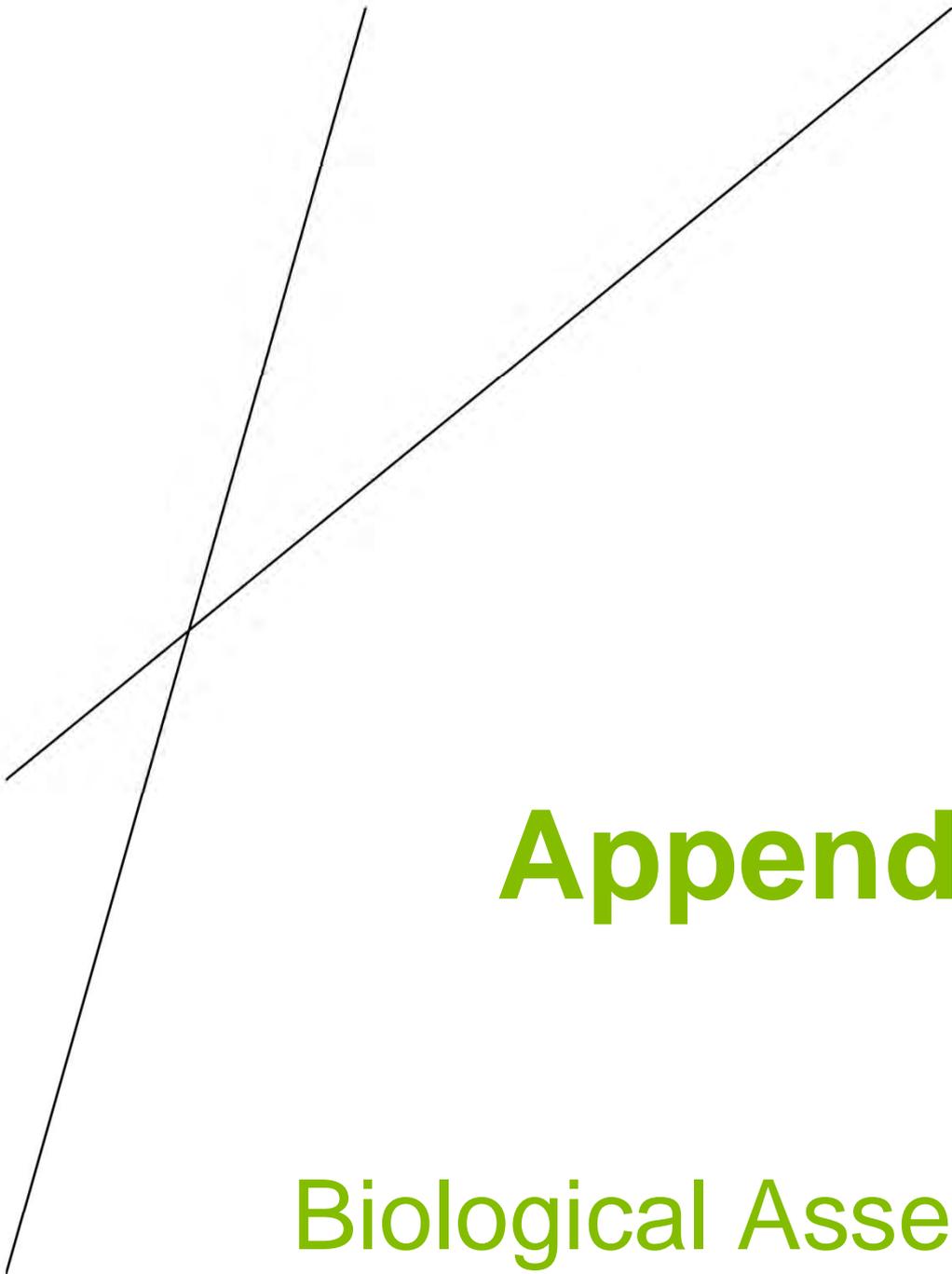
Condition	Requirement	How	Evidence / Section
12-4 (4)(c) MS1008	The Rehabilitation Plan on advice of the Department of Parks and Wildlife shall: (c) outline timeframes and responsibilities for implementation		
12-4 (4)(d) MS1008	The Rehabilitation Plan on advice of the Department of Parks and Wildlife shall: (d) outline the funding schedule and financial arrangements		
12-4 (4)(e) MS1008	The Rehabilitation Plan on advice of the Department of Parks and Wildlife shall: (e) outline monitoring, reporting and evaluation mechanisms		
12-4 (5) MS1008	detail the arrangements and funding for the ongoing management of the land acquired on advice from the Department of Parks and Wildlife	Subject to the conditions of the Memorandum of Understanding (MoU), Main Roads will pay the agreed cost for ongoing management of the land in a single payment within six months of construction commencing. Main Roads will provide the MoU and evidence of the funds transfer to the CEO of the OEPA once agreement has been reached and funds have been transferred.	Section 4.0 and Appendix C
12-4 (6) MS1008	include monitoring and reporting requirements	Monitoring or reporting program will be provided prior to commencement of construction.	Section 4.3
12-5 MS1008	Prior to commencement of construction, or as otherwise agreed by the CEO, the proponent shall acquire, or fully fund the acquisition of, the land identified in the approved Land Acquisition and Management Plan for the purpose of conservation	See Appendix C . Properties have been acquired and funds transferred to DPaW for the acquisition.	Section 4.0

Condition	Requirement	How	Evidence / Section
EPBC 2009/5031 7.	To offset the loss of black cockatoo habitat, prior to commencement, the approval holder must provide the Department with written evidence that funds have been provided to the DPAW for the acquisition of an environmental offset property. The written evidence must include a description and map clearly defining the location and boundaries of the offset property and be accompanied with the offset attributes and a shapefile.	Funds have been provided for the acquisition of the listed offset properties. Certificate of title will be provided in Appendix C .	Section 4.0
EPBC 2009/5031 8.	Within 12 months of the commencement of the action, the approval holder must provide the Department with written evidence, including certificates of title, that the offset property has been transferred to the State of Western Australia for the purpose of addition to the conservation estate.	See Appendix C	Section 4.0
EPBC 2009/5031 9.	Within 5 years of the commencement of the action, the approval holder must provide funds to DPAW to assist in the management of the offset property following the transfer of the land as described in condition 8. The funding must be adequate for DPAW to maintain the quality of black cockatoo habitat within the offset property for at least 20 years. The approval holder must consult with DPAW, in determining the amount of necessary funding to achieve the aims of this condition. Once the funding has been provided to DPAW, the approval holder must provide written evidence of this to the Department.	Evidence will be provided to the department within five years that sufficient funds have been provided to DPaW to maintain the quality of the Black Cockatoo habitat for the next 20 years. This will be in the form of the MoU between DPaW and Main Roads and evidence of the funds transfer occurring.	Section 4.0
Offset property	Means a property that contains at least 523 ha of black cockatoo habitat with similar or better quality than the black cockatoo habitat being impacted by the action.	The offset package comprises greater than 523 ha of Black Cockatoo habitat	Section 3.1.5

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Appendix A

Biological Assessment
of Lake Clifton Offset
Site

Appendix A1 Biological Assessments Lake Clifton

Biological Assessments Lot 1000, 2240, 2275, 2657 & 3045 Preston Beach Road Lake Clifton

Biological Assessments Lot 1000, 2240, 2275, 2657 & 3045 Preston Beach Road Lake Clifton

Client: Main Roads Western Australia

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Quality Information

Document Biological Assessments Lot 1000, 2240, 2275, 2657 & 3045 Preston
Beach Road Lake Clifton

Ref 60100953

Date 26-Sep-2016

Prepared by J Leigh, L van Gorp, L Kirchner

Reviewed by Linda Kirchner

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			Name/Position	Signature
A	28-Jul-2016	Draft for Internal Review	Jamie Shaw Technical Director - Environment	
B	29-Jul-2016	Draft for Client Review	Jamie Shaw Technical Director - Environment	
C	08-Aug-2016	Revised Draft for Internal Review	Linda Kirchner Associate Director - Environment	
E	19-Aug-2016	Re-issued to Client for Review	Linda Kirchner Associate Director - Environment	
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Executive Summary

Main Roads Western Australia commissioned AECOM Australia Pty Ltd (AECOM) to undertake biological assessments for a proposed offset property. The objective of the assessment was to describe the environmental values associated with wetlands and riparian vegetation, flora and vegetation, fauna, and Black Cockatoo potential breeding, roosting and foraging habitat. To meet this objective, a Level 1 Flora and Vegetation Assessment, Level 1 Fauna Assessment, targeted Black Cockatoo Survey, and a Wetlands Assessment were undertaken.

A detailed desktop assessment was undertaken incorporating results (where relevant) from the Department of Parks and Wildlife (DPaW) database, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) and historical surveys available in the public domain. One Threatened and four Priority Ecological Communities are known to occur within the Survey Area, one Commonwealth-listed Threatened flora species and one Priority 1 flora species are known to occur. Sixty three conservation significant fauna species could potentially occur. Of these 63 fauna species; 12 species are likely to occur, 31 species may occur and 20 species are unlikely to occur.

Field surveys were undertaken by two botanists and an ecologist in June 2016 over a ten-day period. Flora and vegetation data was captured at 63 relevés which informed the development of a vegetation map and vegetation condition map. The Level 1 fauna survey primarily focused on recording observations of fauna (particularly conservation significant species), which included evidence of fauna activity such as scats, tracks, burrows, foraging evidence and diggings. Microhabitat searches of leaf litter, bark, fallen logs and rocks were also conducted opportunistically when appropriate areas were located. Eleven microhabitat searches were conducted, and motion activated cameras were installed at five locations to observe fauna, particularly nocturnal fauna. Eighteen detailed habitat assessments were also completed. For Black Cockatoos, a breeding habitat assessment was conducted at 19 sites and foraging assessments were conducted across 35 sites. Roosting sites were assessed opportunistically when appropriate areas were located.

One State-listed Threatened Ecological Community (TEC) was recorded, as identified in the desktop assessment. This community is a State-listed ecological community known as 'SCP26a *Melaleuca huegellii-Melaleuca acerosa (systema)* Shrublands on Limestone Ridges and was recorded extensively. This TEC is represented by vegetation code MsTd and was recorded in predominantly 'Very Good' condition, extending over 202 ha.

Four Priority Ecological Communities (PECs) may occur within the Survey Area, including:

- SCP25 – Southern *Eucalyptus gomphocephala-Agonis flexuosa*
- SCP30b – Quindalup *E. gomphocephala* and/or *A. flexuosa* woodlands
- SCP29a – Coastal shrublands on shallow sands
- SCP29b – Acacia shrublands on taller dunes.

Quadrat data captured over multiple seasons would be required to accurately determine and define the presence of these PECs by undertaking data analysis to infer the appropriate Floristic Community Type.

One Threatened flora species listed under the EPBC Act, *Eucalyptus argutifolia* occurs within the Survey Area. The 2016 survey combined with previous surveys shows more than 200 individuals occur within three populations. Furthermore, the Priority 3 *Stylidium maritimum* occurs throughout the western sand dune vegetation community. This species has been previously extensively mapped with more than 2,800 individuals located.

Forty-two fauna species were recorded. This comprised 31 bird, eight mammal, one reptile and two amphibian species. Of the 42 fauna species, 11 species were of conservation significance and six were introduced fauna species. The European Wild Rabbit (*Oryctolagus cuniculus*) and the Red Fox (*Vulpes vulpes*) were both recorded and are listed as Declared Pests under the *Biosecurity and Agricultural Management Act 2007* (BAM Act).

Five fauna habitats (including Cleared Areas) have been defined and mapped. The most common fauna habitat was the mid to tall shrubland / heathland at approximately 57% of the Survey Area. This is a quite varied habitat that would generally support many of the common species of the area and would potentially also be utilised by many of the conservation significant fauna species recorded such as Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and the Quenda (*Isoodon obesulus fusciventer*). The Survey Area provides an important and ecologically valuable linkage between the north and south sections of Yalgorup National Park, ensuring a contiguous corridor of habitat throughout this area.

The Black Cockatoo foraging assessments determined that the property contains approximately 632 ha of Carnaby's Black Cockatoo foraging habitat, approximately 214 ha of Forest Red-tailed Black Cockatoo foraging habitat and approximately 45 ha of Baudin's Black Cockatoo foraging habitat. Carnaby's Black Cockatoo was heard and / or observed five times during the field survey. They were observed either flying over, foraging on *Banksia sessilis* in the Survey Area, or heard in close proximity. The Project Area contains significant amounts of mature Tuarts, with approximately 294 ha of Black Cockatoo breeding habitat.

The Survey Area intersects four Conservation Category Wetlands, including a small portion of Lake Clifton and an unnamed wetland which represent the Harvey-Yalgorup Ramsar Site. One unnamed wetland is situated entirely within the Survey Area and includes water, riparian vegetation and adjacent fringing vegetation. A total of approximately 65 ha of Conservation Category Wetlands (CCW) was mapped. The field assessment showed that existing geomorphic wetlands of the Swan Coastal Plain mapping depict the accurate boundaries of all wetlands.

1.0 Introduction

1.1 Background and scope

Main Roads Western Australia (MRWA) required biological surveys for three defined areas to determine their suitability as offset sites for current and future projects. Three offset sites located on the Swan Coastal Plain south of Perth were defined and a suite of field surveys undertaken to assess the environmental values of the areas.

The Lake Clifton Survey Area (the Survey Area) was subject to ecological investigations including:

- Verifying whether existing information is still relevant and an accurate depiction of environmental values
- A Wetlands Assessment to verify and map Conservation Category Wetland (CCW) boundaries
- Mapping and assessment of Black Cockatoo foraging habitat
- Mapping of potential Black Cockatoo breeding and roosting trees
- Identification of areas requiring rehabilitation (addressed in the Land Acquisition Management Plan [LAMP]).

1.2 Location

The proposed offset property (the Survey Area) is situated on the border between the City of Mandurah and the Shire of Waroona, 110 km south of Perth in Western Australia. The Survey Area is bordered by Lake Clifton on the east, the foredunes and beach on the west, and by Yalgorup National Park on the north, east and south sides. The Survey Area is comprised of Lots 1000, 2240, 2275, 2657, and 3045 (Figure 1).



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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 380 760 1,140 1,520
 metres

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LEGEND
 Survey Area

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Survey Area

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure
 1

2.0 Legislative Framework

2.1 Overview

Table 1 summarises the key legislation governing the protection and management of Western Australia's environment, discussed further below and in **Appendix A**.

Table 1 Relevant legislation and regulations

Legislation	Purpose
Commonwealth of Australia	
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Provides for the protection of the environment and the conservation of biodiversity.
Western Australia	
<i>Wildlife Conservation Act 1950</i> (WC Act)	Provides for the conservation and protection of Western Australia's wildlife.
<i>Environmental Protection Act 1986</i> (EP Act)	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.
<i>Biosecurity and Agriculture Management Act 2007</i> (BAM Act)	Provides for the management, control and prevention of certain plants and animals, and for the protection of agriculture and related resources generally. (Appendix B)
<i>Land Administration Act 1997</i> (LAA)	An Act to consolidate and reform the law about Crown land and the compulsory acquisition of land generally, to repeal the <i>Land Act 1933</i> and to provide for related matters. The Act allows for the
<i>Rights in Water and Irrigation Act 1914</i> (RIWI Act)	An Act relating to rights in water resources, to make provision for the regulation, management, use and protection of water resources, to provide for irrigation schemes, and for related purposes.

3.0 Existing Environment

3.1 Climate

The Swan Coastal Plain has a warm Mediterranean climate, characterised by hot dry summers and cool to mild wet winters. The closest meteorological recording station to the Survey Area with comprehensive data is Pinjarra Refinery (BOM Station 9891), located 30 km east of the Survey Area. The weather station has been collecting data since 1984.

Rainfall in the 12 months preceding the field survey is shown in Figure 2, and shows higher than average rainfall in March to May. The mean annual rainfall is 828.5 mm at Pinjarra refinery. In the twelve months prior to conducting the field survey, the recording station had received 682.4 mm of rainfall. The 'drying' climate in south-western Australia has been well documented (Climate Commission, 2011) and is likely to continue having minor impacts on the survey results. For this project, it is unlikely to have affected the outcomes of the Level 1 assessment.

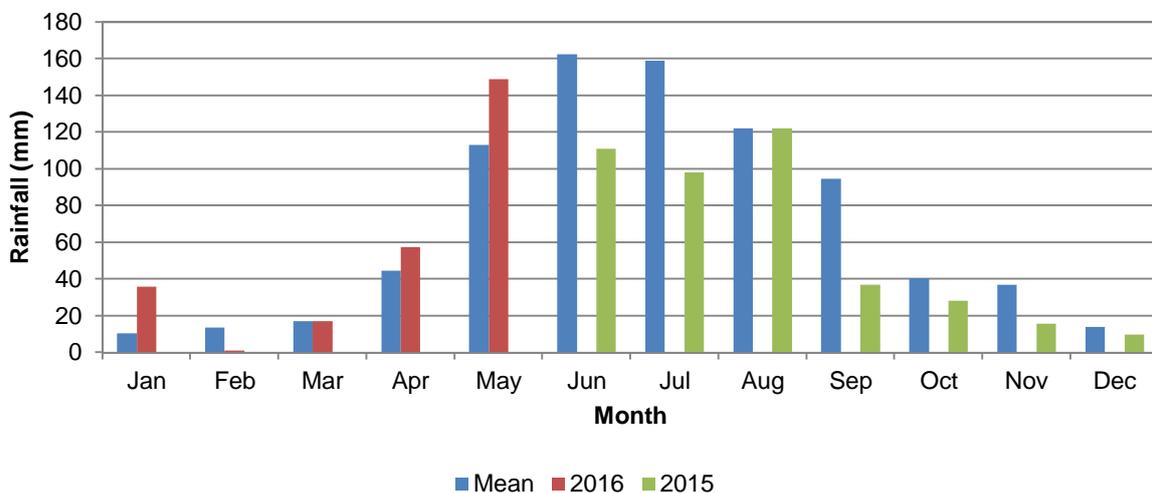


Figure 2 Rainfall graph, data obtained from Pinjarra Refinery Station 9891, BOM (2016)

3.2 IBRA region

There are 89 recognised Interim Biogeographic Regionalisation for Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (Commonwealth of Australia, 2013a). The Survey Area lies within the Swan Coastal Plain IBRA region and, at a finer scale, within the Perth subregion (Mitchell *et al.*, 2002).

The Survey Area is located on the Swan Coastal Plain bioregion described in CALM (2002), includes Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain consists of the Dandaragan Plateau and the Perth Coastal Plain and is comprised of a narrow belt less than 30 km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age incorporating a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several offshore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and Jarrah-*Banksia* woodlands are found on the older dune systems.

The Swan Coastal Plain subregion, described by Mitchell *et al.* (2002), is a low-lying coastal plain covered with woodlands dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The area includes a complex series of seasonal wetlands and includes Rottneest, Carnac and Garden Islands. Land use is predominantly cultivation, conservation, urban and rural residential. The area contains a number of rare features including Holocene dunes and wetlands and a large number of threatened species and ecological communities.

3.3 Vegetation

3.3.1 Pre-European vegetation

The pre-European vegetation association mapping completed by Beard (1981) shows two vegetation associations are present in the Survey Area including a medium woodland of Tuart and shrubland mosaic (Table 2).

Heddle *et al.* (1980) mapping is used to determine the current extent of remnant vegetation when compared to pre-European vegetation extent. The Environmental Protection Authority's (EPA) objective is to retain at least 30% of all pre-European ecological communities, which is consistent with recognised retention levels (EPA, 2000; EPA, 2015).

Heddle *et al.* (1980) mapped four vegetation complexes within the Survey Area (Table 3). None of the vegetation complexes are reduced to less than 30% extent remaining.

Table 2 Beard (1981) vegetation types mapped within the Survey Area

Vegetation Association	Description
998	Medium woodland; Tuart
1007	Mosaic: Shrublands; <i>Acacia lasiocarpa</i> & <i>Melaleuca acerosa</i> heath / Shrublands; <i>Acacia rostellifera</i> & <i>Acacia cyclops</i> thicket

Table 3 Heddle *et al.* (1980) vegetation complexes mapped within the Survey Area and the extent remaining using the Perth @ 3.5 million document (EPA, 2015)

Vegetation association	Description	Extent Remaining
Cottesloe Complex – Central and South	Mosaic of woodland of <i>Eucalyptus gomphocephala</i> and open forest of <i>Eucalyptus gomphocephala</i> – <i>Eucalyptus marginata</i> – <i>Corymbia calophylla</i> ; closed heath on the limestone outcrops	33%
Yoongarillup Complex	Woodland to tall woodland of <i>Eucalyptus gomphocephala</i> with <i>Agonis flexuosa</i> in the second storey. Less consistently an open forest of <i>Eucalyptus gomphocephala</i> – <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i>	38%
Quindalup	Coastal dune complex consisting mainly of two alliances – the strand and foredune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of <i>Melaleuca lanceolata</i> – <i>Callitris preissii</i> and the closed scrub of <i>Acacia rostellifera</i>	55%
Vasse Complex	Estuarine and marine deposits.	35.9%

3.4 Wetlands

3.4.1 Ramsar site

Lake Clifton is located adjacent to the Peel-Yalgorup Ramsar site. The Peel-Yalgorup site comprises the estuarine Peel Inlet and Harvey Estuary, the freshwater wetlands of lakes McLarty and Mealup, and the Yalgorup National Park (including the saline lakes system with sections of fringing upland). The system stretches for 60 km north to south and approximately 10 km east to west.

The Ramsar site was recognised as a wetland of international importance in 1990 and is considered to be representative of wetlands of the Swan Coastal Plain forming a chain of diverse habitat types which in turn support an array of ecologically important species and communities (Peel-Harvey Catchment Council, 2009).

3.4.2 Geomorphic Wetlands of the Swan Coastal Plain

Lake Clifton intersects four Conservation Category Wetlands (CCW), including UFI 3096 (in its entirety), UFI 3089 (edge only), UFI 3094 (edge only) and UFI 3100 (small sliver). All four wetlands, their extent within the Survey Area, and comments regarding vegetation present and condition, are outlined in Table 4. All four wetlands are part of the consanguineous suite of Clifton (DPaW, 2013).

Table 4 Wetlands within the Survey Area

Unique Feature Identifier	Extent within Survey Area	Vegetation Present, Condition and Additional Comments
3096	51.38 ha	The area represents the entire wetland system including water, riparian vegetation and adjacent <i>Agonis flexuosa/Eucalyptus gomphocephala</i> woodland. Majority of wetland vegetation is mapped as 'Excellent' with some fringing vegetation considered 'Very Good'.
3089	6.46 ha	The Survey Area intersects with fringing vegetation of Lake Clifton, representing the Peel-Yalgorup Ramsar Site. Vegetation is in 'Excellent' condition.
3094	7.49 ha	Vegetation includes AfXpHhTp and MrGtTd in excellent condition. This wetland represents the Peel-Yalgorup Ramsar Site.
3100	0.02 ha	Representing the eastern edge of vegetation associated with a wetland southeast of the Survey Area.

3.5 Conservation estates, Bush Forever and Environmentally Sensitive Areas

Lake Clifton is located wholly within an Environmentally Sensitive Area (ESA) which is associated with the Peel-Yalgorup Ramsar site and the Yalgorup National Park. The Yalgorup National Park is located adjacent to the Survey Area along its north, south and eastern borders. Yalgorup National Park represents the largest coastal reserve on the Swan Coastal Plain, and includes coastal wetlands that are part of the Peel-Yalgorup wetland system recognised as a "Wetland of National Importance" under the Ramsar convention.

There are no Bush Forever Sites at Lake Clifton. The conservation estates and Environmentally Sensitive Areas are shown on Figure 4.



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LEGEND

- Survey Area
- Peel-Yalgorup System Ramsar

Geomorphic Wetlands

- Conservation
- Multiple Use
- Resource Enhancement

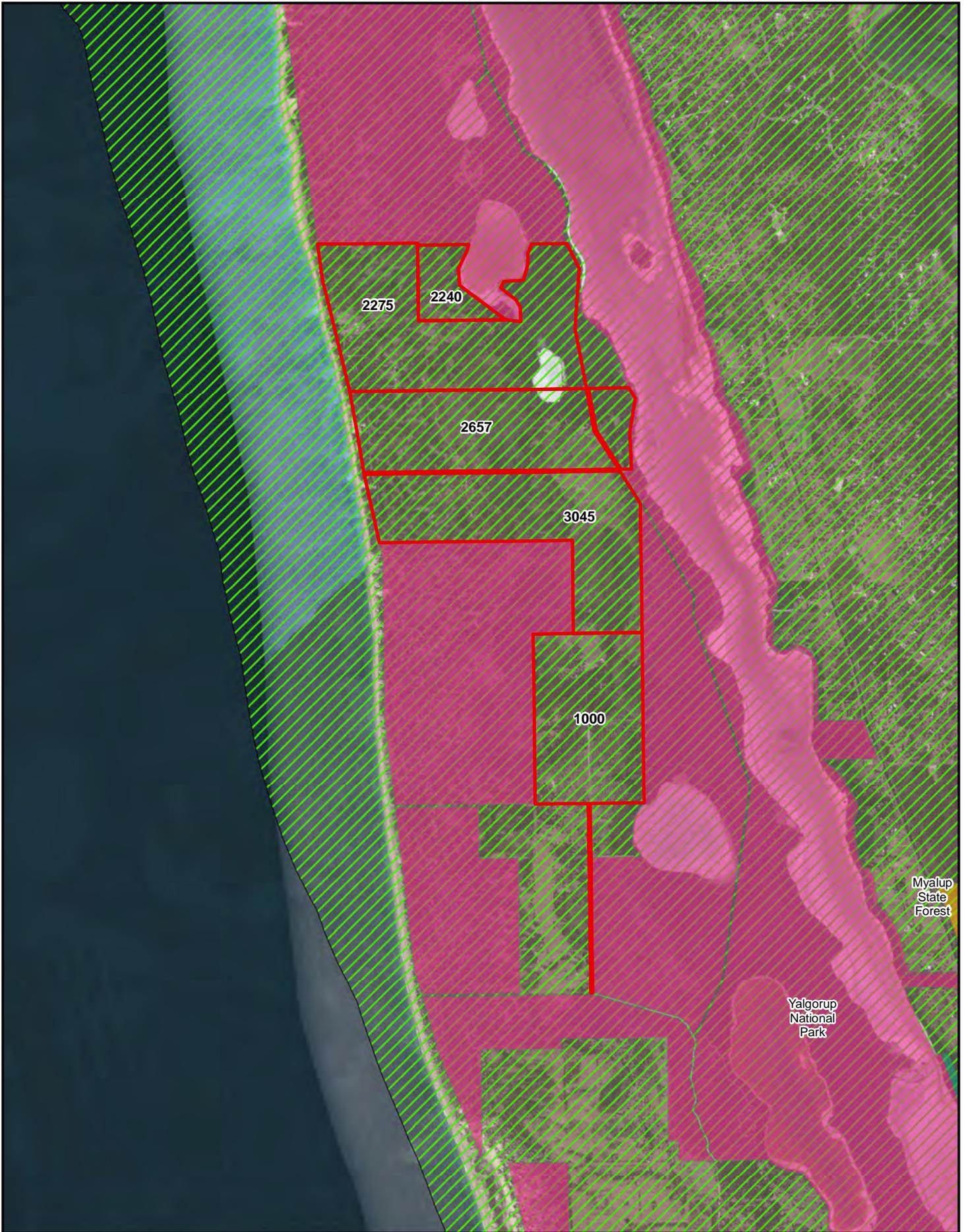
Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Wetlands

MAIN ROADS

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Figure
3



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LEGEND

- Survey Area
- Environmentally Sensitive Areas

DPAW Managed Lands and Water

- 5(1)(g) Reserve
- National Park
- Nature Reserve
- State Forest

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Conservation Estates and ESAs

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure
4

4.0 Methodology

4.1 Desktop assessment

The desktop assessment included compilation of relevant information for conservation significant matters from a variety of sources including publicly available literature, DPaW databases (including additional Black Cockatoo observational data), EPBC Protected Matters Search Tool (online resource) and Naturemap. The literature review was undertaken in May 2016 prior to the June field surveys. Data searches were conducted in May 2016 prior to the 2016 Spring field survey.

A total of 12 historical studies that are directly relevant to this Study Area were identified, listed below. Of the significant survey effort, three reports were available for review prior to conducting the field survey, including the latest ENV (2009) Public Environmental Review (PER) report incorporating the entire Survey Area. Particularly the flora and vegetation technical appendix of the ENV (2009) PER was used for informing the survey sample plan.

The search results were reviewed to assess the potential presence of conservation significant environmental values. All conservation significant matters including flora, fauna and communities were reviewed and a likelihood of occurrence was completed based on the categories outlined in Table 5.

Table 5 Categories of likelihood of occurrence for species and communities

Likelihood Category	Flora	Fauna	Communities
Likely to occur	Habitat is present in the Survey Area and the species has been recorded in close proximity to the Survey Area	Survey Area is within the known distribution of the species, habitat is present in the Survey Area and the species has been recorded in close proximity to the Survey Area	Known occurrences of the community in close proximity to the Survey Area. Vegetation looks the same within the known occurrence and Study area based on aerial imagery. Geographic location is similar to the Survey Area
May occur	Habitat may be present and/or the species has been recorded in close proximity to the Survey Area	Survey Area is within the known distribution of the species, marginal habitat may be present and/or the species has been recorded in close proximity to the Survey Area	Known occurrence of the community in the local area, and/or vegetation looks the same within known occurrence and Survey Area based on aerial imagery. Geographic location is similar to the Survey Area
Unlikely to occur	No suitable habitat is present and the species has not been recorded in close proximity to the Survey Area	Survey Area is outside the known distribution for the species, or no suitable habitat is present and the species has not been recorded in close proximity to the Survey Area	Known occurrence of the community in close proximity to the project area however geographic location does not occur in Survey Area

4.1.1 Previous surveys

A number of studies have been undertaken in, or within the vicinity, of Lake Clifton, that are directly relevant to this assessment. Relevant studies include:

- Bamford 2003 Fauna Values of Cape Bouvard Investments Pty Ltd
- ENV 2009 Clifton Beach Fauna Assessment
- ENV 2009 Clifton Beach Flora and Vegetation Assessment
- Trudgen 1991 Flora and Vegetation Survey of the Coast of the City of Mandurah
- Freeman *et al.* 2009 Flora and Vegetation of the Dawesville to Binningup Region

- Trudgen 1997 Occurrences and Potential Occurrences of Rare and Priority Flora on Access Options to the Cape Bouvard Investments Block
- Weston 1998a Vegetation survey of eastern park of Lake Clifton: Location 4185 and parts of 2240, 2275, 2657, 3045, 4981 and 5182
- Weston 1998b Potential Rare Flora in the proposed White Hill Road to Lake Clifton West Access Road Corridor
- Weston 1998c Floristic Community Types and Comparable Vegetation Units in the Proposed White Hill Road to Lake Clifton West Access Corridor
- Weston 1998d Comparisons of Vegetation, Flora and Rare Flora of Proposed Exchange Areas in Lake Clifton West and Yalgorup National Park
- Weston 2003 Vegetation and Flora of Cape Bouvard Land Holding Lake Clifton West
- Ecoscape 2003 An Atlas of Tuart Woodlands on the Swan Coastal Plain in Western Australia

Of these reports, three including the Freeman *et al.*, (2009) ENV (2009) and Ecoscape (2003) reports were available in the public domain.

4.2 Flora and vegetation assessment

A Level 1 Flora and Vegetation survey was undertaken, as outlined by the EPA in Guidance Statement 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment*, and DPaW and EPA (2015) *Technical Guide for Terrestrial Flora and Vegetation Surveys*. This included a site reconnaissance, and low-level sampling to verify existing mapping already available for Lake Clifton.

Historically, the Survey Area has been traversed on foot and vegetation mapped using transects. Following this, Floristic Community Types (FCTs) were inferred and two permanent 10 x 10m quadrats established within each FCT. In addition, relevés were used to sample other vegetation communities. This field survey aimed to verify existing vegetation mapping and undertake vegetation condition mapping, and collect floristic data representative of the broad vegetation groups present. Due to the level of detail in the previous mapping available for Lake Clifton, a new vegetation map was produced to represent the broad vegetation types present.

The flora and vegetation survey was undertaken by two botanists Floora de Wit (Collection Permit SL011555) and Lyn van Gorp (Collection Permit SL011558) between 20 and 30 June 2016 (**Appendix C**). The sample plan was informed by the vegetation map published in ENV (2009), review of aerial imagery, and a site reconnaissance inspection undertaken on the first day of commencing the field surveys.

Sample point locations were selected to document the floristics, vegetation composition and structure, condition, and other identifying features of the vegetation community. A total of 63 relevés were completed to capture flora and vegetation data. These data were used to inform the vegetation map and condition map. Despite there already being a vegetation map available for Lake Clifton, on-ground observations indicated that the map is outdated, and no longer adequately represents vegetation communities present. A new vegetation map was produced, with communities described using the National Vegetation Information System framework (Australian Government, 2013).

Any species unable to be identified in the field were collected for identification in AECOM's in-house herbarium and the specimens and taxonomic references and keys at the Western Australian Herbarium (WAH). Naming of species followed the convention of the WAH.

Vegetation condition mapping was reviewed and updated as required using the scale developed by M.E. Trudgen (1991) and published by the Wildflower Society WA (Keighery, 1994) condition scale (Table 6). The scale is based on disturbance (e.g. grazing, erosion), degree of alteration to community and habitat structure and site ecology.

Table 6 Bushland condition ratings (Keighery, 1994)

Descriptor	Explanation
Pristine	Pristine or nearly so, no obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance of vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs

4.3 Fauna assessment

The survey primarily focused on recording observations of fauna at Lake Clifton, which included evidence of fauna activity such as scats, tracks, burrows, foraging evidence and diggings. This survey was undertaken in accordance with EPA (2002) Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection, and EPA (2004b) Guidance Statement No. 56 Guidance for the Assessment of Environmental Factors – Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Particular attention was given to locating species of conservation significance that have the potential to occur at Lake Clifton, as identified in the desktop assessment. All observations were made during daylight hours of 0730 and 1700.

Scats unable to be identified in the field were collected in paper bags, dried whilst in the field and then identified by specialist Barbara Triggs.

Microhabitat searches of leaf litter, bark, fallen logs and rocks were also conducted opportunistically when appropriate areas were located. Eleven microhabitat searches were conducted (refer to Figure 5 for locations).

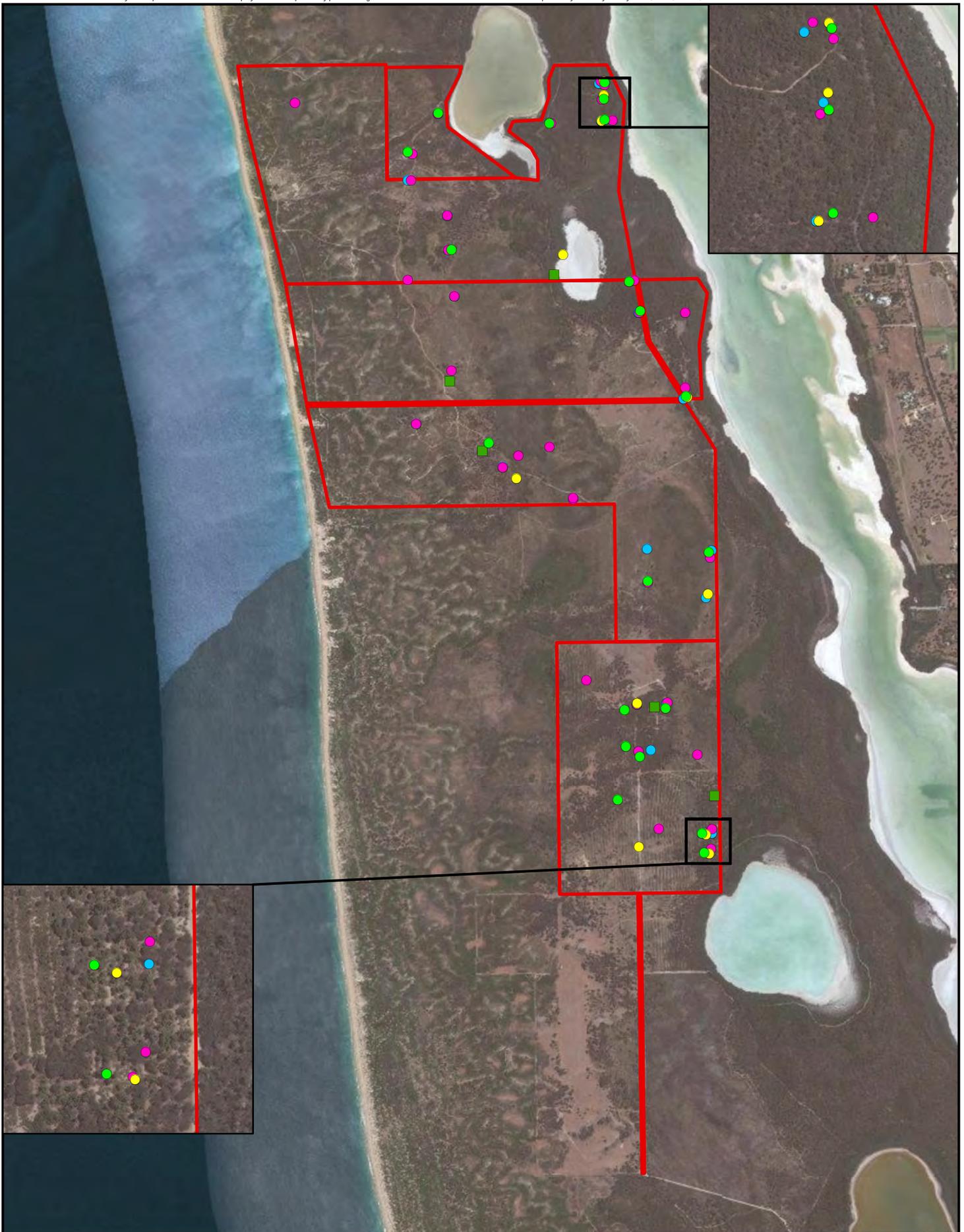
Motion activated cameras (Scoutguard Zeroglow 10M) were also installed to observe fauna, particularly nocturnal fauna. These cameras were placed in five locations in habitats assessed as potentially containing conservation significant fauna, and were generally left out for three nights in each location. Figure 5 illustrates these locations.

The taxonomy and nomenclature of vertebrate species for mammals, reptiles and amphibians is consistent with the Western Australian Museum's Checklist of Vertebrates of Western Australia (2010) and for bird species the Bird's Australia Checklist of Australian Birds by Christidis and Boles (2008).

4.3.1 Fauna habitats

The fauna habitats were mapped during the field survey, in conjunction with the vegetation mapping. Eighteen detailed habitat assessments were completed in habitats throughout Lake Clifton. Fauna habitats were assessed for specific habitat components in order to determine the potential for these habitats to support conservation significant species. Information collected included:

- Location
- General habitat description
- Habitat condition and disturbance types
- Dominant / characteristic flora species and vegetation layers
- Presences and abundance of hollows (large / small), fallen logs (<10 cm / 10-30 cm / >30 cm), litter (course / fine), decorticating bark, bare ground, grass, stones and boulders (<20 cm / 20-60 cm / 60 cm – 2 m / >2 m), rock crevices, soil cracks, cryptogamic crust, vines, mistletoe, dense shrubs, water bodies etc.
- Presence of animal signs (e.g. scats, digging, tracks, burrows, egg shell, bones, feathers etc)
- Fauna observations
- Connectivity and potential significance of habitat.



PROJECT ID 60100953
 CREATED BY DGF
 APPROVED BY FDW
 LAST MODIFIED 19 AUG 2016

AECOM
 www.aecom.com

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 260 520 780 1,040
 metres

1:33,809 when printed at A4

LEGEND

- Survey Area
- Black Cockatoo Breeding Trees Quadrat
- Microhabitat Assessment Locations
- Black Cockatoo Foraging Assessment Quadrats
- Habitat Assessment Locations
- Camera Locations

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aergrid, IGN, IGP, swisstopo, and the GIS User Community

Fauna Survey Assessment Locations

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure
5

4.4 Black Cockatoos

A targeted Black Cockatoo assessment was conducted to identify potential breeding, roosting and foraging habitat for the three threatened Black Cockatoo species that occur in Western Australia. These are Carnaby's Black Cockatoo (*Calyptorhynchus latirostris* [Endangered under the EPBC Act and Vulnerable under the WC Act]), Baudin's Black Cockatoo (*Calyptorhynchus baudinii* [Vulnerable under the EPBC Act and under the WC Act]), and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso* [Vulnerable under the EPBC Act and under the WC Act]). Refer to Section 6.3.3 for further information on these species.

The field survey was conducted in accordance with DSEWPaC (2012) Referral Guidelines for the three species of Black Cockatoos. The field survey was conducted by Floora de Wit (who has more than four years' experience conducting Black Cockatoo assessments), Ecologist Jared Leigh and Environmental Scientist Lyn van Gorp. The field survey was conducted between 20-25 June 2016.

The ENV (2009) vegetation community mapping, Tuart condition mapping and fauna habitat maps were utilised to identify potentially suitable habitat for the three Black Cockatoo species, and to inform the sample plan. The sample plan was then refined in the field, with the following assessments conducted at relevant sample points:

- foraging quality assessment
- breeding habitat including potential and actual breeding trees
- roosting habitat.

4.4.1 Breeding habitat

A Black Cockatoo breeding habitat assessment was conducted which focussed on quantifying potential breeding trees and associated habitat. Table 7 defines breeding habitat and identifies those trees that Black Cockatoos will utilise as breeding trees, according to the DSEWPaC (2012). Vegetation communities were assessed for their potential to provide breeding habitat by installing a 50 x 50 m quadrat as a sample point. All trees within this quadrat were then assessed for their suitability as a breeding tree. A total of 19 quadrats were assessed (refer to Figure 5). These quadrats were used to provide a representative sample to determine the total amount of breeding habitat (and approximate number of trees). Opportunistic records of trees with a DBH >500 mm were also made within the Survey Area, where time permitted. The following information was collected for all potential breeding trees with a DBH >500 mm:

- location
- fire scarring present
- tree species
- DBH
- height
- presence and number of hollows
- potential suitability of hollows.

Photographs were also taken of each tree

Table 7 Breeding habitat for the three Western Australian Threatened Black Cockatoo species

	Baudin's	Carnaby's	Forest Red-Tailed
Specific breeding habitat for the three Cockatoos	Nest in hollows in live or dead trees of <i>Eucalyptus diversicolor</i> , <i>Corymbia calophylla</i> , <i>E. wandoo</i> and <i>E. gomphocephala</i> .	Nest in hollows in live or dead trees of <i>E. salmonophloia</i> , <i>E. wandoo</i> , <i>E. gomphocephala</i> , <i>E. marginata</i> , <i>E. rudis</i> , <i>E. loxophleba</i> subsp. <i>loxophleba</i> , <i>E. accedens</i> , <i>E. diversicolor</i> and <i>Corymbia calophylla</i> .	Nest in hollows in live or dead trees of <i>E. diversicolor</i> and <i>Corymbia calophylla</i> , <i>E. wandoo</i> , <i>E. megacarpa</i> , <i>E. patens</i> , <i>E. gomphocephala</i> and <i>E. marginata</i> .
Definition of breeding habitat	'Breeding habitat' is defined in these referral guidelines as trees of species known to support breeding within the range of the species which either have a suitable nest hollow OR are of a suitable DBH to develop a nest hollow. For most tree species, suitable DBH is 500 mm.		

Source: DSEWPac (2012).

4.4.2 Roosting habitat

Table 8 defines the suitable trees that the three Western Australian Black Cockatoo species may utilise as roosting trees. Both white-tailed Black Cockatoo species roost in or near riparian environments or near other permanent water sources. The Forest Red-Tailed Cockatoos prefers the edges of forests for roosting (DSEWPac, 2012). Potential roosting trees were searched for and assessed during the field survey.

Table 8 Suitable roosting trees for the three Threatened Black Cockatoos

Baudin's	Carnaby's	Forest Red-Tailed
<i>Corymbia calophylla</i> , <i>E. marginata</i> , <i>E. rudis</i> , <i>E. patens</i> , and <i>E. gomphocephala</i> .	<i>E. salmonophloia</i> , <i>E. wandoo</i> , <i>Corymbia calophylla</i> , <i>Eucalyptus diversicolor</i> , <i>E. patens</i> , and <i>E. gomphocephala</i> .	<i>Corymbia calophylla</i> , <i>E. marginata</i> , and <i>E. gomphocephala</i> .

Source: DSEWPac (2012).

4.4.3 Foraging habitat

Foraging species for the three Western Australian Black Cockatoo species is presented in Table 9 as reported in various literature.

Table 9 Foraging species utilised by the three Western Australian Threatened Black Cockatoo species

Baudin's (DSEWPaC, 2012)	Carnaby's (DSEWPaC, 2012)	Forest Red-tail (Johnstone et al. 2013 and DSEWPaC, 2012)
Eucalypt woodlands and forests, proteaceous woodland and heath. During breeding season feed primarily on native vegetation, particularly Marri. Outside breeding season they can feed on fruit orchards (apple and pear, also persimmon) and tips of <i>Pinus</i> species. Common food items also include insects and insect larvae, and pith of kangaroo paw <i>Anigozanthos flavidus</i> .	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species (e.g. <i>Banksia</i> sp., <i>Hakea</i> sp. and <i>Grevillea</i> sp.) as well as eucalypt woodland and forest that is dominated by foraging species. Also will feed on Callistemon, seeds of introduced species such as <i>Pinus</i> species and <i>Erodium</i> species, wild radish, canola, almonds and pecan nuts and occasionally apples and persimmons.	The principal foods of the FRTBC are the seeds of Marri and Jarrah. Other less important foods include Blackbutt <i>E. patens</i> , <i>E. wandoo</i> , Sheoak <i>A. fraseriana</i> , Snottygobble <i>P. longifolia</i> , <i>Hakea</i> spp., also introduced species (including Cape Lilac <i>Melia azedarach</i> , Spotted Gum <i>C. maculata</i> , Lemon-scented Gum <i>C. citriodora</i> , Silver Princess <i>E. caesia</i> , Illyarrie <i>E. erythrocorys</i> and Kaffir Plum <i>Harpephyllum caffrum</i>) and in southern forests Albany Blackbutt <i>E. staeri</i> and Karri <i>E. diversicolor</i> . Rarely observed grubbing for insect larvae on <i>Allocasuarina</i> spp.

The quality of foraging habitat not only reflects the availability of food sources, but also the proximity to reliable water sources, connectivity to other suitable habitat, presence of potential breeding trees, and proximity to confirmed roost and breeding sites (amongst others). These parameters were utilised by the DotE to produce a draft quality of foraging habitat scoring system. AECOM has amended this system and this is presented in Table 11. This scoring system was utilised to assess potential foraging habitat for each Black Cockatoo species. Initially a desktop assessment was conducted to select sample point locations in varying representative habitats throughout the Survey Area, and these sites were then refined in the field. 50 x 50 m quadrats were established in the field at each of these 35 sites and the scoring assessment tool utilised.

The scoring tool is used by initially defining the quality of the overall habitat present (i.e. High, Quality, Valued, Low) and then adding or subtracting points from this depending on the ecological values of the habitat (i.e. proximity to water, proximity to a known roost site, evidence of foraging material etc.). This determines an overall quantitative rating. These scores were then used as representative scores for that vegetation unit. Table 10 defines the levels of foraging habitat quality used during the assessment.

Table 10 Black Cockatoo foraging assessment scoring

Score	Foraging Quality
1 - 3	Low
4 - 6	Valued
7 - 9	Quality
10	High

Table 11 Quality of foraging habitat assessment tool for the three Western Australian Threatened Black Cockatoo species

Score	Carnaby's	Baudin's	Forest Red-tailed
≥10 High	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing, and / or is Quality habitat described below with attributes contributing to meet a score of 10 or greater	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing, and / or is Quality habitat described below with attributes contributing to meet a score of 10 or greater	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing, and / or is Quality habitat described below with attributes contributing to meet a score of 10 or greater
7 Quality	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species (e.g. <i>Banksia</i> sp., <i>Hakea</i> sp. and <i>Grevillea</i> sp.) as well as eucalypt woodland and forest that is dominated by foraging species. Does not include orchards, canola, or areas under a RFA	Eucalypt (not mallee) woodlands and forest, and proteaceous woodland and heath, particularly Marri. Does not include orchards or areas under a RFA	Jarrah and Marri woodlands and forest, and edges of Karri forests, including Wandoo and Blackbutt, within the range of the subspecies. Does not include areas under a RFA
5 Valued	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts	Introduced eucalypts as well as the introduced Cape lilac (<i>Melia acedarach</i>)
1 Low	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)
Additions: Context adjustor – attributes improving habitat quality			
+3	Is within the Swan Coastal Plain	Is within the known foraging area	Jarrah and/or Marri shows good recruitment (i.e. evidence of young trees)
+3	Contains trees known to be used for breeding	Contains trees known to be used for breeding	Contains trees known to be used for breeding
+2	Primarily comprises Marri	Primarily contains Marri	Primarily contains Marri and/or Jarrah
+2	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo)		
+2	Known to be a large or key roosting site		
+1	Is <12 km from known breeding location		
+1	Is <2 km from a watering point		
+1	Is used for roosting		

Score	Carnaby's	Baudin's	Forest Red-tailed
Subtractions: Context adjustor – attributes reducing habitat quality			
-2	No other foraging habitat within 6 km		
-1	Is >12 km from known breeding location		
-1	Is >2 km from watering point		
-1	Disease present (e.g. <i>Phytophthora cinnamomi</i> or Marri canker)		

Source: 2016 DotE workshop

4.5 Wetlands

The vegetation within wetland boundaries, as mapped in the Geomorphic Wetlands dataset, was investigated to determine the extent of riparian vegetation, as well as vegetation condition. A wetland evaluation was completed for wetlands located entirely, or mostly within the Survey Area, inclusive of riparian vegetation, water, and fringing vegetation that grades from riparian to adjacent floodplain woodlands. Wetlands where only a small area intersected with the Survey Area, i.e. slivers and edges, were not considered.

The wetland evaluation methodology for the Swan Coastal Plain is a two tiered approach. This approach has been adopted to avoid detailed evaluations being undertaken where it may not be necessary. The two tiers of evaluation are as follows:

1. Preliminary Evaluation – if any one of the preliminary evaluation criteria is met the wetland is automatically to be assigned a Conservation management category and no further evaluation is required
2. Secondary Evaluation – if the wetland does not meet the preliminary evaluation criteria the secondary evaluation should be conducted to determine the wetland's management category.

The Preliminary evaluation was undertaken using the information contained in the *Wetland evaluation and desktop and site assessment form*. In accordance with DPaW (2013) methodology, if a wetland met any one of the Preliminary evaluation criteria then it was assigned a Conservation management category.

4.5.1 Geomorphic Wetlands dataset of the Swan Coastal Plain

The Geomorphic Wetlands of the SCP dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the SCP. The mapping, classification and evaluation of wetlands on the SCP was initially conducted by Hill *et al.* in 1996 and then subsequently conducted in accordance with EPA Bulletin 686: *A Guide to Wetland Management in the Perth and Near Perth Swan Coastal Plain Area* (EPA, 1993). These mapping and evaluation results have been digitised into the *Geomorphic Wetlands of the SCP dataset* administered by DPaW. Geomorphic classifications are determined based on the duration of wetland inundation and associated landform.

In addition to geomorphic classifications, evaluation of wetlands is undertaken to assign the relevant management categories. EPA Guidance Statement 33 outlines the three key management categories which have been applied on the SCP, along with guidance on management objectives for each category (Table 12).

Table 12 Management Categories and Objectives for the Geomorphic Wetlands of the Swan Coastal Plain

Management Category	General Description	Management Objectives
Conservation (CC or CCW)	Wetlands which support a high level of attributes and functions.	Highest priority wetlands. Objective is to preserve and protect the existing conservation values of the wetlands through various mechanisms including: <ul style="list-style-type: none"> · reservation in national parks, crown reserves and State owned land protection under Environmental Protection Policies · wetland covenanting by landowners. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.
Resource Enhancement (RE)	Wetlands which may have been partially modified but still support substantial ecological attributes and functions	Priority wetlands. Ultimate objective is to manage, restore and protect towards improving their Conservation value. These wetlands have the potential to be restored to Conservation Category. This can be achieved by restoring wetland function, structure and biodiversity. Protection is recommended through a number of mechanisms.

Management Category	General Description	Management Objectives
Multiple Use (MU)	Wetlands with few remaining important attributes and functions	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through landcare.

4.5.2 Riparian vegetation

Riparian vegetation condition was assessed using the Water & Rivers Commission (1999) foreshore condition scale, developed for application in farming areas of south-west Australia. It takes into account vegetation health, presence of weeds and erosion (Waters & Rivers Commission, 1999). The categories and sub-categories for a detailed foreshore assessment are presented in Table 13.

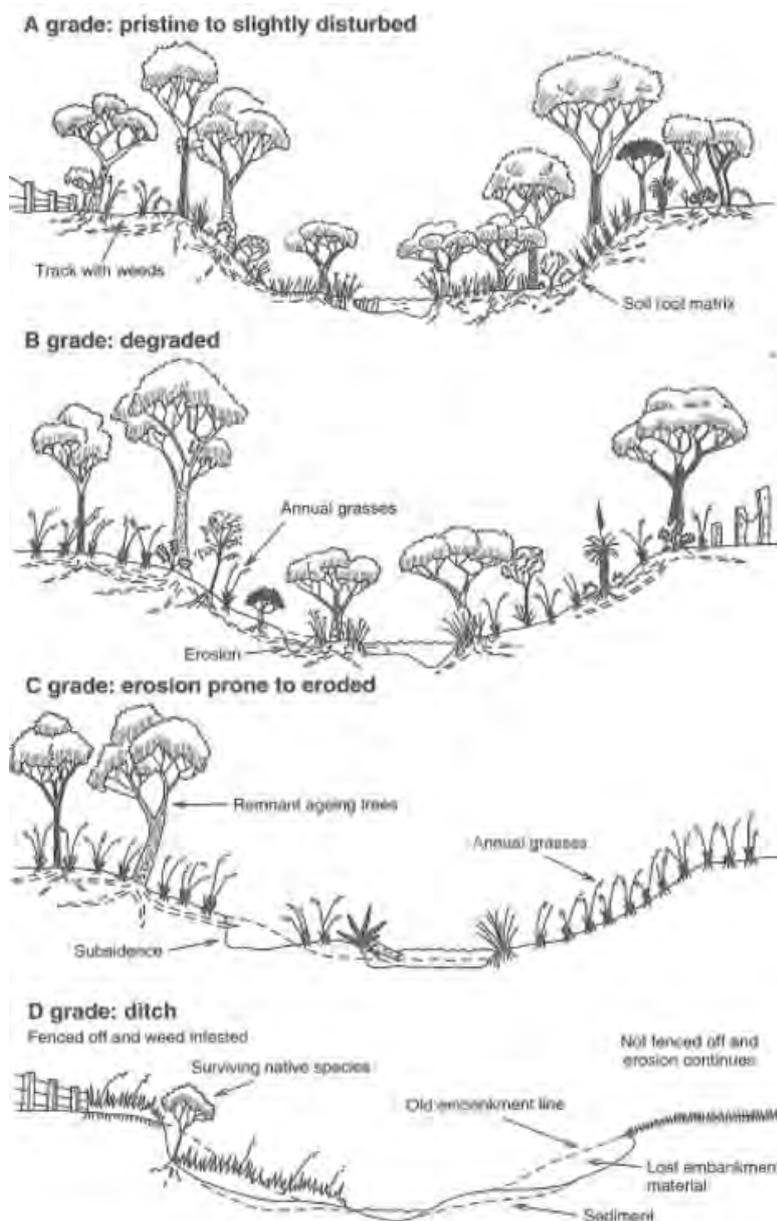
The extent of the riparian vegetation was mapped using on-ground observations and aerial imagery.

Table 13 Condition classes for a detailed assessment of foreshore condition

Category	Sub-category	Description
A	A1	Pristine. The river embankments and floodway are entirely vegetated with native species, and there is no evidence of human presence or livestock damage.
	A2	Near pristine. Native vegetation dominates. Some introduced weeds may be present in the understorey, but not to the extent that they displace native species. Otherwise there is no evidence of human impact. (A river valley in this condition is as good as will be found today)
	A3	Slightly disturbed. Native vegetation dominates, but there are some areas of human disturbance where soil may be exposed and weeds are relatively dense (such as along tracks). The native vegetation would quickly recolonise the disturbed areas if human activity declined.
B	B1	Degraded - weed infested. Weeds have become a significant component of the understorey vegetation. Although native species are dominant, a few have been replaced by weeds.
	B2	Degraded - heavily weed infested. In the understorey, weeds are about as abundant as native species. The regeneration of some tree and large shrub species may have declined.
	B3	Degraded - weed dominated. Weeds dominate the understorey, but many native species remain. Some trees and large shrub species may have declined or disappeared altogether.
C	C1	Erosion prone. Trees remain, and possibly some large shrubs or tree grasses, but the understorey consists entirely of weeds, mainly annual grasses. The trees are generally resilient or long lived species but there is little or no evidence of regeneration. The shallow-rooted weedy understorey provides no support to the soil, and only a small increase in physical disturbance will expose the soil and make the river embankments and floodway vulnerable to erosion.
	C2	Soil exposed. Older trees remain, but the ground is virtually bare. Annual grasses and other weeds have been removed by livestock trampling or grazing, or through over use by humans. Low-level soil erosion has begun, by the action of either wind or water.
	C3	Eroded Soil is washed away from between tree roots, trees are being undermined and unsupported embankments are subsiding into the river valley.

Category	Sub-category	Description
D	D1	Ditch – eroding. There is not enough fringing vegetation to control erosion. Some trees and shrubs remain and act to retard erosion in certain spots, but are doomed to be undermined eventually.
	D2	Ditch - freely eroding. No significant fringing vegetation remains and erosion is completely out of control. Undermined and subsided embankments are common, and large sediment plumes are visible along the river channel.
	D3	Drain - weed dominated. The highly eroded river valley has been fenced off, preventing control of weeds by stock. Perennial (long lived) weeds have become established. The river has become a simple drain, similar or identical to a typical major urban drain.

Source: Water & Rivers Commission, 1999.



Source: Water & Rivers Commission, 1999.

Figure 6 Foreshore condition assessment used to assess riparian vegetation condition

4.6 Limitations

The objective of the assessment was to verify existing information on ecological values of the defined Survey Area. Field surveys were completed as a Level 1 investigation. This requires a desktop study and reconnaissance survey to verify desktop results, delineate and characterise flora and the range of vegetation units and fauna habitats present (EPA, 2004a; EPA 2004b). The limitations were therefore addressed based on this objective.

Table 14 Limitations associated with the biological surveys

Limitation	Constraints	
	Flora and Vegetation Assessment	Fauna / Black Cockatoo Assessment
Competency/experience of consultant conducting survey	Nil. The flora and vegetation assessment was led by Floora de Wit who has 8 years' experience addressing similar scopes on the Swan Coastal Plain.	Nil. Floora has four years' experience conducting Black Cockatoo assessments. Jared is an ecologist with over 14 years' experience in the environmental industry and has conducted fauna surveys in a range of bioregions within Western Australia. Jared has also conducted multiple Black Cockatoo assessments.
Scope (i.e. what life forms were sampled)	Nil. Effort was spent on documenting all vascular flora species. Sterile juvenile forbs were sometimes difficult to identify to species level and were therefore named to genus only. As a Level 1 survey, this is not considered a limitation as it is unlikely to have influenced the overall results.	Nil. The level 1 fauna survey: <ul style="list-style-type: none"> · Assessed all fauna habitats within the Survey Area · Documented secondary evidence (scats, diggings, burrows etc.) and fauna sightings · Conducted microhabitat searches at appropriate sites · Utilised motion activated cameras. Although reptiles would generally have been in brumation and not sampled effectively, it is not the objective of a Level 1 survey to trap or sample for fauna groups extensively.
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	Nil. Sterile juvenile forbs were sometimes difficult to identify to species level and were therefore named to genus only. Sampling effort included 63 relevés and numerous additional observations recorded on field maps.	Nil. Information gained for a Level 1 Fauna survey was sufficient. Fauna were observed (through direct or indirect evidence) during daylight hours (0700 and 1730hrs). Therefore nocturnal species were only predominantly observed through indirect evidence, although three motion activated cameras were installed in appropriate habitats. Although reptiles would generally have been in brumation and not sampled effectively, it is not the objective of a Level 1 survey to trap or sample for fauna groups extensively.

Limitation	Constraints	
	Flora and Vegetation Assessment	Fauna / Black Cockatoo Assessment
Sources of information	<p>Minor.</p> <p>The latest published survey for Lake Clifton was used to inform this assessment. This was further supported by DPaW database searches.</p>	<p>Moderate.</p> <p>DPaW database (with additional Black Cockatoo observational data), Naturemap and EPBC Act Protected Matters Search Tool were utilised. Numerous studies have also been undertaken in the Study Area, however only three reports are available in the public domain. Information within these historical reports (e.g. vegetation mapping) were utilised to aid in the selection of Black Cockatoo foraging assessment sites for the survey. However, the on-ground observations indicated that these maps are outdated, and no longer adequately represents vegetation communities present. The location of the Black Cockatoo foraging assessment sites was refined in the field.</p>
Completion (is further work needed)	<p>Nil.</p> <p>For the purpose of meeting the objective of this assessment, no further work is required.</p>	<p>Nil.</p> <p>The objectives of the assessment were completed and no further work is required.</p>
Timing, weather, season, cycle	<p>Nil.</p> <p>The survey was conducted in winter, outside the ideal detection period for Swan Coastal Plain vegetation. For the purposes of undertaking a Level 1 Flora and Vegetation Assessment, this is not considered a limitation. It was considered that enough information was able to be captured at this time to provide an understanding of the ecological values of the Survey Area.</p>	<p>Minor</p> <p>The survey was conducted during the colder months when some fauna groups (reptiles in particular) are not as active. This assessment was also limited to one survey period during one year. However, this does not significantly impact a Level 1 fauna survey.</p>

Limitation	Constraints	
	Flora and Vegetation Assessment	Fauna / Black Cockatoo Assessment
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	Minor. Historical clearing and weed invasion has affected the condition of the Survey Area. Partial clearing of rows in the southern portion of the Survey Area led to cryptic vegetation mosaics present between rows.	Nil. The fauna survey was not disrupted or impacted.
Intensity (was the intensity adequate)	Nil. A total of 63 relevés were completed over ten field days to assess the floristic values of the Survey Area. This is considered suitable for meeting a Level 1 Assessment requirement as stipulated by EPA (2004a).	Nil. The Survey Area was surveyed over a five day period. It enabled sufficient time to conduct the Black Cockatoo foraging, breeding and roosting assessments. It also enabled sufficient time to assess the fauna habitats present, search for and collect opportunistic records for conservation significant species. The fauna survey was conducted in accordance with EPA Guidance Statement 56 (EPA, 2004b).
Resources (degree of expertise available in plant/animal identification)	Nil. Sufficient time was allocated for the survey. Plant identification was undertaken by Floora de Wit and Lyn van Gorp at the WA Herbarium.	Nil. Sufficient time was allocated for the survey and equipment utilised (e.g. motion activated cameras) were above that required for a Level 1 fauna survey. Floora has four years' experience conducting Black Cockatoo assessments, and Jared is an ecologist with over 14 years' experience in the environmental industry who has also conducted multiple Black Cockatoo assessments.
Remoteness and/or access problems	Nil. Multiple tracks dissect the Survey Area, enabling access to all vegetation communities encountered.	Minor. Not all of the Survey Area was covered on-ground due to the size of the project Area and the availability of tracks. However, this minor limitation was not deemed significant as the requirements of a Level 1 fauna survey were met.

Limitation	Constraints	
	Flora and Vegetation Assessment	Fauna / Black Cockatoo Assessment
Availability of contextual information on the region	Minor. Publicly available resources such as Beard (1981), Heddle (1980), and historical reports including ENV (2009) informed the report. Many historical biological reports relevant for this Survey Area are not available in the public domain and were therefore not able to be further considered.	Minor. Many historical biological reports relevant for this Survey Area are not available in the public domain and were therefore not able to be further considered.

5.0 Desktop Results

5.1 Threatened and Priority Ecological Communities

5.1.1 Commonwealth

Lake Clifton is located within the buffer of one Commonwealth-listed Threatened Ecological Community (TEC) (Figure 7). The Thrombolite (microbialite) Community of a Coastal Brackish Lake (Lake Clifton) is listed as Critically Endangered under the EPBC Act, and Critically Endangered under the WC Act (where it is listed as Stromatolite like Freshwater Microbialite Community of Coastal Brackish Lakes). This TEC incorporates Lake Clifton and the stromatolites present in the Lake. Despite the buffer of this community encompassing the Survey Area, this TEC is not present within the Survey Area.

5.1.1 State

Two State-listed TECs and five Priority Ecological Communities (PECs) were identified in the desktop assessment as occurring in the vicinity of Lake Clifton. Of the seven communities, five are known to occur, one may occur, and one is unlikely to occur (Table 15; Figure 7).

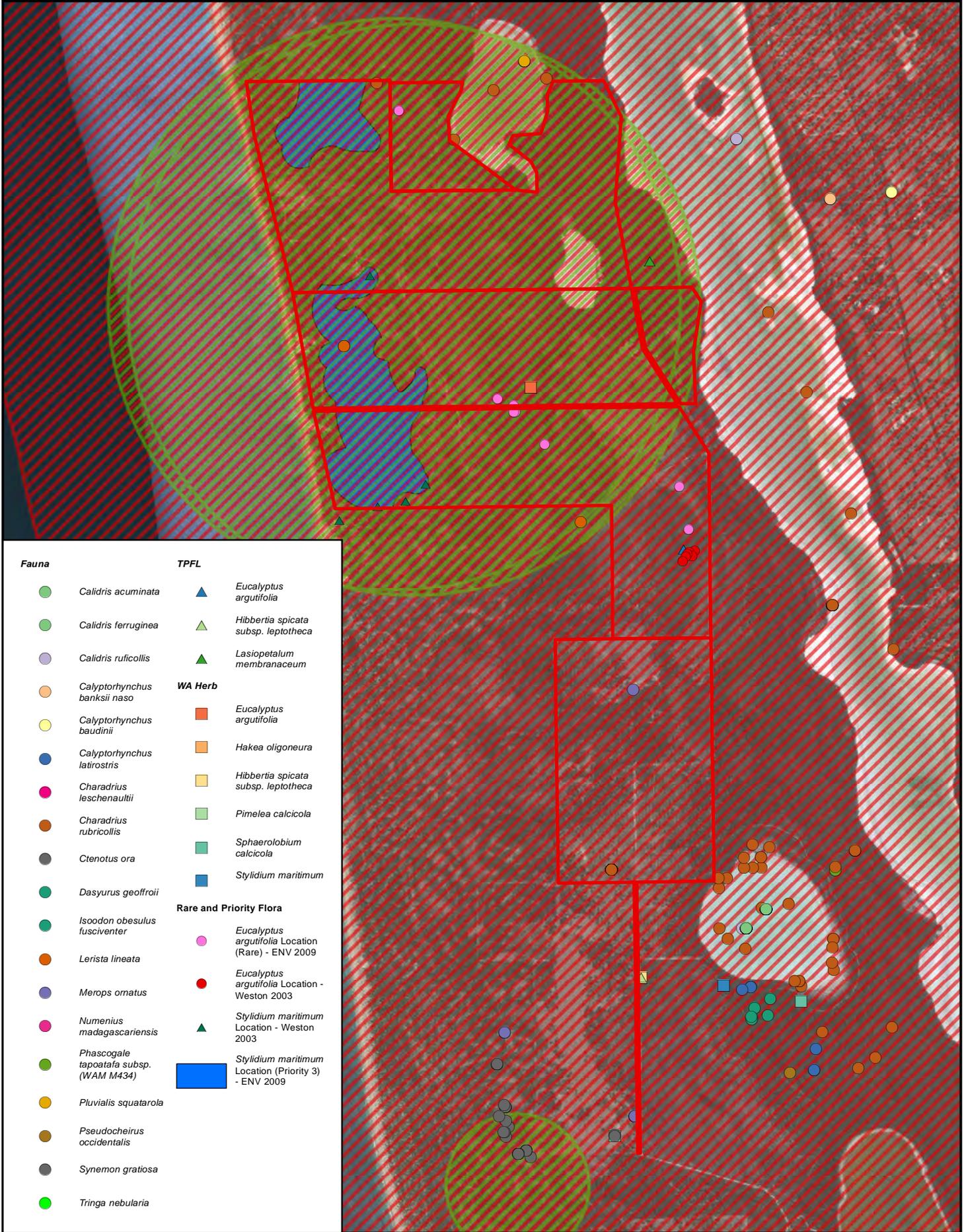
The TEC, FCT26a – *Melaleuca huegelii* – *Melaleuca acerosa* (*systema*) Shrublands on Limestone Ridges, is listed as Endangered (EN) by DPaW and endorsed by the Minister of the Environment. Gibson et al. (1994) characterised this community as including *Acacia lasiocarpa*, *Banksia sessilis*, *Grevillea thelemanniana* subsp. *preissii*, *Melaleuca acerosa*, *Melaleuca huegelii* and *Trymalium albicans* with numerous herbs. FCT26a is restricted to large limestone ridges north of Perth and those in the Yalgorup area on skeletal soils of ridge slopes and ridge tops dominated by heath vegetation. This community has been identified as occurring in the Survey Area in ENV (2009). The DPaW database has no records of this community at this location, but does show a known location 2.7 km east of the Survey Area.

Similarly, the TEC, FCT18 Shrublands on Calcareous Silts was recorded by ENV (2009) however the DPaW databases show no records of this community in the Survey Area. Gibson *et al.* (1994) recorded this community in Yalgorup National Park and describes it as a very species-rich community characterised by open low scrubs with rich annual flora. Common taxa include *Acacia saligna*, *Leptomeria lehmannii*, *Xanthorrhoea preissii*, *Gahnia trifida* and *Melaleuca teretifolia* on damplands.

Table 15 Threatened and Priority Ecological Communities identified as occurring in the Study Area

	Cons. Status	Presence
FCT18 Shrublands on calcareous silts	WC Act: Vulnerable	May occur. There are no DPaW database records however ENV (2009) identified it as potentially occurring at one location following FCT analysis of field survey results.
SCP25 – Southern <i>Eucalyptus gomphocephala</i> – <i>Agonis flexuosa</i> woodlands	Priority 3	Known. Mapped by ENV (2009) however no DPaW database records in the Survey Area with the nearest record 4 km east of Lake Clifton.
SCP29a – Coastal shrublands on shallow sands	Priority 3	Known from DPaW database 2016 and mapped by ENV (2009).
SCP29b – Acacia shrublands on taller dunes	Priority 3	Known from DPaW database 2016 and mapped by ENV (2009).
SCP30b – Quindalup <i>Eucalyptus gomphocephala</i> and / or <i>Agonis flexuosa</i> woodlands	Priority 3	Known from DPaW database 2016 and mapped by ENV (2009).

	Cons. Status	Presence
Elongate Fluvial Delta System – Peel-Harvey inlet	Priority 1	Unlikely. Associated with Peel-Harvey inlet located 5km east of the Survey Area on the east side of Lake Clifton.
FCT26a – <i>Melaleuca huegelii</i> – <i>Melaleuca acerosa (systema)</i> shrublands on limestone ridges	WC Act: Endangered	Known. Mapped by ENV (2009) however no DPaW database records in the Survey Area, with the nearest record 2.7 km east of Lake Clifton.



Fauna		TPFL	
	<i>Calidris acuminata</i>		<i>Eucalyptus argutifolia</i>
	<i>Calidris ferruginea</i>		<i>Hibbertia spicata subsp. leptotheca</i>
	<i>Calidris ruficollis</i>		<i>Lasiopetalum membranaceum</i>
	<i>Calyptorhynchus banksii naso</i>	WA Herb	
	<i>Calyptorhynchus baudinii</i>		<i>Eucalyptus argutifolia</i>
	<i>Calyptorhynchus latirostris</i>		<i>Hakea oligoneura</i>
	<i>Charadrius leschenaultii</i>		<i>Hibbertia spicata subsp. leptotheca</i>
	<i>Charadrius rubricollis</i>		<i>Pimelea calcicola</i>
	<i>Ctenotus ora</i>		<i>Sphaerolobium calcicola</i>
	<i>Dasyurus geoffroi</i>		<i>Stylidium maritimum</i>
	<i>Isoodon obesulus fusciventer</i>	Rare and Priority Flora	
	<i>Lerista lineata</i>		<i>Eucalyptus argutifolia</i> Location (Rare) - ENV 2009
	<i>Merops ornatus</i>		<i>Eucalyptus argutifolia</i> Location - Weston 2003
	<i>Numenius madagascariensis</i>		<i>Stylidium maritimum</i> Location - Weston 2003
	<i>Phascogale tapoatafa subsp. (WAM M434)</i>		<i>Stylidium maritimum</i> Location (Priority 3) - ENV 2009
	<i>Pluvialis squatarola</i>		
	<i>Pseudocheirus occidentalis</i>		
	<i>Synemon gratiosa</i>		
	<i>Tringa nebularia</i>		

PROJECT ID 60100953
 CREATED BY DGF
 APPROVED BY FDW
 LAST MODIFIED 19 AUG 2016

DATUM GDA 1994, PROJECTION MGA ZONE 50

1:35,000 when printed at A4

LEGEND

- Survey Area
- TEC/PEC**
- Priority 3
- Critically Endangered

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Desktop Assessment Results

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure 7

5.2 Threatened and Priority flora

The desktop assessment identified ten flora species of conservation significance, including two species listed under the EPBC Act and WC Act, and eight species listed as Priority by DPaW and endorsed by the Minister for Environment.

Of the ten species, five species are known to occur within the Survey Area based on ENV (2009) which includes a figure showing Weston (2003) Threatened flora locations, and DPaW database search results. Furthermore, one species is considered likely to occur, three may occur, and one is considered unlikely to occur.

Details of all ten species are provided in Table 16 and historical locations shown in Figure 7.

Table 16 Desktop flora results showing species, conservation code (Commonwealth and State), habitat description and likelihood of occurrence

Species	Conservation code ¹	Habitat ²	Flowering Period	Likelihood
<i>Eucalyptus argutifolia</i> , Yanchep Mallee, Wabbling Mallee	VU, VU	Grows on slopes and gullies near coast and close to summits of limestone ridges. Soils are shallow, well drained and grey with outcrops of limestone. Commonly associated with heath and thicket species.		Known , ENV (2009) mapped three populations with more than 200 individuals. Weston (2003) mapped one population. DPaW database shows ten records from two distinct populations.
<i>Caladenia huegelii</i> Grand Spider Orchid	EN, CR	Grows in deep sandy soil in <i>Banksia-Eucalyptus marginata</i> woodland	Sep-late Oct	Unlikely , no suitable habitat present.
<i>Caladenia swartziorum</i>	P1	Winter wet areas.	Unknown	May , suitable habitat present but no known occurrences in the Study Area.
<i>Stylidium maritimum</i>	P3	Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open <i>Banksia</i> woodland	Sep-Nov	Known , more than 2,800 records (ENV (2009) in the western sand dune communities. No DPaW database records in the Study Area.
<i>Hakea oligoneura</i>	P4	Limestone. Known only from Mandurah and Waroona. Recorded by Weston (2003) in Yalgorup National Park in <i>Banksia sessilis</i> woodlands	Unknown	Known , recorded by Weston (2003) and suitable habitat present. No known occurrences from DPaW or ENV (2009).
<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	P3	Near-coastal limestone ridges, outcrops and cliffs.	Jul-Oct	Known , recorded by Weston (2003) and one DPaW database record near the access road.
<i>Lasiopetalum membranaceum</i>	P3	Sand over limestone.	Sep-Dec	Known , one DPaW database record located in the northeast of Lake Clifton.
<i>Platysace ramosissima</i>	P3	Sandy soils.	Oct-Nov	Likely , suitable habitat present and one DPaW database record in close proximity.
<i>Pimelea calcicola</i>	P3	Coastal limestone ridges, sand.	Sep-Nov	May , suitable habitat present but no records in the Study Area.
<i>Sphaerolobium calcicola</i>	P3	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Jun or Sep	May , suitable habitat present but no records in the Study Area.

1. Shows EPBC Act listing and WC Act listing based on categories described in Appendix A and Section 2.0. P refers to Priority flora listed by DPaW.

2. Information obtained from DotE (2016) Species Profiles Database (SPRAT) or WA Herbarium Florabase (1998)

5.3 Threatened and Priority fauna

The desktop assessment identified 63 conservation significant fauna species that could potentially occur within the Survey Area. Of these:

- 12 species are likely to occur (Table 17)
- 31 species may occur
- 20 species are unlikely to occur.

The species likely to occur in the Survey Area include eight bird, two mammal, one reptile and one invertebrate species. The likelihood of occurrence of fauna species was determined by assessing the presence of suitable habitat in the Survey Area, and reviewing the recent records and distribution of the species. Table 17 identifies the 12 species likely to occur. The conservation significant categories as defined by DPaW, the WC Act and EPBC Act are defined in **Appendix A**.

The full desktop assessment for all 63 fauna species and their likelihood of occurrence are presented in **Appendix D**.

Table 17 Threatened Fauna species likely to occur within the Survey Area

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
Birds				
<i>Calidris ruficollis</i>	Red-necked Stint	Migratory / Marine	IA	The Red-necked Stint is a small Calidridinae approximately 13–16 cm in length and is the smallest shorebird in Australia (Geering <i>et al.</i> 2007). The Red-necked Stint has been recorded in all coastal regions, and found inland in all states when conditions are suitable. The Red-necked Stint breeds in Siberia and sporadically in north and west Alaska. In Australasia, the Red-necked Stint is mostly found in coastal areas. The Red-necked Stint mostly forages on bare wet mud on intertidal mudflats or sandflats, or in very shallow water; mostly in areas with a film of surface water and mostly close to edge of water. During high tides they sometimes forage in non-tidal wetlands (DotE, 2016b). Within Australia, there are a number of threats common to most migratory shorebirds, including habitat loss, habitat degradation, disturbance and direct mortality (DotE, 2016b).
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	E	EN	Carnaby's Black Cockatoo is endemic to the southwest of Western Australia and is a large black cockatoo with a white patch on its cheek, white bands on its tail and a strong short curved bill. This species display strong pair bonds and nest in the hollows of live or dead Eucalypts. On the Swan Coastal Plain, the birds feed on a large variety of plants, preferring proteaceae species and Marri nuts, and some introduced species (e.g. <i>Pinus</i> sp.). Carnaby's Black Cockatoo has undergone a dramatic decline in recent years, declining by 50 percent in the past 45 years, one of the main contributing factors being land clearing (DotE, 2016). Refer to Section 6.3.3.1 for further detail.

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
<i>Charadrius rubricollis</i>	Hooded Plover	Marine	P4	Hooded Plovers are small to medium-sized, stocky shorebirds with short bills, large eyes and rounded heads. The Hooded Plover is pale-coloured, 19 - 23 cm in length with a wingspan of 26 - 44 cm. Hooded Plovers utilise sandy ocean beaches, tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, small beaches in lines of cliffs, near-coastal saline and freshwater lakes and lagoons. In south-west Western Australia the Hooded Plover is not restricted to the coast, and can also live and breed around inland salt lakes (OEH, 2016). Threats to the Hooded Plover include disturbance, predation of eggs and chicks by foxes, dogs, and cats, Australian ravens, silver gulls and raptors, habitat modification (OEH, 2016).
<i>Charadrius ruficapillus</i>	Red-capped Plover	Marine	-	The Red-capped Plover is a small grey-brown plover that is white underneath and has a red-brown crown. The Red-capped Plover is the most common of Australia's beach-nesting shorebirds. It is widespread throughout Australia and is found in wetlands, especially in arid areas, and prefers saline and brackish waters. They usually inhabit wide, bare sandflats or mudflats at the margins of saline, brackish or freshwater wetlands where they forage by taking small invertebrates from the surface (http://www.birdlife.org.au/bird-profile/red-capped-plover).

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Marine	-	The White-bellied Sea-Eagle is a large raptor that has long, broad wings and a short, wedge-shaped tail. It measures 75–85 cm in length, and has a wingspan of 180–220 cm. This species is distributed along the Australian coastline, and it also extends inland along some of the larger waterways. The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands (DotE, 2016b). Potential threats to the White-bellied Sea-Eagle are the loss of habitat due to land development, disturbance of nesting pairs by human activity, poisoning, shooting, competition with Wedge-tailed Eagles, and the deterioration of inland water resources (DotE, 2016b).
<i>Merops ornatus</i>	Rainbow Bee-eater	Marine	-	The Rainbow Bee-eater is a common species which occupies numerous habitats including open woodlands with sandy loamy soil, sand ridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests (Morcombe, 2003). The Rainbow Bee-eater breeds in monogamous pairs and nests are usually concentrated together in loose colonies with other pairs. In Australia the breeding season begins in August and carries through until January. Nests are constructed in a chamber at the end of a long burrow that is excavated by the pair. Burrows are typically recorded in flat or sloping ground in a variety of locations where suitable sandy loam substrate occurs (DotE, 2016b).

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
<i>Numenius madagascariensis</i>	Eastern Curlew	CE	VU & IA	The Eastern Curlew is a large wader with a long neck, long legs, and a heavy bill that curves downwards. Within Australia, the Eastern Curlew has a primarily coastal distribution and is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. The birds are also found in saltworks and sewage farms (Marchant & Higgins 1993). Threats to the Eastern Curlew include human disturbance, habitat loss and modification, pollution and hunting (DoTE, 2016b).
<i>Tringa nebularia</i>	Common Greenshank	Migratory / Marine	IA	The Common Greenshank is a heavily built, elegant wader, 30–35 cm in length, with a wingspan of 55–65 cm and weight up to 190 g. The Common Greenshank does not breed in Australia, but does occur in all types of wetlands and has the widest distribution of any shorebird in Australia (DoTE, 2016). Within Australia, threats to the Common Greenshank include loss and modification of habitat; silt, weeds or pest invasion; disturbance and introduced species (DoTE, 2016b).

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
Mammals				
<i>Isoodon obesulus fusciventer</i>	Quenda, Southern Brown Bandicoot	-	P4	The Quenda or Southern Brown Bandicoot is a small marsupial with coarse dark grey / yellow brown fur above, creamy-white below and a short, tapered, dark brown tail (DPaW, 2016). It is found in woodland, heath and shrub communities on the Swan Coastal Plain and prefers a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan 2008). Key threatening processes for the Quenda include habitat loss and degradation, road trauma and predation by introduced carnivores.
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	V	EN	The Western Ringtail Possum is a medium sized nocturnal marsupial, up to 1.3 kg in weight and approximately 40 cm in body length. Its fur is dark brown above with cream to grey fur underneath, with a strong prehensile tail (Van Dyck & Strahan 2008). The Western Ringtail Possum has a patchy distribution in predominantly two areas: near Bunbury to Leeuwin-Naturaliste National Park (with a small translocated subpopulation near Dawesville); and near Albany. Habitat parameters affecting the distribution of the subpopulation on the Swan Coastal Plain are associated with stands of myrtaceous trees (usually <i>Agonis flexuosa</i>) growing near swamps, water courses or floodplains, and at topographic low points which provide cooler, often more fertile, conditions (DoTE, 2016). The main threats to the Western Ringtail Possum include climate change and extreme weather events, predation by the European Red Fox (<i>Vulpes vulpes</i>) and the Cat (<i>Felis catus</i>), inappropriate fire regimes, and habitat loss and fragmentation (Woinarski <i>et al.</i> , 2014).

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
Reptiles				
<i>Lerista lineata</i>	Lined Skink	-	P3	<i>Lerista lineata</i> is a small reptile growing to 11 cm long, with characteristic dark brown ventral stripes (Storr <i>et al.</i> , 1999). This burrowing species is found in loose sand beneath logs and termite mounds and inhabits coastal heath and shrubland areas in the southwest and midwest coast of Western Australia (Wilson & Swan, 2010).
Invertebrates				
<i>Synemon gratiosa</i>	Graceful Sunmoth	-	P4	The Graceful Sunmoth is a medium-sized diurnal flying sunmoth that is similar in appearance to a butterfly. It has a wingspan of 25–35 mm with females generally larger than males. The upper surface of the forewings is dark grey, whereas the upper surface of the hind wings and the entire underside of all the wings are bright orange, with some dark grey markings (TSSC, undated). The Graceful Sunmoth is found only in southwest Western Australia, along a narrow strip of approximately 630 km of coastal habitat, from Kalbarri to Binningup (DEC, 2012). The main threats to this species are clearing of habitat for urban, rural and industrial development, particularly in the greater Perth to Peel urban area (Yanchep to Dawesville), and inappropriate management of habitat (TSSC, undated).

Note: Species listed as Marine under the EPBC Act are only considered conservation significant when in a Commonwealth marine reserve.

5.4 Black Cockatoos

5.4.1 Carnaby's Black Cockatoos

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DotE, 2016). This black cockatoo has a white patch on its cheek, white bands on its tail, and a strong curved bill.

Carnaby's Black Cockatoo feed on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include the various proteaceous species (e.g. *Banksia*, *Grevillea* and *Hakea*), *Corymbia calophylla* (Marri), *Eucalyptus* (e.g. Jarrah [*Eucalyptus marginata*]), and seeds from the cones of Pine trees (*Pinus* sp.).

Carnaby's Black Cockatoo display strong pair bonds and nest in the hollows of live or dead mature eucalypts including Salmon Gum (*Eucalyptus salmonophloia*), York Gum (*Eucalyptus loxophleba* subsp. *loxophleba*), Flooded Gum (*Eucalyptus rudis*), Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Tuart (*Eucalyptus gomphocephala* [DSEWPaC, 2012]). Nest hollows generally range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone & Storr, 1998). On the SCP, Carnaby's Black Cockatoo are known to breed in small numbers at Regans Ford, Yanchep, Gingin, Mandurah and Bunbury (Johnstone & Johnstone, 2004). The species appears to be expanding its current breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the SCP (Johnstone & Kirkby, 2006). After breeding, Carnaby's Black Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July (DEC, 2009). Breeding has been recorded from early July to mid-December.

Carnaby's Black Cockatoo has undergone a dramatic decline of approximately 50 percent in the past 45 years, with the main contributing factors the clearing of core breeding habitat in the wheatbelt, the deterioration of nesting hollows, and clearing of foraging habitat.

Under the Perth-Peel strategic assessment, it is proposed that a minimum of 116,000 ha of additional conservation reserves be created that supports suitable Carnaby's habitat including the replacement of 5,000 ha of pines (Government of Western Australia, 2015).

5.4.2 Forest Red-tailed Black Cockatoos

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (DSEWPaC, 2012). The species has a pair of black central tail feathers and a bright red, orange or yellow barring on the tail.

This species predominantly feeds in eucalypt forests, preferring Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) seeds, but also feeding in Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*Eucalyptus staeri*), Karri (*Eucalyptus diversicolor*), Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*) (Johnstone, 2016 pers. comm.). Forest Red-tailed Black Cockatoo are monogamous and pairs nest in tree hollows from 6.5–33 m above ground. Most nests are in very large and very old, mature Marri (*Corymbia calophylla*) (Johnstone, Kirkby & Sarti, 2013), though they will nest in other eucalypts such as Tuart (Johnstone, 2016 pers. comm.).

The modelled distribution of Forest Red-Tailed black Cockatoos in the *Referral Guidelines for three threatened black cockatoo species* (DSEWPaC, 2012) ranges from Perth to Albany encompassing the south west of the state. Formerly common, but now rare to uncommon and patchily distributed, the Forest Red-tailed Black Cockatoo has disappeared from about 30% of its former range. It has suffered a marked decline in numbers over the past 60 years because of the destruction and fragmentation of habitat (especially Jarrah-Marri forest), the apparent decline in Marri along the eastern side of the Darling Scarp (possibly due to climate change), logging, the impact of competitors for nest hollows, and fire (Chapman, 2008).

According to Johnstone *et al.* (2013) the foraging ecology of the Forest Red-tail is changing as their range is expanding. New foraging species, including introduced species, are being added to their diet. Lack of food and the discovery of new food sources is leading this change in foraging range. Sedentary flocks are now becoming regular visitors to the Swan coastal Plain, particularly for breeding. Principal foods are Marri and Jarrah with less important foods including Blackbutt, Sheoak, *Hakea*, introduced eucalypts and cape lilac.

Habitat mapping for the Forest Red-tail was undertaken as part of the Strategic Assessment for the Perth and Peel Regions (Government of Western Australia, 2015). In the Strategic Assessment the following plant species were included as target species for the feeding habitat layer for the Forest Red-tailed Black Cockatoo and are also used by Carnaby's Cockatoo: Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Parrot Bush (*Banksia sessilis*), Wandoo (*E. wandoo*), Flooded Gum (*E. rudis*) and Tuart (*E. gomphocephala*). The majority of the Survey Area was mapped as Forest Red-tailed Black Cockatoo habitat in the *Draft EPBC Act Strategic Impact Assessment Report Part D: MNES Assessment*.

The potential for Flooded Gum (*E. rudis*) and Tuart (*E. gomphocephala*) as forage species was discussed with Johnstone as part of this survey and he confirmed that these species were not foraging species. Contradictions regarding foraging species for the Forest Red-tailed Black Cockatoo have caused difficulty with determining foraging habitat at the Survey Area. Species ultimately used to define habitat for this report were those as listed in Table 9.

5.4.3 Baudin's Black Cockatoo

Baudin's Black Cockatoo is distributed throughout the south-western humid and subhumid zones, from the northern Darling Range and adjacent far east of the SCP (south of the Swan River), south to Bunbury and across to Albany (Johnstone & Storr 1998). It is a large black cockatoo with rectangular white patches in the tail. Males have a pink eye ring, the female a dark eye ring.

Baudin's Black Cockatoo forages primarily in eucalypt forest, where it feeds on seeds, flowers, nectar and buds from Marri (*Corymbia calophylla*), and seeds of *Eucalyptus* and proteaceous species (e.g. *Banksia* and *Hakea*), as well as orchard fruits and Pines (*Pinus* sp.). It also takes insect larvae and insects (including beetle, wasp and moth larvae) from under bark and in wood of live and dead trees, from galls and from flower spikes of *Xanthorrhoea* and the pith of *Anigozanthos flavidus* (Johnstone & Kirkby, 2008).

This black cockatoo primarily nests in tree hollows in live or dead Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Tuart (*Eucalyptus gomphocephala* [DSEWPaC, 2012]). Baudin's Black Cockatoo nests in spring in the deep southwest of Western Australia. It has suffered a substantial decline in numbers in the past 50 years. Direct causes of population decline include large numbers shot by orchardists, fragmentation of habitat and the impact of hollow competitors.

6.0 Field Results

6.1 Vegetation

6.1.1 Threatened and Priority Ecological Communities

6.1.2 Commonwealth

No EPBC Act listed vegetation communities occur within the Survey Area.

6.1.3 State

One State-listed TEC occurs within the Survey Area, as identified in the desktop assessment. The TEC FCT26a – *Melaleuca huegelii* – *Melaleuca acerosa* (*systema*) Shrublands on Limestone Ridges occurs at two distinct locations in the Survey Area. This community was confirmed by the presence of the two keystone species *Melaleuca huegelii* and *M. systema*, and the limestone outcropping. The results coincide with ENV (2009) results. This TEC is mapped as MsTd, and was rated as being in predominantly 'Very Good' condition. This community extends over 202 ha and is described in more detail in Table 18.

The TEC FCT18 Shrublands on calcereous silts may have been recorded during the 2016 field survey. ENV (2009) mapped this as potentially occurring within the 2016 mapping code MrGtHg. This community is dominated by *Melaleuca teretifolia* and *M. raphiophylla* over *Gahnia trifida*, which is consistent with some of the species characterising FCT18. A Level 2 flora and vegetation survey incorporating permanent quadrats sampled over multiple seasons would be required to ascertain the presence of this TEC. Quadrat data could then be used to infer a FCT by undertaking data analysis such as similarity indices and hierarchical clustering methods.

The Priority 3 PEC SCP25 – Southern *Eucalyptus gomphocephala*-*Agonis flexuosa* woodlands were recorded on the Cottesloe Complex – central and south (part of the Spearwood complex) at Lake Clifton. This PEC corresponds to parts of AfHcEp, AfXpHg, AfXpHh and EgMhAp where these communities intersect with the Cottesloe or Quindalup complexes. Similarly, another Priority 3 PEC, SCP30b – Quindalup *E. gomphocephala* and/or *A. flexuosa* woodlands that are restricted to the Quindalup system also occur at Lake Clifton. This community corresponds to EgMhAp and parts of AfHcEp.

The Priority 3 PEC SCP29a – Coastal shrublands on shallow sands and SCP29b – *Acacia* shrublands on taller dunes are restricted to the Quindalup dunes system. These PECs are known to occur within the Survey Area (DPaW records) and potentially correspond to ArMsTd. A Level 2 flor and vegetation survey including quadrat sampling over multiple seasons would be required to undertake data analysis to infer these FCTs with confidence. Vegetation communities, their detailed descriptions, and inferred TEC or PEC are presented in Table 18.

6.1.4 Vegetation communities

Two vegetation community maps have previously been developed for the Survey Area including the Freeman *et al.* (2009) broadscale vegetation mapping and the ENV (2009) Clifton Beach Flora and Vegetation Assessments. A review of ENV (2009) indicates that their vegetation map was produced by someone prior to their assessment, however no reference is given and none of the other studies are available for consideration. The two available maps show two extremes of scale for mapping vegetation.

Freeman *et al.* (2009) mapped four broad vegetation groups at Lake Clifton, based on DPaW mapping and FCT mapping. This vegetation map generally coincides with the Heddle *et al.* (1980) vegetation association mapping.

ENV (2009) mapped 68 vegetation communities, capturing a level of detail considered unnecessary for this assessment. On-ground observations and floristic data captured in 63 relevés were used to produce an updated vegetation map at a 1:35,000 scale.

Following the field survey in June 2016, the floristic data captured in relevés were used to inform the vegetation mapping. Hierarchical clustering was undertaken to determine the relationships between relevés and illustrate groupings of similar sites. This led to 15 communities being described in Table 18 and mapped in Figure 8. These vegetation communities are similar to those described in ENV (2009) and Freeman *et al.* (2009).

Table 18 Vegetation communities

Community	Vegetation description	Photograph(s)
Woodland communities		
AfHcEp	<p><i>Agonis flexuosa</i> mid open forest with emergent <i>Eucalyptus gomphocephala</i> over <i>Hibbertia cuneiformis</i>, <i>Xanthorrhoea preissii</i> and <i>Clematis linearifolia</i> mid sparse shrubland over *<i>Euphorbia peplus</i>, *<i>Geranium molle</i>, *and *<i>Trachyandra divaricata</i> low sparse forbland.</p> <p>This community has pockets of rehabilitation. Soils of the community are sand or sandy loam and vegetation condition ranges from 'Good' to 'Very Good' Condition associated largely with the presence of understorey weeds, evidence of disturbance by rabbits and lack of native understorey vegetation in places.</p> <p>Area: 134.89 ha Sites: five relevés (including 2, 3, 4, 13, 39) Species richness: 10 native and 14 weed species Significance: Potential for portions of this community that occur on Cottesloe or Quindalup Complex to represent Priority 3 PECs SCP25 or SCP30b</p>	
AfXpHg	<p><i>Agonis flexuosa</i> and <i>Eucalyptus marginata</i> mid woodland with emergent <i>Eucalyptus gomphocephala</i> over <i>Xanthorrhoea preissii</i>, <i>Hakea lissocarpha</i> and <i>Hardenbergia comptoniana</i> low to tall open shrubland over *<i>Hypochaeris glabra</i> and *<i>Lysimachia arvensis</i> low sparse forbland.</p> <p>Soils of this community were recorded as dark brown sands with loam in places. Vegetation condition was 'Very Good', influenced by the presence of understorey weeds and evidence of previous human disturbance.</p> <p>Area: 11.87 ha Sites: two relevés (1, 62) Species richness: 24 native and six weed species Significance: Potential for portions of this community that occur on Cottesloe complex to represent Priority 3 PEC SCP25</p>	

Community	Vegetation description	Photograph(s)
AfXpHh	<p>Low to mid open to closed forest of <i>Agonis flexuosa</i>, <i>Eucalyptus gomphocephala</i> and occasional <i>Banksia grandis</i> over <i>Xanthorrhoea preissii</i>, <i>Templetonia retusa</i> and occasional <i>Banksia sessilis</i> var. <i>cygnorum</i> tall open shrubland over <i>Hibbertia hypericoides</i> and <i>Macrozamia riedlei</i> sparse to open low shrubland.</p> <p>This vegetation communities has areas of the Declared Pests *<i>Gomphocarpus fruticosus</i> and *<i>Zantedeschia aethiopica</i>. Within the community there are occasional <i>Banksia attenuata</i>, <i>Banksia littoralis</i> and <i>Banksia grandis</i> as well as <i>Eucalyptus petrensis</i> along ecotones and <i>Nuytsia floribunda</i>. The soil type within the community comprised white to brown sand and loam. Vegetation condition ranged between 'Very Good' and 'Excellent' reflecting generally relatively low intensity of weeds and also evidence of disturbance by rabbits.</p> <p>Area: 95.93 ha Sites: eight relevés (8, 9, 10, 11, 23, 24, 25, 30) Species richness: 51 native and 10 weed species Significance: Potential for portions of this community that occur on Cottesloe complex to represent Priority 3 PEC SCP25</p>	
EgMhAp	<p>Isolated tall trees of <i>Eucalyptus gomphocephala</i> over mid woodland of <i>Agonis flexuosa</i> and occasional <i>Santalum acuminatum</i> over <i>Melaleuca huegelii</i> subsp. <i>huegelii</i>, <i>Acacia rostellifera</i> and <i>Clematis linearifolia</i> tall shrubland over <i>Acanthocarpus preissii</i>, *<i>Trachyandra divaricata</i> and *<i>Euphorbia peplus</i> closed low forbland.</p> <p>Soil was a sandy loam, brown in colour reflecting the presence of organic matter. Vegetation condition was recorded as 'Good' due to the presence of weeds, a low diversity of plants and the absence of much native understorey stratum.</p> <p>Area: 17.53 ha Sites: one relevé (18) Species richness: 10 native and four weed species Significance: Potential for this community to represent Priority 3 PECs SCP25 or SCP30b</p>	

Community	Vegetation description	Photograph(s)
EgMsTd	<p><i>Eucalyptus gomphocephala</i> mid woodland over <i>Melaleuca systena</i>, <i>Hibbertia cuneiformis</i> and <i>Xanthorrhoea preissii</i> mid to tall shrubland over *<i>Trachyandra divaricata</i>, *<i>Geranium molle</i> and *<i>Trifolium campestre</i> low forbland.</p> <p>Isolated <i>Acacia rostelifera</i> thickets occur within this community and occasional <i>Eucalyptus platypus</i>.</p> <p>Soil type was brown sand with loam in places. Limestone was recorded at one of the sites within this community. Vegetation condition ranged from 'Good' to 'Very Good' primarily as a result of the presence of understory weeds, lacking native understory species in parts and the occasional presence of planted Eucalypts.</p> <p>Area: 6.50 ha Sites: three relevés (27, 28, 45) Species richness: 22 native and 12 weed species</p>	
EgXpTd	<p><i>Eucalyptus gomphocephala</i>, <i>Agonis flexuosa</i> and <i>Banksia attenuata</i> tall open forest over <i>Xanthorrhoea preissii</i>, <i>Macrozamia riedlei</i> and <i>Hibbertia cuneiformis</i> mid to tall shrubland over *<i>Trachyandra divaricata</i>, *<i>Solanum nigrum</i> and *<i>Geranium molle</i> low isolated forbs.</p> <p>Soils comprised sand with loam and limestone was present at one site. Vegetation condition was mapped as 'Very Good'. Condition was affected by the presence of understory weeds.</p> <p>Area: 26.44 ha Sites: two relevés (15, 22), one opportunistic (20) Species richness: 12 native and six weed species</p>	

Community	Vegetation description	Photograph(s)
Heath and Shrubland communities		
MsTd	<p>Mid to tall heathland to closed heathland of <i>Melaleuca systema</i>, <i>Hibbertia cuneiformis</i> and <i>Templetonia retusa</i> over <i>*Trachyandra divaricata</i>, <i>*Hypochaeris glabra</i> and <i>*Arctotheca calendula</i> low forbland.</p> <p>Sandy loam soils with limestone outcrops. Vegetation condition ranged from 'Good' to 'Excellent', primarily affected by the presence of common weeds and the Declared Pest <i>*Gomphocarpus fruticosus</i>. In the southern portion of the Survey Area the vegetation condition reflects an altered structure resulting from historical linear row clearing. This community contains isolated pockets of mallee trees including <i>Agonis flexuosa</i>, <i>Hakea prostrata</i>, <i>Eucalyptus argutifolia</i> (Threatened), <i>Eucalyptus foecunda</i>, <i>Eucalyptus petrensis</i>, <i>Eucalyptus decipiens</i> and <i>Eucalyptus platypus</i> with occasional <i>Nuytsia floribunda</i>.</p> <p>Area: 202.47 ha Sites: 14 relevés (5, 6, 7, 17, 19, 29, 41, 42, 56, 57, 58, 59, 60, 61), two opportunistic (42b, 63) Species richness: 54 native and 15 weed species Significance: Likely to represent State-listed TEC FCT26a</p>	

Community	Vegetation description	Photograph(s)
ArMsTd	<p><i>Acacia rostellifera</i>, <i>Spyridium globulosum</i> and <i>Clematis linearifolia</i> tall shrubland over <i>Melaleuca systema</i>, <i>Phyllanthus calycinus</i> and <i>Acanthocarpus preissii</i> mid heathland to open heathland over low sparse to closed forbland of <i>*Trachyandra divaricata</i>, <i>*Solanum nigrum</i> and <i>*Geranium molle</i>.</p> <p>Emergent <i>Agonis flexuosa</i> and <i>Eucalyptus platypus</i> in places as well as areas of planted Eucalypts.</p> <p>Soils of this vegetation community were cream to brown sands. Condition ranged from 'Very Good' to 'Excellent'. Areas of lower condition were associated with understorey weeds.</p> <p>Area: 263.51 ha Sites: 13 relevés (sites 31, 32, 43, 54, 34, 35, 48, 49, 50, 52, 53, 46, 47), one opportunistic (site 51) Species richness: 50 native and eight weed species Significance: Potential for portions of this community located on Cottesloe or Quindalup complexes to represent Priority 3 PECs SCP29a and SCP29b, respectively</p>	
AfSgTd	<p>Isolated low trees of <i>Agonis flexuosa</i> over mid to tall shrubland of <i>Spyridium globulosum</i>, <i>Alyxia buxifolia</i> and <i>Acanthocarpus preissii</i> over low sparse forbland of <i>*Trachyandra divaricata</i> and other common annual weeds.</p> <p>Soils underlying this vegetation community are sands and limestone was evident at one site. Vegetation condition was rated as 'Excellent' with relatively minor weed incursion evident.</p> <p>Area: 17.68 ha Sites: two relevés (sites 36, 37) Species richness: 26 native and five weed species</p>	

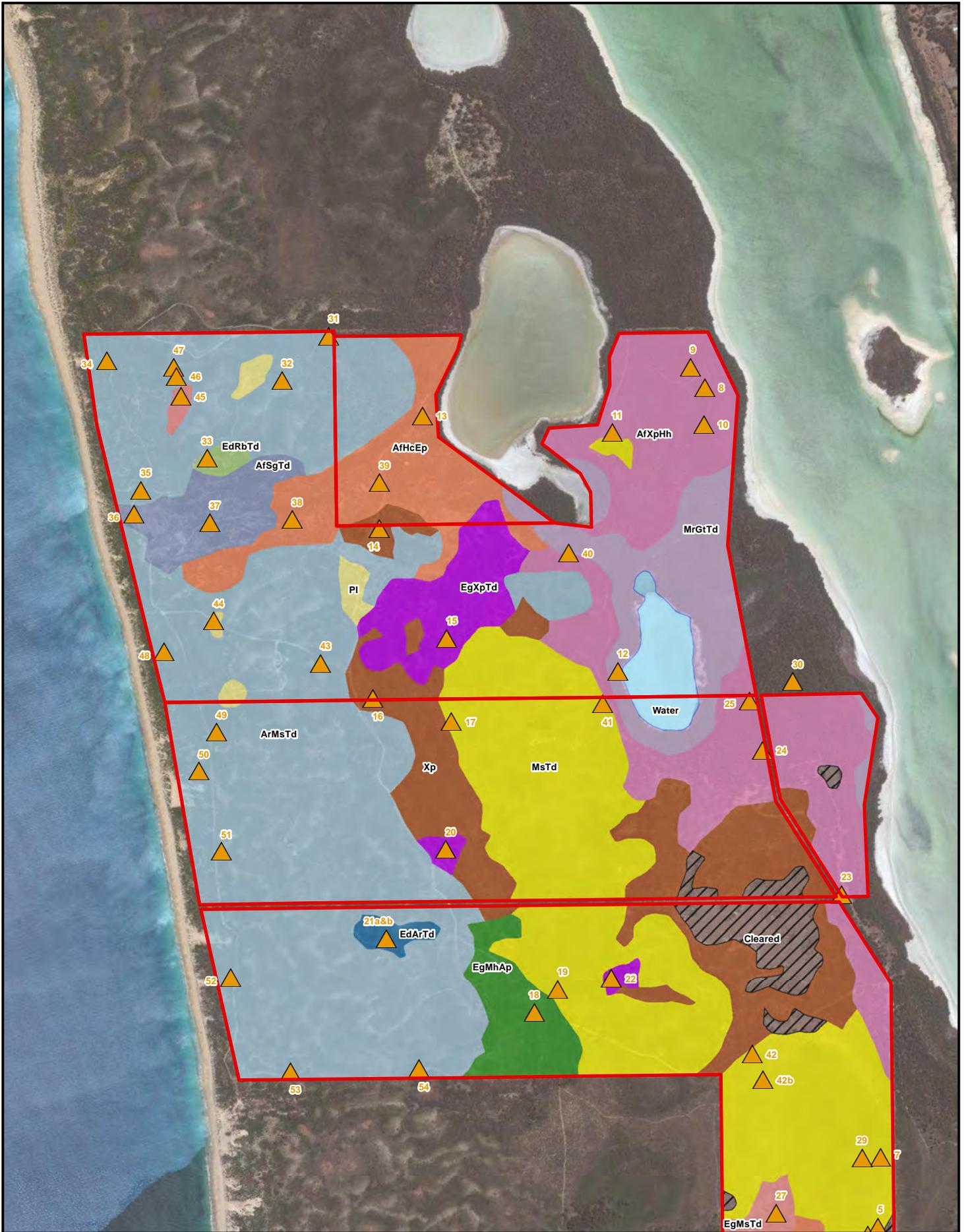
Wetland communities	
MrGtTd	<p><i>Melaleuca raphiophylla</i> and <i>Melaleuca cuticularis</i> low closed forest over <i>Gahnia trifida</i>, <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Lepyrodia drummondiana</i> mid to tall sedgeland over <i>*Trachyandra divaricata</i>, <i>*Geranium molle</i> and <i>*Lysimachia arvensis</i> low isolated forbs.</p> <p>This community captures three distinct zones of riparian vegetation associated with the wetland in the Survey Area. Adjacent to the open water the vegetation is characterised by <i>Melaleuca cuticularis</i> low closed forest over <i>?Threlkeldia diffusa</i>, <i>Sarcocornia blackiana</i> and <i>*Lysimachia arvensis</i> low chenopod shrubland. This community grades to the MrGtTd description as soils become less water where <i>M. cuticularis</i> is supplemented with <i>M. raphiophylla</i>. The third zone, furthest from the water becomes <i>Eucalyptus petrensis</i>, <i>Agonis flexuosa</i> and <i>Eucalyptus gomphocephala</i> mid closed forest over <i>Xanthorrhoea preissii</i>, <i>Templetonia retusa</i> and <i>Melaleuca systena</i> mid open shrubland over <i>Lepyrodia drummondiana</i> and <i>Gahnia trifida</i> tall sedgeland.</p> <p>The soils are black clay loam with some limestone present in places. Vegetation condition was rated as 'Excellent'. The condition is impacted by the presence of some weedy undergrowth and presence of the declared pest <i>*Zantedeschia aethiopica</i>.</p> <p>Area: 39.48 ha Sites: two relevés (12, 40) Species richness: 29 native and six weed species</p>
	

MrGtHg	<p><i>Melaleuca raphiophylla</i> and <i>Melaleuca teretifolia</i> low open forest with occasional <i>Melaleuca lanceolata</i> over <i>Gahnia trifida</i> tall sedgeland over *<i>Hypochaeris glabra</i>, *<i>Dittrichia graveolens</i> and *<i>Lysimachia arvensis</i> low open forbland.</p> <p>This community includes occasional emergent <i>Eucalyptus gomphocephala</i> and <i>Agonis flexuosa</i>.</p> <p>Soil clay loam. Vegetation condition ranged from 'Degraded' to 'Excellent'. Areas of 'Degraded' condition are associated with historic clearing and weed incursion including the declared pest *<i>Gomphocarpus fruticosus</i>.</p> <p>Area: 12.90 ha Sites: two relevés (26, 55) Species richness: nine native and 11 weed species Significance: Potential to represent the State-listed TEC FCT18</p>	
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EdArTd	<p>Wetland fringing vegetation comprising <i>Eucalyptus decipiens</i>, <i>Callitris preissii</i> and <i>Allocasuarina fraseriana</i> low open forest over <i>Acacia rostellifera</i>, <i>Xanthorrhoea preissii</i> and <i>Melaleuca huegelii</i> subsp. <i>huegelii</i> tall shrubland over <i>*Trachyandra divaricata</i>, <i>*Solanum nigrum</i> and <i>*Trifolium campestre</i> low open forbland.</p> <p>Waterbody is a closed rushland dominated by <i>*Typha sp.</i> and <i>Baumea juncea</i>. Some planted Eucalypts surrounding the wetland. Vegetation condition was rated as 'Good' as a result of weeds in the understorey. Soils are sand.</p> <p>Area: 3.37 ha Sites: two relevés (21a, 21b) Species richness: 17 native and four weed species</p>	
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EdRbTd	<p>Wetland fringing vegetation comprising <i>Eucalyptus decipiens</i>, <i>Callitris preissii</i> and <i>Melaleuca lanceolata</i> low open forest over <i>Rhagodia baccata</i> subsp. <i>baccata</i>, <i>Acacia rostellifera</i> and <i>Melaleuca huegelii</i> mid to tall shrubland over <i>*Trachyandra divaricata</i>, <i>*Solanum nigrum</i> and <i>*Geranium molle</i> low forbland.</p> <p>Wetland itself is a closed rushland of <i>Typha</i> sp. And <i>Baumea juncea</i> surrounded by <i>Melaleuca raphiophylla</i>, <i>Allocasuarina fraseriana</i> and Planted Eucalypts. Soil at the site is sand. Vegetation condition was rated as 'Very Good' due to the presence of weeds.</p> <p>Area: 2.11 Sites: one relevé (33) Species richness: 18 native and 3 weed species</p>	
AfDdLg	<p><i>Agonis flexuosa</i> mid woodland with emergent <i>Eucalyptus gomphocephala</i> over <i>Diplolaena dampieri</i>, <i>Alyxia buxifolia</i> and <i>Hibbertia cuneiformis</i> mid to tall open shrubland over <i>Lepidosperma gladiatum</i>, <i>*Trachyandra divaricata</i> and <i>*Geranium molle</i> tall closed sedgeland</p> <p>Area: 0.09 ha Sites: one relevé (38) Species richness: 11 native and five weed species</p>	

Modified communities		
Xp	<p><i>Xanthorrhoea preissii</i> tall shrubland over common weeds.</p> <p>Vegetation condition was rated as 'Good' due to the absence of an over storey and the presence of common weeds. Soils were sand and loam. Scattered limestone was observed in some areas.</p> <p>Area: 85.62 ha Sites: two relevés (14, 16), one opportunistic (59b) Species richness: 10 native and nine weed species</p>	
Cleared	<p>Cleared of native vegetation Area: 40.68 ha</p>	None available
PI	<p>Planted Eucalypts sometimes over sparse native and/or non-native shrubs over common annual weeds such as *<i>Trachyandra divaricata</i>.</p> <p>Area; 5.48 ha Sites: one opportunistic (44)</p>	None available
Water	<p>Water</p> <p>Area: 12.40 ha</p>	None available



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 APPROVED BY FDW
 LAST MODIFIED 19 AUG 2016

AECOM
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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 150 300 450 600
 metres

1:20,000 when printed at A4

LEGEND

Survey Area
▲ Relevés

 AfDdLg	 AfXpHh	 AfXpHhHg	 EgXpTd
 AfHcEp	 ArMsTd	 EdArTd	 MrGtHg
 AfSgTd	 EdRbTd	 EgMhAp	 MrGtTd
 AfXpHg	 EgMsTd	 MsTd	 PI
		 Water	 Xp
			 Cleared

Vegetation Community Mapping

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure 8

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

6.1.5 Condition

Vegetation condition varied from 'Excellent' to 'Completely Degraded'. A large portion of the vegetation was mapped as 'Excellent', extending over 333 ha (comprising 34 % of the Survey Area). The major contributing factors causing degradation are historical clearing, altered fire regimes and weed invasion.

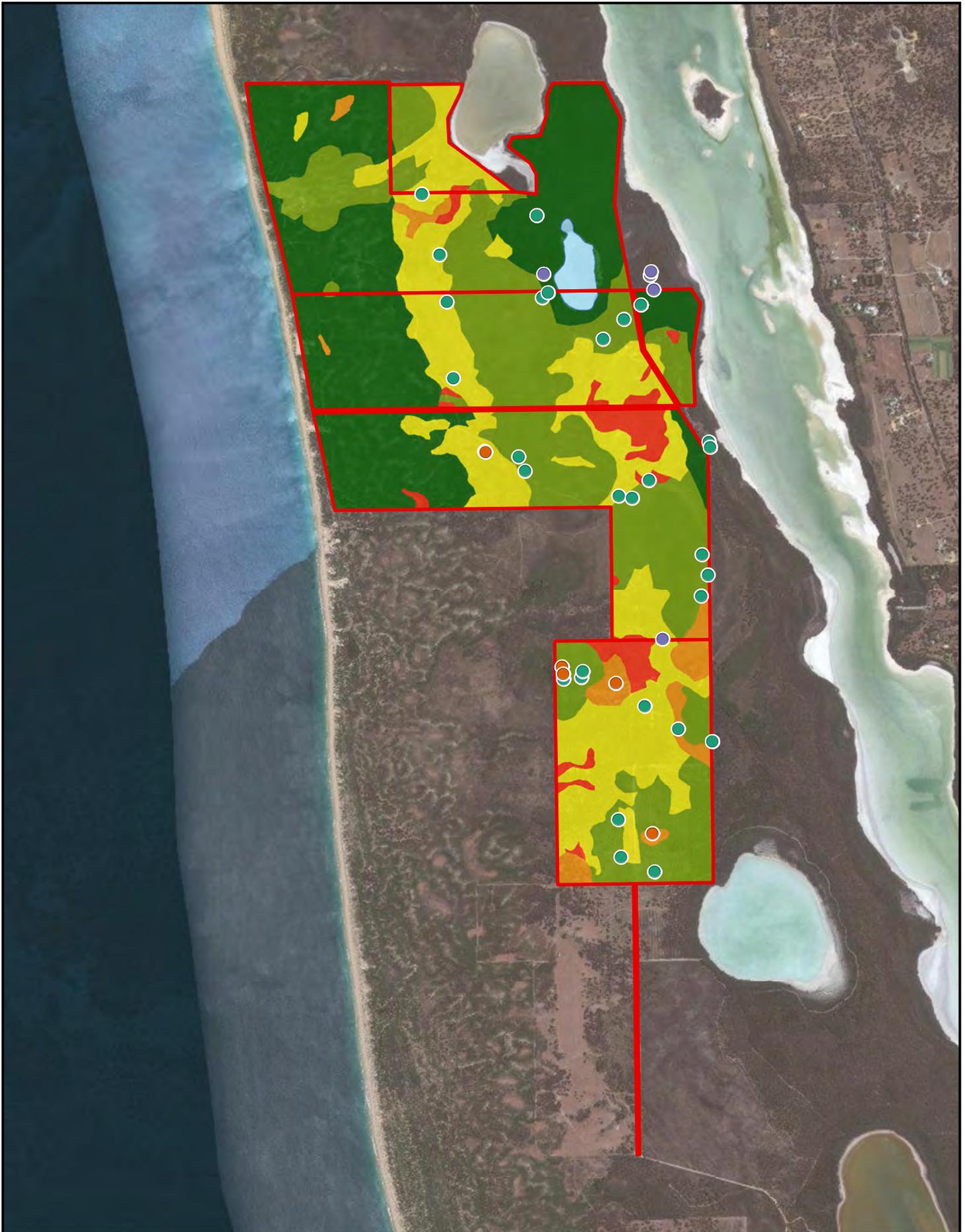
Altered fire regimes may have led to ecological change in Tuart forests within and adjacent to Yalgorup National Park (Bradshaw, 2000; Ward, 2000). Since the Yalgorup National Park was declared protected in 1968, fire frequency declined considerably as a fire exclusion zone was implemented (Longman & Keighery, 2002). Fires are essential for recruitment and persistence of obligate seeder plant species (i.e. *Banksia* species [Australian Government, 2011]).

Weed invasion, particularly invasive species that dominate and displace native vegetation put pressure on land environmental values and impact on biodiversity (Australian Government, 2011). A total of 20 weed species were recorded within 86% of relevés completed. Weeds are considered one of the major threats to the natural environment, destroying native habitats, threatening native plants and animals, and choking our natural systems including rivers and forests (Australian Government, 2016).

Vegetation condition has been mapped in Figure 9 and their relative extent shown in Table 19.

Table 19 Vegetation condition mapped within the Survey Area

Condition Rating	Area (ha)	Percentage of Survey Area (%)
Excellent	333.60	34.10
Very Good	314.87	32.19
Good	241.58	24.70
Degraded	35.13	3.59
Completely Degraded	40.63	4.15



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AECOM
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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 270 540 810 1,080
 metres

1:35,000 when printed at A4

LEGEND

Survey Area

Declared Pest Weeds Locations

- *Gomphocarpus fruticosus*
- *Solanum linnaeanum*
- *Zantedeschia aethiopica*

Condition

- Water
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded

Vegetation Condition Mapping

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure 9

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

6.2 Flora

6.2.1 Threatened and Priority flora

One EPBC Act listed species, *Eucalyptus argutifolia*, was confirmed to occur within the Survey Area at one location. At the time of the field survey, no spatial data for *Eucalyptus argutifolia* as mapped by Weston (2003) and ENV (2009) was available, therefore only the DPaW location was visited.

The Priority 3 species *Stylidium maritimum* was confirmed to occur on the sand dunes that extend north to south along the western edge of the Survey Area. No flowers were present at the time of the survey, which affected detection rates. Their distinctive leaves and colour assisted in the accurate identification in the field in the vicinity of ENV (2009) records.

6.2.2 Diversity

A total of 131 species from 85 genera and 48 families were recorded. The total includes 110 (84%) locally native species and 20 (16%) introduced (exotic) or naturalised weed species. A number of planted species were observed however no effort was spent to identify these to species level.

Families with the highest representation are Myrtaceae (17 native, one planted), Fabaceae (14 taxa; 11 native and three introduced) and Proteaceae (11 taxa; nine native and two introduced). The full list of vascular flora species recorded and representative communities in which they occur in are presented in **Appendix E**. Qualitative data recorded from individual quadrats is presented in **Appendix F**.

Diversity for the 2016 survey was lower than previously recorded, with ENV (2009) recording 179 taxa from 53 families and Weston (2003) recording 202 taxa across 65 families. This could be representative of the survey timing and the disturbance of weed invasion.

The ENV (2009) species list was merged with the current species list to provide one comprehensive overview of floristic diversity within the Survey Area (**Appendix G**). Following the merge of species lists, a total of 223 species from 138 genera and 61 families have been recorded. The total includes 161 (72%) locally native species. Of note is the number of Poaceae (grass) species collected previously (22 species) compared to the 2016 survey (two species).



Plate 1 Conservation significant species from left to right: EPBC Act-listed Threatened *Eucalyptus argutifolia*; Priority 3 *Styliidium maritimum*

6.2.3 Weeds

A total of 21 weeds were recorded during the field survey. This included three species listed as Declared Pests under the BAM Act. Details of the three Declared Pests are provided in Table 20 and Plate 2.

Weeds were observed throughout the entire Survey Area. In particular, the extensive spread of *Trachyandra divaricata* and the Declared Pest *Gomphocarpus fruticosus* led to a lower rating of vegetation community condition. The most common weeds recorded within sample sites were *Trachyandra divaricata* (48 sites), *Lysimachia arvensis* (35 sites) and *Solanum nigrum* and *Hypochaeris glabra* (33 sites each). The impacts of weeds have been previously discussed in Section 6.1.5. Examples of weed infestations observed are shown in Plate 3.

A complete list of weeds, their common names, their WA weed strategy rating (CALM, 1999) and the Swan Priority rating (Bettink & Keighery, 2008) is provided in **Appendix H**.



Plate 2 Declared Pests from left to right: *Gomphocarpus fruticosus*, *Solanum linnaeanum* and *Zantedeschia aethiopica*

Table 20 Declared Pests

Taxon	Details	Reproduction and Dispersal ¹	BAM Act Category
<i>Gomphocarpus fruticosus</i> Narrow Leaf Cotton Bush	Widely dispersed throughout the area with only the sand dunes excluded. 30 locations recorded, representing 1,622 individuals. This is a conservative estimate as not all individuals were counted or recorded due to the extent of the infestation.	From seed and suckers from lateral roots closest to the soil surface. Seeds are commonly spread by wind and water.	Declared Pest – C3, s22(2) across entire State.
<i>Solanum linnaeanum</i> Apple of Sodom	Four populations recorded, representing 22 adult plants and two juveniles.	From seed. Seeds do not disperse far from parent plants but fruit may be dragged when prickly fruit get attached to animals.	Declared Pest – C3, s22(2) in Shire of Waroona and Shire of Mandurah
<i>Zantedeschia aethiopica</i> Arum Lily	Recorded at five locations representing 35 juvenile individuals. No flowers present at the time of the survey.	Reproduces from seed and vegetatively via rhizomes and tubers. Seeds dispersed via water movements, birds and other animals. Local spread occurs from rhizomes.	Declared Pest – C3, s22(2) across entire State

1. Details derived from Identic (2016).



Plate 3 Weed invasion from top to bottom left to right: *Trachyandra divaricata invasion in cleared area; typical weed understorey of Agonis flexuosa woodlands; *Solanum nigrum juvenile with *Lysimachia arvensis.

6.3 Fauna

6.3.1 Fauna species

Forty-two fauna species were recorded during the field survey. This comprised 31 bird, eight mammal, one reptile and two amphibian species. The full species list is presented in **Appendix I**. Of the 42 fauna species, 11 species were of conservation significance. These 11 conservation significant fauna species comprised nine bird and two mammal species. These are listed and discussed in Table 21.

6.3.1.1 Introduced fauna

Six introduced fauna species were recorded at Lake Clifton. These comprised:

- Dog (*Canis lupis familiaris*)
- European Wild Rabbit (*Oryctolagus cuniculus*) Declared Pest - s22(2) (C3 Prohibited)
- House Mouse (*Mus musculus*)
- Red Fox (*Vulpes vulpes*) Declared Pest - s22(2) (C3 Exempt)
- Laughing Kookaburra (*Dacelo novaeguineae*)
- Laughing Turtle-dove (*Streptopelia senegalensis*).

The European Wild Rabbit and the Red Fox are both listed as Declared Pests under the BAM Act. Most species were recorded intermittently during the field survey, identified either by sight, call, scats, den or tracks.

6.3.2 Fauna habitat

Five main fauna habitats (including Cleared Areas) have been defined and mapped within the Survey Area (Table 22 and Figure 10). The delineation of fauna habitats considered the fauna habitat field assessments and the vegetation mapping.

The most common fauna habitat was the mid to tall shrubland / heathland at approximately 57% of the Survey Area. This is a varied habitat that would generally support many of the common species of the area, as recorded during the field survey. It would also be utilised by many of the conservation significant fauna species recorded at Lake Clifton such as Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Quenda (*Isoodon obesulus fusciventer*), Nankeen Kestrel (*Falco cenchroides*) and Magpie-lark (*Grallina cyanoleuca*).

The second most common habitat was the *Agonis flexuosa* and Tuart forest. This habitat covered approximately 30% of the Lake Clifton Survey Area. This habitat was also varied but generally contained an open Tuart overstorey over an open to closed *Agonis flexuosa* layer over an open shrub layer. The conservation significant fauna species that would potentially utilise this habitat include Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Quenda (*Isoodon obesulus fusciventer*), Western Ring-tail Possum (*Pseudocheirus occidentalis*), Whistling Kite (*Haliastur sphenurus*) and Southern Boobook (*Ninox novaeseelandiae*).

Table 21 Conservation Significant Fauna Recorded during the Field Survey

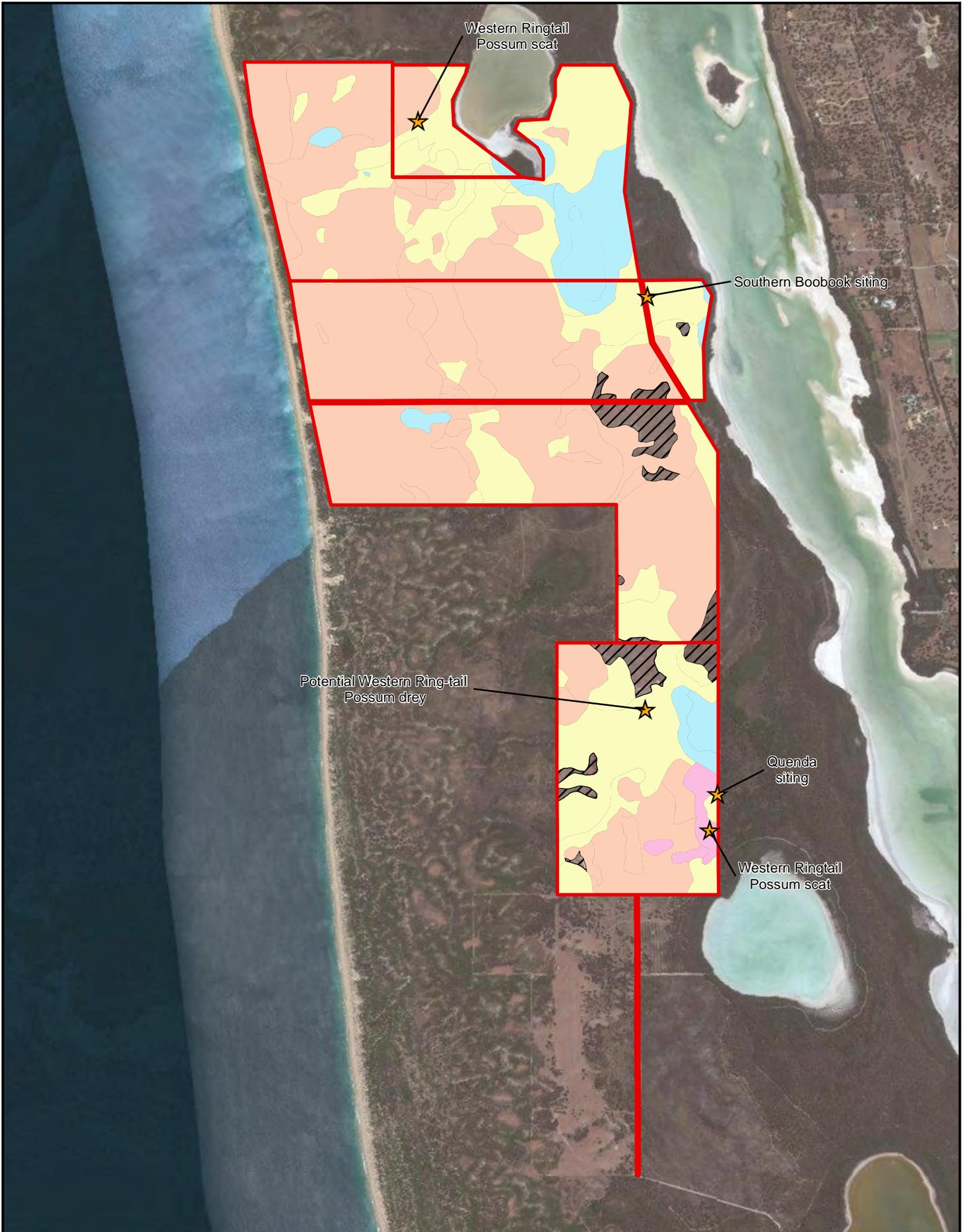
Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
Birds				
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	Marine	-	The Fan-tailed Cuckoo is a slender cuckoo with the adult having a yellow eye ring, dark slate-grey back and wings, with a boldly barred black and white under tail. Younger birds are duller and browner in colour. This species is found in all kinds of well wooded habitats from Karri forests to Acacia thickets (Johnstone and Storr, 1998), and can be found in eastern Australia, southern south Australia, Tasmania and the southwest of Western Australia (Pizzey & Knight, 2007). This bird was heard in the woodland habitats of the Project area.
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	E	EN	Refer to Sections 6.3.3.
<i>Circus approximans</i>	Swamp Harrier	Marine	-	The Swamp Harrier is a large slim-bodied raptor with long slender legs and a long, round-tipped tail, rounded at the tip. It is mainly dark brown above and the white rump is prominent. It has an owl-like face mask. The Swamp Harrier feeds mainly on birds and rats (Johnstone and Storr, 1998). The Swamp Harrier inhabits swamps and wetlands, tall grasslands, grain crops, coasts, islands, heathlands, saltmarshes, bracken and bore drains (Pizzey and Knight, 2010). At Lake Clifton this species was recorded flying over the unnamed wetland within the Project area. The Swamp Harrier is widespread in Australasia and the South Pacific.
<i>Falco cenchroides</i>	Nankeen Kestrel	Marine	-	The Nankeen Kestrel is a slender falcon and a relatively small raptor with the upper parts mostly rufous and some dark streaking. The wings are tipped with black and the underparts are pale buff, streaked with black. The under tail is finely barred with black, with a broader black band towards the tip. The Nankeen Kestrel's diet is varied, feeding mainly feeds on small mammals, reptiles, small birds and a variety of insects. Once prey is spotted, the bird drops nearer to the ground until it is close enough to pounce. Preferred habitats of the Nankeen Kestrel are lightly wooded areas and open agricultural areas. A pair of Nankeen Kestrels was observed several times during the survey in the cleared area of the Project area. Nankeen Kestrels are found in most areas of Australia.

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
<i>Grallina cyanoleuca</i>	Magpie-lark	Marine	-	The Magpie-lark is a distinctively marked black and white bird with a thin bill and pale irises. The Magpie-lark is predominantly ground-dwelling, where it forages for invertebrates. It utilises most habitats and will be found anywhere there are trees and mud for nest building (Pizzey and Knight, 2010). The Magpie-lark is likely to be found in most of the fauna habitats at Lake Clifton and was recorded multiple times. Magpie-larks are confined to Australasia and found throughout Australia.
<i>Haliastur sphenurus</i>	Whistling Kite	Marine	-	The Whistling Kite is a medium-sized raptor with an almost shaggy appearance. It has a light brown head and underparts, and dark sandy-brown wings with paler undersides. Whistling Kites have been observed feeding on carrion and small birds (Johnstone and Storr, 1998). The Whistling Kite is found in a variety of habitats, usually near water, including woodlands, open country and wetlands (Pizzey and Knight, 2010). It prefers tall trees for nesting. At Lake Clifton, the Whistling Kite was observed perching on a large stag above a Wedge-tailed Eagles nest, and is likely to utilise most of the fauna habitats present. The Whistling Kite is widespread over mainland Australia.
<i>Hirundo neoxena</i>	Welcome Swallow	Marine	-	The Welcome Swallow is blue-black above and light grey on the breast and belly, with rust coloured markings on the forehead, throat and upper breast. It has a long forked tail, with a row of white spots on the individual feathers. The Welcome Swallow feeds on a wide variety of insects, which it acrobatically catches in flight. Welcome Swallows congregate in large flocks when food is abundant. Welcome Swallows frequent a wide variety of habitats with the exception of heavily forested and drier inland areas. Welcome Swallows were observed foraging over the unnamed lake to the northeast of Lake Clifton. Welcome Swallows are widespread in Australia but are scarce in the arid zone (Pizzey and Knight, 2010).

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
<i>Ninox novaeseelandiae</i>	Southern Boobook	Marine	-	The Southern Boobook is the smallest and most common owl in Australia. It has dark brown plumage above and rufous-brown below, heavily streaked and spotted with white. The facial disc is brown and its eyes are large and yellowish. Feeding generally occurs at dusk and during the night when the owl flies from its perch to capture flying insects (Pizzey and Knight, 2010) and geckos and small mammals (Johnstone and Storr, 1998). The Southern Boobook is found in a variety of habitats from dense forest to open desert. This owl was recorded twice in the northern woodlands at Lake Clifton, where it was observed flying out of hollows in mature Tuart trees. It may potentially utilise the majority of the fauna habitats. Southern Boobooks are found throughout Australia.
<i>Petrochelidon nigricans</i>	Tree Martin	Marine	-	The Tree Martin is a small dark swallow which is stubbier than a Welcome Swallow, with dull white rump and short tail (Pizzey and Knight, 2010). Tree Martins eat insects which they mainly catch in flight. Tree Martins are found in the air above a range of habitats including open country with large trees, watercourses, rivers and wetlands (Pizzey and Knight, 2010). This bird was observed near the unnamed lake to the northeast of the Project area, and is likely to fly over the majority of the fauna habitats at Lake Clifton. The Tree Martin is widespread throughout Australia.

Name	Common Name	Conservation Status		Ecology
		Commonwealth	State	
Mammals				
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	V	EN	The Western Ringtail Possum is a medium sized nocturnal marsupial, weighing up to 1.3 kg and with a body length of approximately 40 cm. It has dark brown fur above with cream to grey fur underneath. This species strong prehensile tail grows to 41 cm long and ends in a white tip (Van Dyck & Strahan, 2008). The possum constructs dreys from fine to medium-sized material collected from overstorey and understorey vegetation. Dreys vary from flimsy or platform-like constructions providing minimal shelter, to elaborate constructions providing substantial protection (de Tores & Rosier, 1997). The Western Ringtail Possum has a patchy distribution in predominantly two areas: near Bunbury to Leeuwin-Naturaliste National Park (with a small translocated subpopulation near Dawesville); and near Albany (Woinarski <i>et al.</i> , 2014). The subpopulation of the Western Ringtail Possum on the SCP are associated with stands of myrtaceous trees (usually Peppermint Tree [<i>Agonis flexuosa</i>]) growing near swamps, water courses or floodplains (DoTE, 2016). The Western Ringtail Possum was indirectly recorded potentially three times, twice through scats collected (33,081.901 172,762.009; 35,048.152 167,945.240) and once through locating a potential drey. Refer to Plate 4 and Figure 10. The Western Ringtail Possum will potentially utilise the woodland habitats that contain <i>Agonis flexuosa</i> .
<i>Isoodon obesulus fusciventer</i>	Quenda, Southern Brown Bandicoot	-	P4	The Quenda has coarse dark grey or yellow brown fur above and creamy-white below, with a short, tapered, dark brown tail. The ears are short and rounded, and the tail is lightly furred. The Quenda is omnivorous, feeding on invertebrates, underground fungi, subterranean plant material, and occasionally on small vertebrates. The Quenda inhabits scrubby, often swampy, vegetation with dense cover up to one metre high. The Quenda was directly sited in the woodland habitat, and is also likely to utilise the heathland and wetland habitats present. The Quenda is widely distributed near the southwest coast from Guilderton north of Perth to east of Esperance. Quenda have a patchy distribution through the Jarrah and Karri forest, the SCP, and inland as far as Hyden (DPaW, 2012).

Note: Species listed as Marine under the EPBC Act are only considered conservation significant when in a Commonwealth marine reserve.

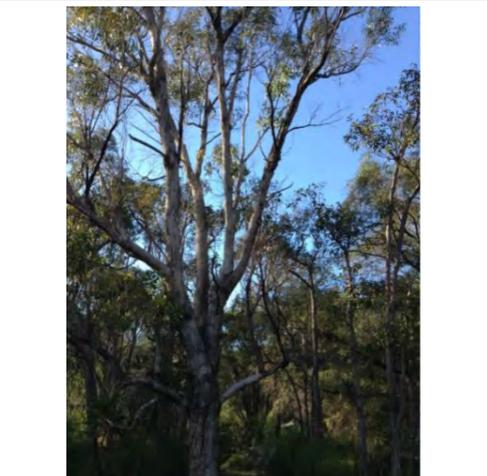
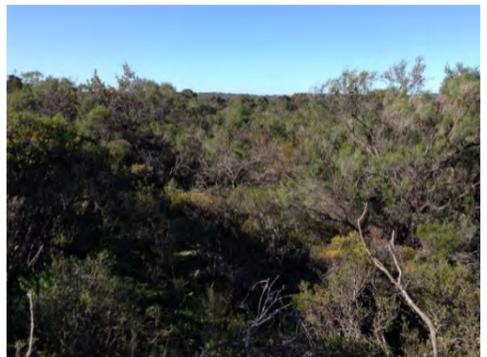


<p>PROJECT ID 60100953 CREATED BY DGF APPROVED BY JL LAST MODIFIED 19 AUG 2016</p> <p>AECOM www.aecom.com</p> <p>DATUM GDA 1994, PROJECTION MGA ZONE 50</p> <p>0 260 520 780 1,040 metres</p> <p>1:33,809 when printed at A4</p>	<p>LEGEND</p> <p> Survey Area</p> <p>★ Fauna Siting</p> <p>Fauna Habitat</p> <ul style="list-style-type: none"> <i>Agonis flexuosa</i> and Jarrah woodland <i>Agonis flexuosa</i> and Tuart forest Cleared Riparian vegetation, constructed ponds and wetlands Shrubland heathland 	<p>Fauna Habitat and Opportunistic Fauna Records</p> <p>MAIN ROADS</p> <p>LAKE CLIFTON BIOLOGICAL ASSESSMENT</p> <p style="text-align: right;">Figure 10</p> <p style="font-size: small;">Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community</p>
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Plate 4 Potential Ring-tailed Possum drey

Table 22 Fauna habitats of the Survey Area

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos	
<p><i>Agonis flexuosa</i> and Tuart forest</p>	<p>This habitat was varied in density of Tuarts and understory, but generally contained an open Tuart overstorey over an open to closed <i>Agonis flexuosa</i> layer over an open shrub layer. Habitat features included:</p> <ul style="list-style-type: none"> large mature trees were occasionally present, although there were pockets of significantly higher density large, mature trees hollows within Tuarts were rare to occasionally present fallen logs of varied sizes were generally common bare ground was generally rare, as were soil cracks course and fine litter were generally common stone presence was varied depending on size, boulders were absent a cryptogamic crust was generally rare and vines were occasionally present dense shrubs were absent to occasionally present proteaceous plant species were generally absent to occasionally present no water bodies were present. 	<p>Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>), Quenda (<i>Isodon obesulus fusciventer</i>), Western Ring-tail Possum (<i>Pseudocheirus occidentalis</i>), Whistling Kite (<i>Haliastur sphenurus</i>), Southern Boobook (<i>Ninox novaeseelandiae</i>), Rainbow Bee-eater (<i>Merops ornatus</i>) and Fan-tailed Cuckoo (<i>Cacomantis flabelliformis</i>).</p>	<p>286.42</p>	<p>29.28</p>		
<p><i>Agonis flexuosa</i> and Jarrah woodland</p>	<p>This habitat generally contained an open Jarrah overstorey over an open to closed <i>Agonis flexuosa</i> layer, over an open shrub / scrub layer. Habitat features included:</p> <ul style="list-style-type: none"> large mature trees were rare to occasionally present hollows were rare to occasionally present in mature Jarrah trees fallen logs of varied sizes were common bare ground was common, as were soil cracks course and fine litter were abundant stone and boulder presence was rare a cryptogamic crust was generally absent and the presence of vines was occasional dense shrubs were absent to occasionally present proteaceous plant species were generally rare no water bodies were present. 	<p>Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>), Quenda (<i>Isodon obesulus fusciventer</i>), Western Ring-tail Possum (<i>Pseudocheirus occidentalis</i>), Whistling Kite (<i>Haliastur sphenurus</i>), Southern Boobook (<i>Ninox novaeseelandiae</i>), Rainbow Bee-eater (<i>Merops ornatus</i>) and Fan-tailed Cuckoo (<i>Cacomantis flabelliformis</i>).</p>	<p>11.80</p>	<p>1.21</p>		
<p>Mid to tall shrubland / heathland</p>	<p>This habitat was varied and generally contained an open to closed shrub / scrub layer with a moderately open groundcover layer. Habitat features included:</p> <ul style="list-style-type: none"> Large mature trees were generally absent, as were hollows fallen logs with a diameter less than 30 cm were absent to common bare ground was occasionally to commonly present, and soil cracks were absent to rare course and fine litter were rare to common stone and boulder presence was absent to occasionally present a cryptogamic crust was generally common vines were absent to occasionally present dense shrub presence was absent to common proteaceous plant species were absent to occasional no water bodies were present. 	<p>Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>), Quenda (<i>Isodon obesulus fusciventer</i>), Whistling Kite (<i>Haliastur sphenurus</i>), Rainbow Bee-eater (<i>Merops ornatus</i>), White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>), Lined Skink (<i>Lerista lineata</i>), Graceful Sunmoth (<i>Synemon gratiosa</i>), Nankeen Kestrel (<i>Falco cenchroides</i>), Magpie-lark (<i>Grallina cyanoleuca</i>), Welcome Swallow (<i>Hirundo neoxena</i>), Southern Boobook (<i>Ninox novaeseelandiae</i>) and Tree Martin (<i>Petrochelidon nigricans</i>).</p>	<p>569.18</p>	<p>58.19</p>		

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos	
Wetlands and riparian vegetation	<p>This habitat consisted of natural wetlands, constructed pond and associated riparian zones. Habitat features included:</p> <ul style="list-style-type: none"> Large mature trees were generally absent, though some emergent Tuart trees were present in the ecotone areas hollows were not present various sized fallen logs were occasionally to commonly present bare ground was common and soil cracks were rare to occasional course and fine litter were occasional present stone and boulders were either absent or common cryptogamic crust presence was occasional vines were absent to occasionally present dense shrub presence was occasionally recorded proteaceous plant species were generally absent water bodies were present. <p>Note: ENV (2009) noted several other constructed ponds which were have not been represented on Figure 9.</p>	<p>Red-necked Stint (<i>Calidris ruficollis</i>), Hooded Plover (<i>Charadrius rubricollis</i>), Red-capped Plover (<i>Charadrius ruficapillus</i>), Eastern Curlew (<i>Numenius madagascariensis</i>), Common Greenshank (<i>Tringa nebularia</i>), Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>), Quenda (<i>Isoodon obesulus fusciventer</i>), Whistling Kite (<i>Haliastur sphenurus</i>), Rainbow Bee-eater (<i>Merops ornatus</i>), White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>), Nankeen Kestrel (<i>Falco cenchroides</i>), Magpie-lark (<i>Grallina cyanoleuca</i>), Welcome Swallow (<i>Hirundo neoxena</i>), Southern Boobook (<i>Ninox novaeseelandiae</i>) and Tree Martin (<i>Petrochelidon nigricans</i>).</p>	70.35	7.19		
Cleared	Completely degraded and cleared areas.	<p>Whistling Kite (<i>Haliastur sphenurus</i>), Rainbow Bee-eater (<i>Merops ornatus</i>), Nankeen Kestrel (<i>Falco cenchroides</i>), Magpie-lark (<i>Grallina cyanoleuca</i>), Welcome Swallow (<i>Hirundo neoxena</i>), Southern Boobook (<i>Ninox novaeseelandiae</i>) and Tree Martin (<i>Petrochelidon nigricans</i>).</p>	40.46	4.16		

6.3.3 Black Cockatoos

6.3.3.1 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo were heard and / or observed five times during the field survey. They were observed either flying over Lake Clifton, foraging on *Banksia sessilis* within the Lake Clifton Survey Area, or heard in close proximity. The details of these records are presented in Table 23 and locations illustrated on Figure 11.

Table 23 Carnaby's Black Cockatoo observations

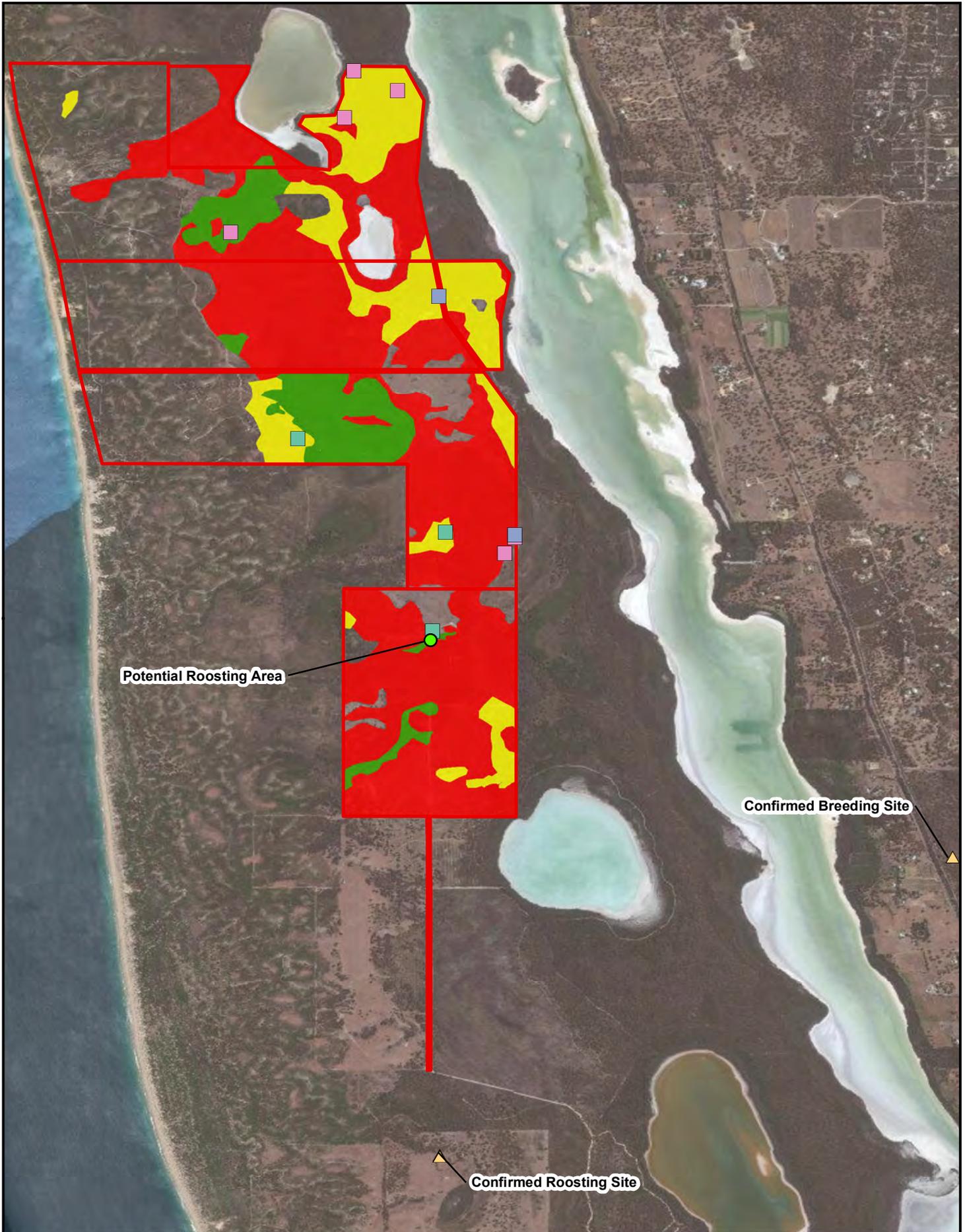
Record ID	Observation	Date	Location (m)	
Opp_13	Multiple birds heard towards the east	21 June 2016	34,578.405	168,899.646
Opp_19	Approx. 35 birds observed feeding on <i>Banksia sessilis</i> and then flying to the southeast	21 June 2016	35,122.715	169,518.519
Opp_43	Multiple birds heard towards the south	23 June 2016	33,728.387	170,338.712
Opp_50	Approx. 10 birds seen flying north	23 June 2016	34,615.686	171,412.419
Opp_55	Approx. 10 birds heard towards the east	24 June 2016	34,660.424	169,637.820

6.3.3.2 Baudin's Black Cockatoo

Baudin's Black Cockatoo was not recorded during the field survey.

6.3.3.3 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo was not recorded during the field survey or in other previous surveys.



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0 290 580 870 1,160
 metres

1:37,500 when printed at A4

LEGEND

Survey Area

- Confirmed Black Cockatoo Breeding and Roosting Sites

Carnaby's Black Cockatoo Foraging Habitat

- High (77.84 Ha)
- Valued (129.06 Ha)
- Low (424.85 Ha)

Carnaby's Black Cockatoo Sitings and Records

- Flock Heard
- Flock Observed Foraging
- Flock Seen
- Foraging Evidence

Carnaby's Black Cockatoo Foraging Habitat and Opportunistic Records

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure 11

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

6.3.4 Black Cockatoo foraging habitat quality

6.3.4.1 Carnaby's Black Cockatoo

Lake Clifton contains a significant amount of mature Tuart trees. It does not contain habitats dominated by proteaceous species but does contain moderate areas of Parrot Bush (*Banksia sessilis*) and *Banksia attenuata*, and large areas of non-principle foraging species such as *Xanthorrhoea preissii*. Carnaby's Black Cockatoo was observed foraging on Parrot Bush within the Survey Area on 21 June 2016 and recent evidence of Carnaby's Black Cockatoo foraging was recorded an additional five times during the field survey. Table 24 provides the details regarding these observations, locations illustrated on Figure 11.

Table 24 Potential Carnaby's Black Cockatoo foraging evidence

Record ID	Observation	Date	Location (m)		Plate
Opp_15	Recent torn <i>Banksia sessilis</i> branches	21 June 2016	35,033.239	169,481.237	Plate 5
Opp_28	Recent torn <i>Banksia sessilis</i> branches	22 June 2016	34,078.833	173,104.998	-
Opp_29	Recent torn <i>Banksia sessilis</i> branches and potentially chewed <i>Xanthorrhoea preissii</i> inflorescence	22 June 2016	34,354.716	172,955.873	-
Opp_30	Torn <i>Banksia sessilis</i> branches and potentially chewed <i>Xanthorrhoea preissii</i> inflorescence	22 June 2016	34,019.182	172,754.552	-
Opp_35	Grub foraged from <i>Banksia</i> cone	22 June 2016	33,303.378	171,889.622	Plate 6



Plate 5 Parrot Bush foraged on by Carnaby's Black Cockatoo



Plate 6 Invertebrate foraged from *Banksia* cone, most likely by Carnaby's Black Cockatoo

The Carnaby's Black Cockatoo foraging assessment determined that Lake Clifton contains approximately 632 ha of foraging habitat. This included 77.84 ha of High quality foraging habitat (Plate 7). The complete breakdown of the quality of the foraging habitat is detailed in Table 25 and illustrated on Figure 11. In general, Lake Clifton contains a significant area of Low to Valued Carnaby's Black Cockatoo foraging habitat.

Table 25 Carnaby's Black Cockatoo foraging habitat

Quality	Area (ha)
High	77.84
Quality	0
Valued	129.06
Low	424.85
Total	631.75

**Plate 7 High quality Carnaby's Black Cockatoo foraging habitat**

There is a confirmed Carnaby's Black Cockatoo breeding location within 12 km of the site and there is also a confirmed Carnaby's Black Cockatoo roosting site within 700 m of the southernmost point of the Survey Area (Figure 11). These sites provide further context as to the quality of the foraging habitat in the Survey Area, as per the foraging assessment scoring tool described in Section 4.4.3. The assessment has been included as **Appendix J**.

6.3.4.2 Forest Red-tailed Black Cockatoo

The Survey Area contains a significant number of mature Tuart trees, but does not contain Marri or significant areas of habitat containing Jarrah. No evidence of the Forest Red-tail Black Cockatoo utilising the Survey Area were observed during the field survey.

The Forest Red-tailed Black Cockatoo foraging assessment determined that the Survey Area contains approximately 11.88 ha of High quality foraging habitat (Plate 8). It also contains 202.47 ha of Low quality foraging habitat. The vegetation community MsTd contains up to 10% hakea species which are included in the list of foraging species for the Forest Red-tailed Black Cockatoo. Vegetation community MsTd contained foraging plants near a watering point and near potential breeding habitat. The lack of Marri means this habitat is Low Quality. The breakdown is detailed further in Table 25 and illustrated on Figure 12. The assessment has been included as **Appendix J**.

Table 26 Forest Red-tailed Black Cockatoo foraging habitat

Quality	Area (ha)
High	11.88
Quality	0
Valued	0
Low	202.47
Total	214.35

**Plate 8 High quality Forest Red-tailed Black Cockatoo foraging habitat**



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0 270 540 810 1,080
 metres

1:35,000 when printed at A4

LEGEND

Survey Area

Forest Red-tailed Black Foraging Habitat

High (11.88 Ha)

Low (202.56 Ha)

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Geomatics, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Forest Red-tailed Black Cockatoo Foraging Habitat

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure 12

6.3.4.3 Baudin's Black Cockatoo

As discussed, Lake Clifton contains a significant amount of mature Tuart trees, but does not contain Marri. It also does not contain habitats dominated by proteaceous species but does contain moderate areas of Parrot Bush (*Banksia sessilis*) and *Banksia attenuata*. However, Lake Clifton is also out of the known foraging area for Baudin's Black Cockatoo and this reflects in the cumulative foraging assessment scores. The Baudin's Black Cockatoo foraging assessment determined that Lake Clifton contains approximately 45 ha of Valued foraging habitat. This is illustrated on Figure 13. The assessment has been included as **Appendix J**.

6.3.5 Breeding habitat

Breeding habitat has been defined as High, Valued or Low quality breeding habitat, depending on the density of mature eucalypt trees within the associated vegetation unit. In total, Lake Clifton contains approximately 294 ha of Black Cockatoo breeding habitat, with approximately 4,000 potentially suitable breeding trees.

High quality breeding habitat generally comprised dense stands of mature Tuart trees (with DBH > 500 cm and containing potentially suitable breeding hollows). Approximately 39 ha of High quality Black Cockatoo breeding habitat was mapped, which equates to approximately 1,400 trees (Plate 9).

Valued breeding habitat was defined as habitat that contained scattered Tuarts (with a DBH > 500 cm and potentially suitable breeding hollows) at a moderate density across a vegetation unit. Approximately 116 ha of Valued breeding habitat was mapped within the Survey Area, which equates to approximately 2,000 trees (Plate 10).

Low quality breeding habitat was defined as habitat that contained scattered Tuarts (with a DBH > 500 cm and potentially suitable breeding hollows) at a low density across a vegetation unit. Approximately 139 ha of Low quality breeding habitat within the Survey Area was mapped, which equates to approximately 400 trees (Plate 11).

Table 27 provides further detail on the breeding habitat assessment and a breeding habitat map has been produced in Figure 14 and raw data is available in **Appendix K**.

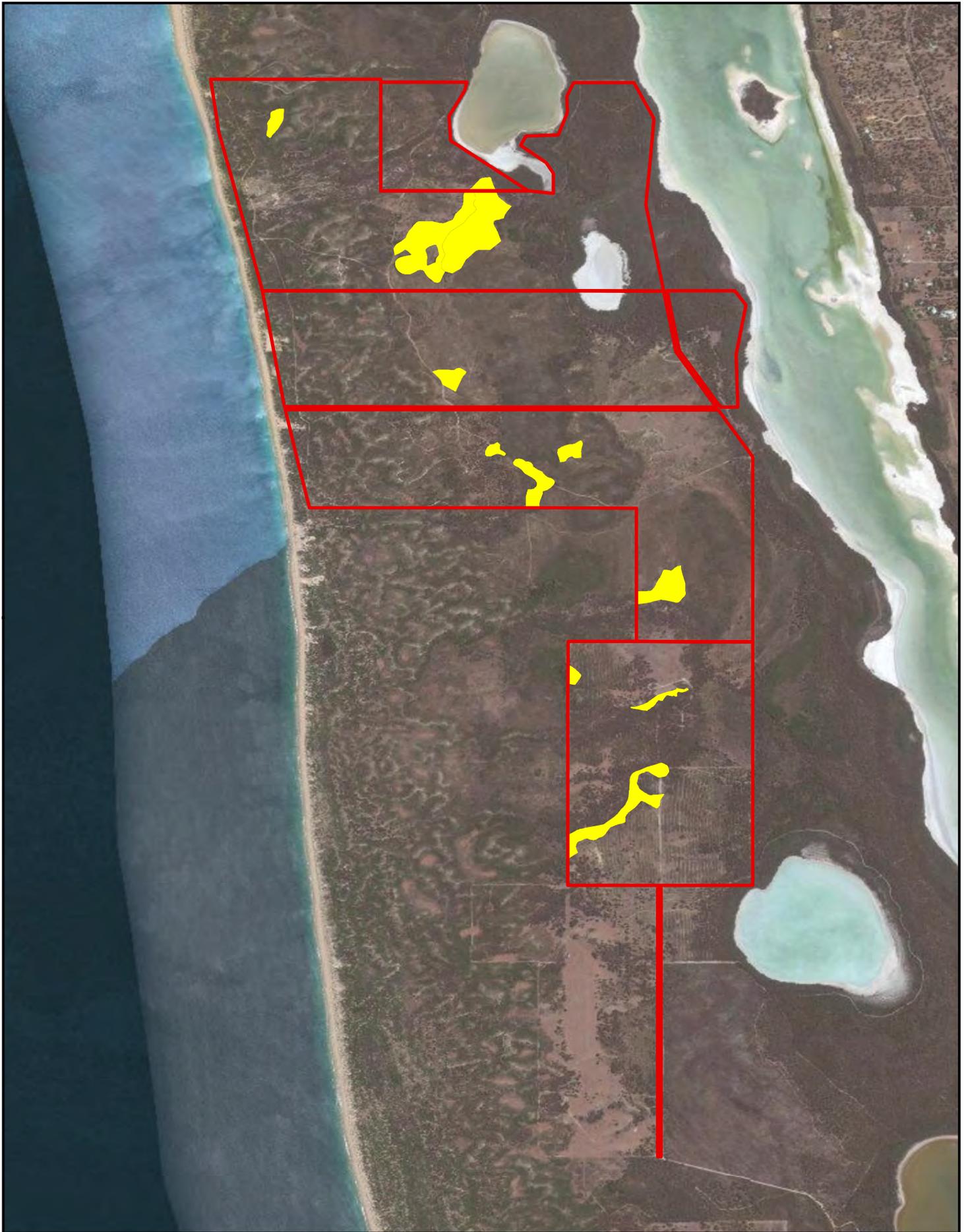
Table 27 Black Cockatoo breeding habitat assessment

Breeding Habitat	Vegetation Unit	Number of Breeding Tree Quadrats	Total Number of Trees within Quadrats	Total Area of Vegetation Units (Ha)	Approximate Number of Trees in Total Vegetation Units
High	Eg and EgXpTd	4	35	39.34	1,400
Valued	EgMsTd and AfXpHh	8	37	116.40	2,100
Low	AfXpHhHg and AfHcEp	7	7	138.63	400
Totals				294.37	3,900

Note: Eg was not defined as a vegetation community during the biological assessments. These areas were stands of mature trees within broader vegetation units that were separated out during the post-field work analysis. This was completed to better represent the Black Cockatoo breeding habitat present at Lake Clifton.



Plate 9 High quality breeding habitat for Baudin's Black Cockatoo



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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 270 540 810 1,080
 metres

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LEGEND

Survey Area

Baudin's Black Cockatoo Foraging Habitat

Valued (45.09 Ha)

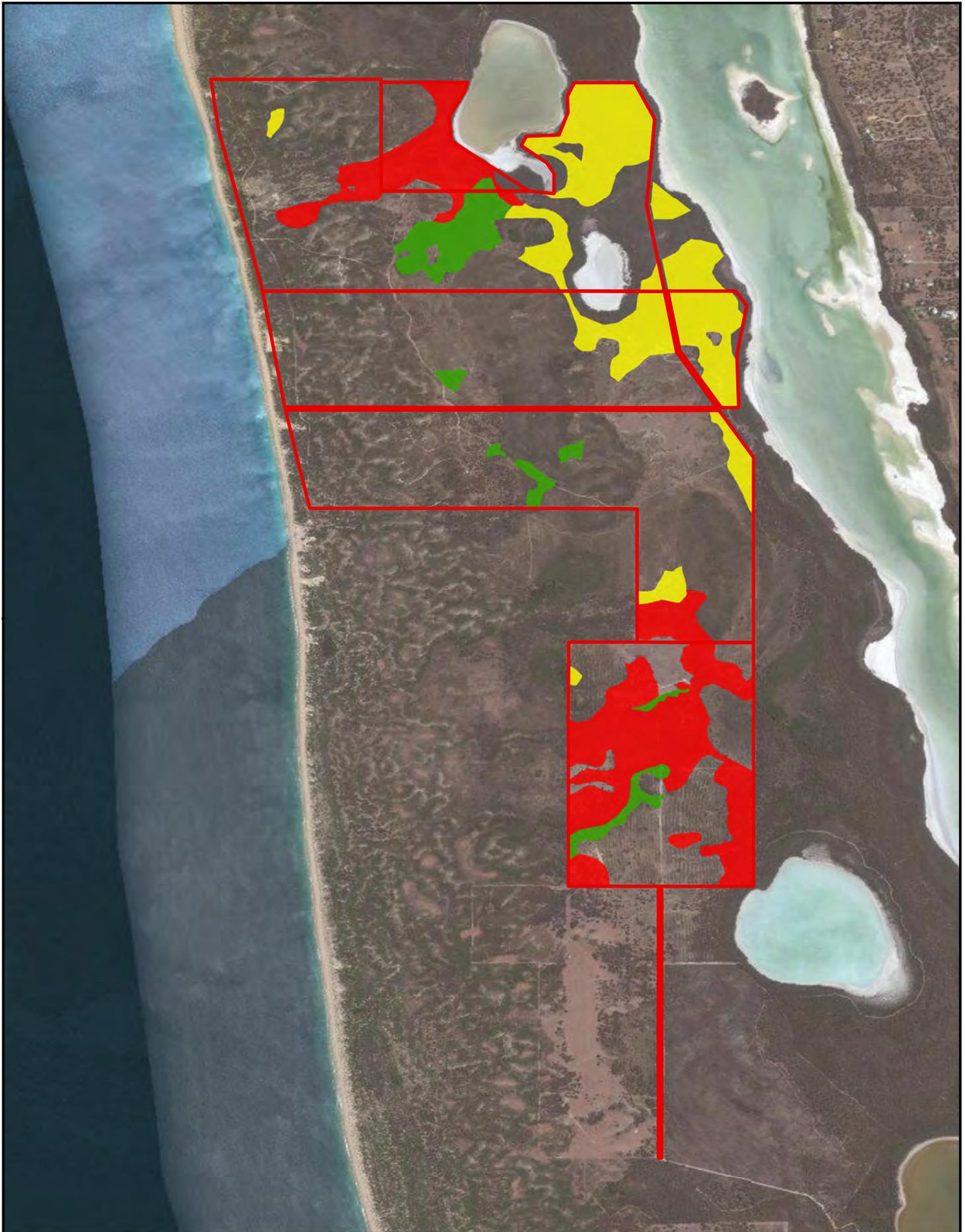
Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Baudin's Black Cockatoo Foraging Habitat

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure 13



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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 270 540 810 1,080
 metres

1:35,000 when printed at A4

LEGEND

Survey Area

Black Cockatoo Breeding Habitat

- High (38.59 Ha)
- Valued (116.39 Ha)
- Low (138.623 Ha)

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Potential Black Cockatoo Breeding Habitat

MAIN ROADS

LAKE CLIFTON BIOLOGICAL ASSESSMENT

Figure 14



Plate 10 Valued breeding habitat



Plate 11 Low quality breeding habitat

In total, 181 *Eucalyptus* trees with a DBH >500 cm were recorded during the assessment. These were recorded either in the breeding habitat assessment quadrats, or opportunistically during the field survey. Of these 181 trees, 40 trees had potential hollows. Hollows are not always easy to identify and assess accurately from the ground. These 40 trees had a total of approximately 104 hollows, with 36 of these being potentially suitable hollows for Black Cockatoos. Some evidence of bees utilising these hollows was observed. Approximately 70% of these trees had little to no fire scarring.

6.3.6 Roosting sites

Both white-tailed Black Cockatoo species roost in or near riparian environments or near other permanent water sources and typically in the tallest trees in the landscape. The Forest Red-tailed Black Cockatoo prefers the edges of forests for roosting (DSEWPaC, 2012). Evidence of roosting usually involves large amounts of bird scat beneath a large, mature tree, with a significant amount of broken branches on the ground. Searches for roosting evidence were undertaken alongside the other Black Cockatoo assessments and no confirmed Black Cockatoo roost sites were identified in the field. However, a potential roost area was identified (Figure 14), which contained large mature Tuarts that were very high in the landscape and with foraging habitat and a freshwater source located in close proximity.

6.3.7 Fauna habitat linkages

Habitat linkages are typically areas or corridors of vegetation that link (larger) areas of fauna habitat. Linkages are important as they enable fauna to move freely between remnant bushland patches, therefore increasing gene-flow between populations. A study conducted by Gilbert *et al.* (1998) found that corridors and/or linkages do maintain species richness in the fragmented landscapes.

The Lake Clifton Survey Area is bordered on the west by the coastline, on the east by Lake Clifton, and to the north and south by Yalgorup National Park. The area provides an important and ecologically valuable linkage between the north and south sections of Yalgorup National Park, ensuring a contiguous corridor of habitat throughout this area.

6.4 Wetlands

6.4.1 Riparian vegetation

Riparian vegetation grows along the banks of waterways extending to the edge of the floodplain (fringing vegetation), including emergent aquatic plants, ground cover plants, shrubs and trees (DoW, 2016). Riparian vegetation was recorded along the fringe of the CCW UFI 3,096.

The riparian vegetation condition was mapped as 'A grade: pristine to slightly disturbed' and 'A1 Pristine' as outlined in the preliminary and detailed assessment methods (Water & Rivers Commission, 1999). A vegetation relevé was completed, dividing the riparian vegetation into two zones including the partially submerged zone and the winter-wet zone.

The partially submerged zone was dominated by *Threlkeldia diffusa* groundcover on inundated clay soils with a fringe of *Melaleuca* paperbark species. The winter-wet zone includes *Gahnia trifida* sedges under a dense *Melaleuca* paperbark closed overstorey. Weeds that were present include low-impact species with cover of less than 0.1%.

A wetland assessment was undertaken in accordance with DPaW (2013) wetland assessment methodology. The preliminary wetland assessment triggered automatic consideration as a conservation wetland for the following parameters:

- Wetland supports breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, EPBC Act, migratory bird agreements (such as JAMBA, CAMBA and RoKAMBA) or the State
- Equal to or greater than 90% of the wetland supports vegetation in a good or better condition using the vegetation condition scale.

A secondary evaluation was undertaken which showed that 15 of the attributes scored High value. The outcome was that the Conservation management category is applicable based on the fauna, flora and wetland processes values, attributes and functions. The wetland assessment forms are provided in

Appendix L.

6.4.2 Boundary mapping

The Survey Area intersects four geomorphic wetlands of the SCP, all considered Conservation Category Wetlands (CCWs). Wetland details are provided below. Vegetation within these wetland boundaries is considered in 'Very Good' to 'Excellent' condition. The geomorphic wetlands boundary mapping was considered accurate for depicting wetlands and associated riparian vegetation within the Survey Area.

A total of 65.35 ha of CCW wetland are located within the Survey Area.

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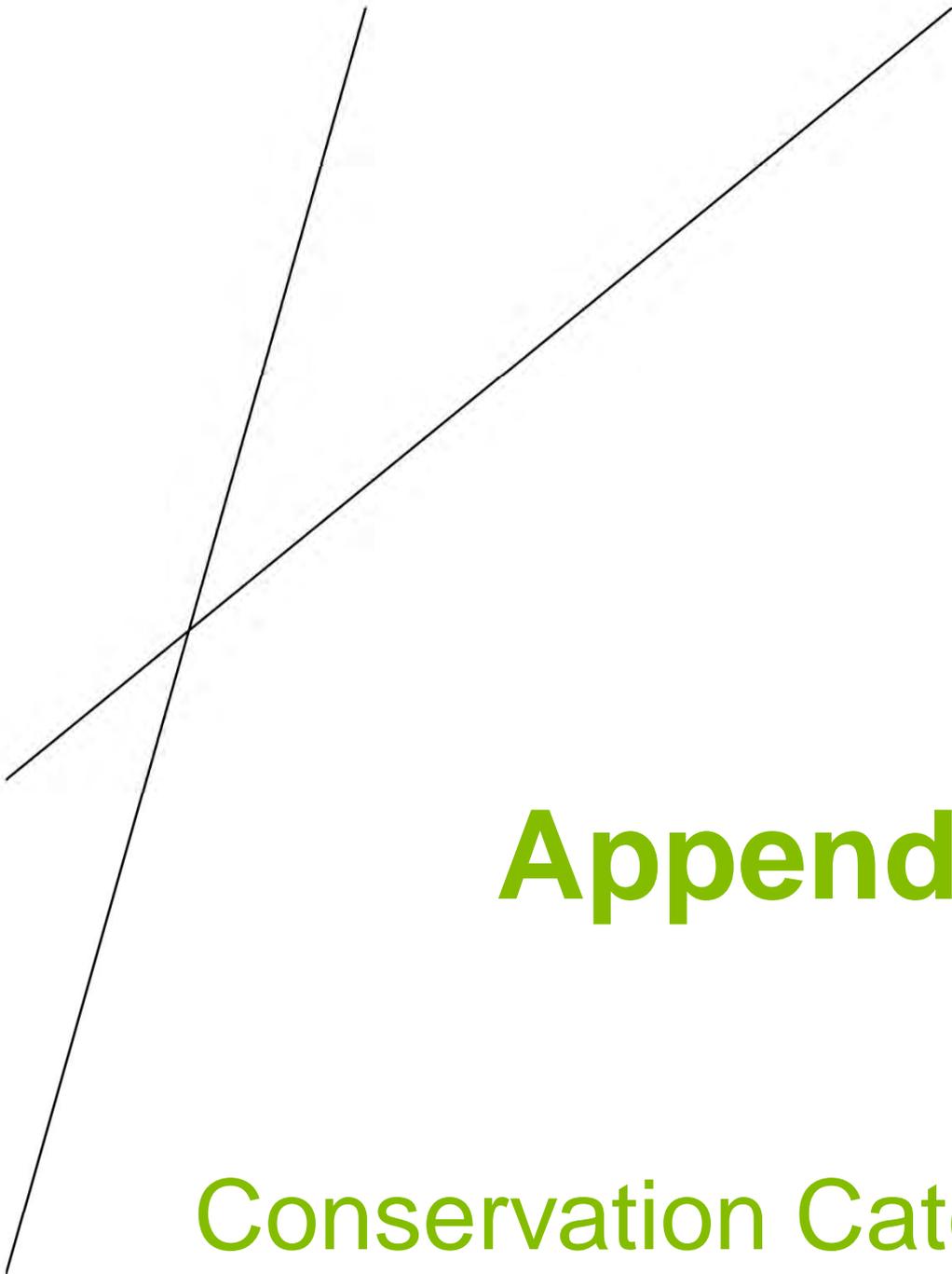
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Appendix A

Conservation Categories

Appendix A – Legislative Framework

1.0 Legislation

1.1 Commonwealth

1.1.1 Matters of National Environmental Significance

Matters of National Environmental Significance (MNES) include:

- listed threatened species and ecological communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- world Heritage properties
- national Heritage places
- Great Barrier Reef Marine Park
- a water resource, in relation to coal seam gas development and large coal mining development
- nuclear actions.

If an action is likely to have a significant impact on a MNES this action must be referred to the Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

1.1.2 Flora and fauna

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is Australia’s central piece of environmental legislation which provides for the listing of nationally Threatened native species and ecological communities, native migratory species and marine species. Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 1.

Table 1 Categories of Species Listed under Schedule 179 of the EPBC Act (Commonwealth)

Conservation	Code Category
Ex	Extinct Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent Taxa which at a particular time if, at that time: <ol style="list-style-type: none"> a. the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered b. the following subparagraphs are satisfied: <ol style="list-style-type: none"> i. the species is a species of fish

Conservation	Code Category
	ii. the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised iii. the plan of management is in force under a law of the Commonwealth or of a State or Territory iv. cessation of the plan of management would adversely affect the conservation status of the species.

1.1.3 Vegetation communities

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. The EPBC Act protects Australia’s ecological communities by providing for:

- identification and listing of ecological communities as threatened
- development of conservation advice and recovery plans for listed ecological communities
- recognition of key threatening processes
- reduction of the impact of these processes through threat abatement plans.

Categories of Commonwealth listed TECs are described in **Error! Reference source not found.**

Table 2 Categories of TECs that are listed under the EPBC Act

Conservation Code	Category
CE	Critically Endangered If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	Vulnerable If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

1.2 Western Australia

1.2.1 EPA Policy and Guidelines

In Western Australia the Environmental Protection Authority represents a independent government authority that are governed by the EP Act. The objective of the EPA is to ‘use its best endeavours to a) protect the environment; and b) to prevent, control and abate pollution and environmental harm.

The EPA have released several guidance and position statements directly relevant to biological assessments undertaken in Western Australia, described in Table 3.

Table 3 EPA Policy and guidelines relevant to biological assessments in Western Australia

Document Title	Short Description
Environmental Protection Authority (EPA) Position Statement No. 2 Environmental Protection of Native Vegetation in Western Australia: Clearing of native vegetation, with particular reference to the agricultural area	Provides guidance on clearing of native vegetation, with particular reference to the agricultural area.
EPA Guidance Statement No. 51 Guidance for the Assessment of Environmental Factors – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia’s terrestrial flora and vegetation and their ecosystems.

Document Title	Short Description
EPA Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection	Provides guidance on the requirements of biological surveys in Western Australia.
EPA Guidance Statement No. 56 Guidance for the Assessment of Environmental Factors – Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia’s terrestrial fauna.
DPaW and EPA Technical Guide for undertaking Flora and Vegetation Assessments for Environmental Impact Assessment in Western Australia	Guide for ensuring adequate data of appropriate standard are obtained to inform environmental impact assessment applicable to terrestrial vascular flora and vegetation surveys.
DPaW Methodology for the evaluation of specific wetland types on the Swan Coastal Plain, Western Australia	Provides a single methodology for evaluating wetlands on the Swan Coastal Plain.

1.2.2 Flora and fauna

Plants and animals that are considered threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the *Wildlife Conservation Act (WC Act)*. These categories are defined in Table 1. Threatened species are published as Specially Protected under the Wildlife Conservation Act 1950, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as outlined in Table 1.

Species that have not yet been adequately surveyed to warrant being listed under Schedule 1 or 2 are added to the Priority Flora or Fauna Lists under Priority 1, 2 or 3. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4 and require regular monitoring. Conservation Dependent species and ecological communities are placed in Priority 5. Categories and definitions of Priority Flora and Fauna species are provided in Table 2.

Table 4 Conservation codes for WA flora and fauna listed under the *Wildlife Conservation Act 1950* updated November 2015

Conservation Code	Category
CR	Critically endangered species Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	Endangered species Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	Vulnerable species Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	Presumed extinct species Species which have been adequately searched for and there is no reasonable doubt that the

Conservation Code	Category
	last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	<p>Migratory birds protected under an international agreement</p> <p>Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.</p>

Table 5 Conservation codes for WA flora and fauna (DPaW 2015)

Conservation Code	Category
P1	<p>Priority One – Poorly Known Species</p> <p>Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.</p>
P2	<p>Priority Two – Poorly Known Species</p> <p>Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.</p>
P3	<p>Priority Three – Poorly Known Species</p> <p>Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.</p>
P4	<p>Priority Four – Rare, Near Threatened and other species in need of monitoring</p> <ol style="list-style-type: none"> a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	<p>Priority Five: Conservation Dependent species</p> <p>Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.</p>

1.2.3 Vegetation communities

State listed TECs are not protected under any legislation, rather they are endorsed by the Environment Minister. Categories of TECs are defined in Table 6. Priority Ecological Communities are endorsed by the Environment Minister as having insufficient information available to be considered a TEC, or which are rare but not currently threatened. Categories are described in Table 7.

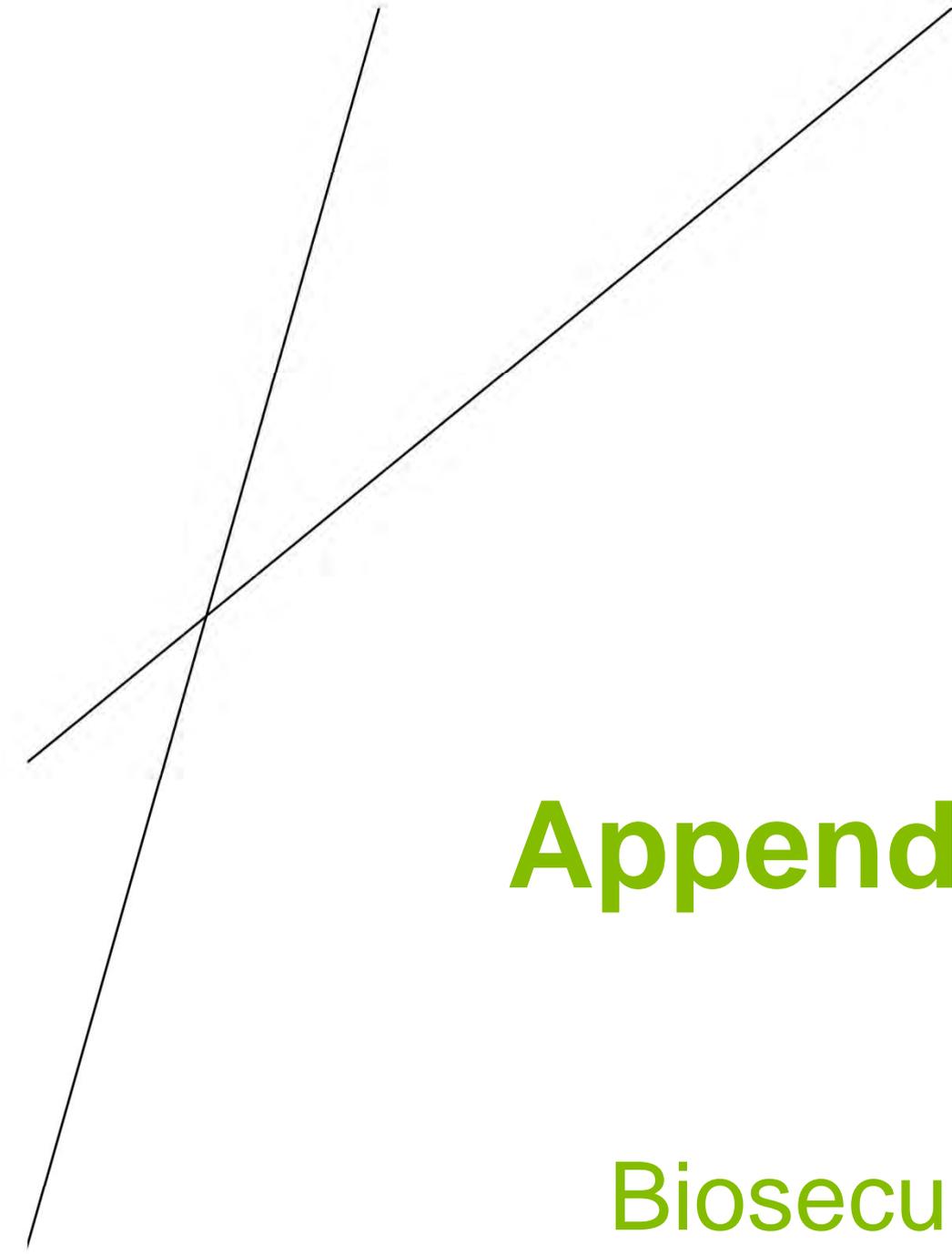
Table 6 Conservation codes for state-listed Threatened Ecological Communities

Conservation Code	Category
PD	<p>Presumed Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An Ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B) All occurrences recorded within the last 50 years have since been destroyed</p>
CR	<p>Critically Endangered An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).</p>

Conservation Code	Category
EN	<p>Endangered An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p> <p>An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C).</p> <p>A) The geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and either or both of the following apply (i or ii):</p> <ol style="list-style-type: none"> i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 20 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 20 years) the community is unlikely to be capable of being substantially rehabilitated. <p>B) Current distribution is limited, and one or more of the following apply (i, ii or iii):</p> <ol style="list-style-type: none"> i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 20 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. <p>The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 20 years).</p>
VU	<p>Vulnerable An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatened processes continue or begin operating throughout its range.</p> <p>An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C).</p> <p>A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.</p> <p>B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.</p> <p>C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium or long term future because of existing or impending threatening processes.</p>

Table 7 Categories for Priority Ecological Communities

Conservation	Code Category
P1	<p>Priority One: poorly-known ecological communities Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
P2	<p>Priority Two: poorly-known ecological communities Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
P3	<p>Priority Three: poorly known ecological communities</p> <ul style="list-style-type: none"> i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation ii. communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat iii. communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
P4	<p>Priority Four: ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <ul style="list-style-type: none"> i. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.
P5	<p>Priority Five: Conservation Dependent ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>



Appendix B

Biosecurity and
Agriculture Management
Act 2007 Classifications

Appendix B Weeds and their Classifications

1.1 The BAM Act

Biosecurity is the management of the risk of animal and plant pests and diseases entering, emerging, establishing or spreading in WA to protect the economy, environment and community. Biosecurity is managed under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) which came into effect 1 May 2013. Exotic animals and plants can become an invasive species if they can establish in new areas where local conditions are favourable for their growth. They usually invade as a result of human activities both accidental and deliberate. These invasive species can often have a damaging impact on the natural environment and agriculture, and therefore requires careful management. The Department of Agriculture and Food, Western Australia (DAFWA) has developed an Invasive Species Program which provides the strategic and operational management of serious weeds and pest animals.

The Minister for Agriculture and Food can declare invasive exotic plants and animals as pests under the BAM Act. These species are listed on the Western Australian Organism List (WAOL) and classified in four categories, explained in Table 1.

Table 1 Legal status of Declared Pests under the BAM Act

Category	Description
Declared Pest, Prohibited – s12	Prohibited organisms are declared pests by virtue of section 22(1), and may only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest – s22(2)	Declared pests must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia.
Permitted – s11	Permitted organisms must satisfy any applicable import requirements when imported. They may be subject to an import permit if they are potential carriers of high-risk organisms.
Permitted, Requires Permit – r73	Regulation 73 permitted organisms may only be imported subject to an import permit. These organisms may be subject to restriction under legislation other than the Biosecurity and Agriculture Management Act 2007. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Unlisted – s14	If you are considering importing an unlisted organism/s you will need to submit the name/s for assessment, as unlisted organisms are automatically prohibited entry into WA.

The Minister can declare an organism as a declared pest if there are reasonable grounds for believing that the organism:

- a. has or may have an adverse effect on
 - a. another organism in the area
 - b. human beings in the area
 - c. the environment or part of the environment in an area
 - d. agricultural activities, fishing or pearling activities, or related commercial activities carried on or intended to be carried on in the area.
- b. May have an adverse effect on any of those things if it were present in the area, or if it were present in the area in greater numbers or to a greater extent.

Under the BAM Act declared pests are placed in one of three categories, as explained in Table 2. Many of the declared pest plant species are also on the list of Weeds of National Significance. This list was compiled to prioritise future management and allocation of resources for weed control. Species were selected based on their

invasiveness and impact characteristics, potential and current area of spread and their environmental, industrial or socioeconomic impacts.

Under the BAM Act, local government authorities can prescribe any plant, other than a declared plant, to be a pest plant. Local law can be used to assist in pest plant management by enforcing that the owner or occupier of the land can be held financially responsible for the management of any pest plant.

Department of Parks and Wildlife (DPaW) recognise weeds as one of the most significant threats to biodiversity as they outcompete native species for resources, reduce natural diversity by smothering native plants, displace and replace native plants, and alter fire regimes. DPaW have prioritised their focus on infestations of species considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. DPaW's rankings are provided to help landholders, community groups and private enterprises manage weeds that may impact on the natural environment. Weed species are listed according to the region they occur in and are ranked as very high, high, medium, low, negligible, or further assessment required. Furthermore, an example of management actions that may be appropriate for a species of that ranking is provided (DPaW, 2013b).

Table 2 Control categories for Declared Pests listed under the BAM Act

Category	Definition
C1 Exclusion	Organisms which should be excluded from part or all of Western Australia.
C2 Eradication	Organisms which should be eradicated from part or all of Western Australia.
C3 Management	Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
Unassigned	Unassigned: Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the Act.

1.2 Environmental Weeds Strategy of WA

The Environment Weed Strategy of WA (EWSWA) rating is shown along with the BAM Act classification and Environmental Weed Census. The EWSWA ratings identify weeds that pose significant environmental risk based on invasiveness, distribution and environmental impacts. The ratings include:

- High – have all three of the characteristics
- Moderate – have two of the characteristics
- Mild – have one of the characteristics
- Low – not deemed to have any of the characteristics.

1.3 Swan NRM Weed Prioritisation

In 2008 DPaW (at the time Department of Environmental Conservation), rated weeds species in Perth bushland conditions using eight ratings. They were rated according to the risk each species posed on environmental assets in the region based on invasiveness, ecological impact, current and potential distribution and priority for management (CALM, 2008). Ratings included:

- Very High
- High
- Further Assessment Required (FAR)/High
- Moderate/ High
- Moderate
- Low/ Moderate
- Low
- Further Assessment required (FAR).

Appendix C

Curriculum Vitae for Botanists

Floora de Wit Senior Botanist

Qualifications

Postgraduate Diploma in Environmental Management and Impact Assessment (2013) Murdoch

Bachelor of Science in Environmental Biology (Environmental Restoration) - Curtin University of Technology (2005)

Affiliations

Environmental Consultant Association

Publications and Technical Papers

De Wit F, 2014. Seasonality of Flora Surveys in Arid Australia. Paper presented to Goldfields Environmental Management Conference, May 2014

Career History

Floora is a Senior Botanist and Black Cockatoo survey specialist with ten years' experience in the environmental consulting industry. Floora specialises in flora and vegetation assessments and is responsible for planning and executing field surveys and delivering technical reports suitable for supporting environmental approval documentation and/or environmental compliance reports.

In more recent years, Black Cockatoo surveys have become another focus for Floora's expertise. These include Cockatoo foraging quality assessments and potential breeding/roosting surveys. Her familiarity with the Australian Government guidelines for Black Cockatoos ensures the surveys and results are suitable for informing any impact assessment and support approval documentation.

Her botanical history includes level 1 and 2 flora and vegetation assessments, targeted flora and community surveys, weed mapping, wetland assessments and rehabilitation monitoring programs. Her botanical knowledge extends from the Kimberley to Pilbara, through the Goldfields, Wheatbelt, Swan Coastal Plain and Geraldton Sandplains, Jarrah Forest and South Coast. Her extensive field experience allows her to quickly adapt and familiarise with new areas.

Floora has also been involved in several wetland assessments since the release of the updated wetland methodology relevant to the Swan Coastal Plain.

All flora and vegetation assessments are conducted in accordance with EPA Guidance Statement 51 and the DPaW and EPA Flora and Vegetation Technical Guide published in 2015. Where appropriate, suitable methodologies are adapted to suit the project and environmental outcomes. Floora has good relationships with DPaW and State Herbarium staff, allowing her to obtain insights into appropriate best-practice data collection and limitations associated with different WA regions.

Flora and Vegetation Assessments

Main Roads Roe Tonkin Interchange Follow Up Surveys. Targeted *Drakaea elastica* and *Caladenia huegelii* surveys and wetlands assessment undertaken at 3 project areas on Swan Coastal Plain.

Water Corporation, Level 2 F&V Assessment, Caddadup, 2012 and 2015. Team lead. Baseline survey including second season sampling and targeted *Caladenia huegelii* assessment. Floristic Community Analysis was undertaken to ascertain the presence of a PEC and liaison with DPaW discussing *Caladenia* populations and identification. Results of the project informed impact assessment and approval documentation.

Holcim Gosnells Quarry Level 2 F&V Assessment and targeted *Thelymitra* searches at the edge of the Darling Scarp. Team lead including planning, field work, taxonomy, data analysis and technical reporting.

Landcorp Preliminary Ecological Assessments including Level 1 Fauna and F&V for six remote sites including Goomalling, Cervantes, Dalwallinu, Denmark, Bridgetown and Katanning. Team lead including planning, field work, taxonomy, data analysis and technical reporting.

Main Roads Toodyay Biological Assessment. F&V assessment of 60km infrastructure corridor including targeted orchid searches. Team lead including planning, field work, taxonomy, data analysis and technical reporting.

Main Roads Roe and Tonkin Grade Separation Biological Assessments. Team lead for F&V surveys, wetlands assessment and targeted orchid searches. Liaison with DPaW led to the development of suitable search methods and timing. The results will inform impact assessment documentation.

Broome International Airport Biological Investigations. Team lead, data analysis, taxonomist and technical reporting.

Shire of Gingin single-phase Level 2 F&V Assessment. Team leader for conducting a single-phase Level 2 Flora and Vegetation Assessment.

Main Roads Indian Ocean Drive Biological Assessments. Floora was lead author for compiling results from biological investigations in a report suitable for supporting impact assessment and clearing permit compliance documents according to MRWA standards.

Main Roads Bridges (Denmark and Mt Magnet) Level 1 F&V Surveys. Floora was team lead for conducting a Level 1 Flora and Vegetation Assessment and Targeted Surveys in Denmark and surrounds. The results were used to comply to MRWA State-wide clearing permit.

Main Roads Fremantle to Rockingham Controlled Access Highway Level 2 F&V Assessment and targeted surveys. Team leader. The results of the survey informed the Scheme Amendment application.

Department of Industry Square Kilometre Array Biological Assessments. Floora was team leader for a Level 2 Flora and Vegetation Assessment and Targeted Surveys in the remote Murchison bioregion. The ten-day survey expanded across Boolardy Station with results used to inform an environmental constraints map and potential approval documentation required in the future.

Main Roads Neaves Road Upgrade. Detailed flora and vegetation assessment for proposed Neaves Road upgrade. Challenges included mapping TEC buffers, Threatened Flora population boundary mapping, Gibson FCT analysis and discussing all environmental constraints in a local and regional context.

Water Corporation-Perth Northern Pipeline Corridor. Technical lead, conducted ecological surveys including flora and vegetation, wetlands and targeted flora surveys. Project area includes three 120km infrastructure corridors between Forrestfield and Lancelin.

Main Roads Great Northern Highway Upgrade 2014 Ecological investigations for 120km infrastructure corridor in the Kimberleys. The project was delivered successfully and within budget before the end of the financial year.

FMG Nyidinghu project Level 2 flora and vegetation assessment. Team leader for a 2-phase sampling program for the mining tenement and detailed 1-phase surveys for rail spur using a helicopter. Included impact assessment, statistical analysis and mapping for a 18,000 hectare area and 120km infrastructure corridor in East Pilbara.

Landcorp Maitland Environmental Due Diligence. Field team lead for preliminary biological assessment and technical reporting.

Bauxite Alumina Joint Venture Access Strategy. Field lead for baseline F&V assessment and pre-clearance surveys along existing tracks. Technical support and field leader. Considering locations of a disturbance opportunist Priority species, dieback, and track access. Flora and vegetation was mapped and a flora inventory made for all track-side vegetation.

Eneabba to Gindalbie Power Line Level 2 F&V Assessment. Flora and vegetation surveys were conducted in 2008 for the new powerline working for Mattiske Consulting. The decommissioning of the old powerline required further survey work, done on behalf of AECOM. The 150km infrastructure corridor was traversed by vehicle, collecting floristic quadrat data within areas of remnant native vegetation.

Black Cockatoo Surveys

Main Roads Toodyay Road 2015 Black Cockatoo Assessment field team member. The results enabled the client to quantify potential impacts on Black Cockatoo habitat within a defined project area.

Main Roads Fremantle to Rockingham Restricted Access Highway 2014/15 Black Cockatoo potential breeding habitat and foraging quality assessment field team member. The results enabled the client to quantify potential impacts on Black Cockatoo habitat within a defined project area.

Shire of Gingin 2014 Black Cockatoo Assessment field team member. The results of the survey ensured the client met their legislative obligations for referral under the EPBC Act.

Main Roads Indian Ocean Drive 2014 Black Cockatoo foraging quality assessment. The results informed the EPBC Act referral documentation and allowed a more detailed impact assessment on foraging quality to be undertaken.

Western Power Eneabba to Karara Transmission Corridor 2013/14 Black Cockatoo potential breeding and foraging habitat assessment.

Main Roads Neaves 2013 Road Black Cockatoo potential breeding habitat field team member. The results enabled the client to quantify potential impacts on Black Cockatoo habitat within a defined project area.

Main Roads Vasse Bypass 2012 Black Cockatoo field team member for potential breeding habitat assessment. The results enabled the client to quantify potential impacts on Black Cockatoo habitat within a defined project area.

Orchid surveys

Holcim Gosnells Quarry *Thelymitra magnifica* and *Thelymitra stellata* surveys, Oct-Nov 2015.

Main Roads Roe and Tonkin *Drakaea elastica* and *Caladenia huegelii* targeted surveys Aug-Oct 2015.

Main Roads FRCAH *Drakaea elastica* and *Caladenia huegelii* targeted surveys Aug-Oct 2015.

Water Corporation Caddadup *Caladenia huegelii* targeted searches Oct 2015.

Conferences

EIANZ Annual Conference "EIA: Challenging the Status Quo" – 2015

Goldfields Environmental Management Conference 2012 and 2014 (speaker at 2014)

DIG Dieback Conference – 2007 and 2009

Mining in Ecologically Sensitive Landscapes Symposium – 2009

Publications and Technical Papers

De Wit F, 2014. Seasonality of Flora Surveys in Arid Australia. Paper presented to Goldfields Environmental Management Conference, May 2014.

Training

Provide First Aid – St John Ambulance 30 March 2015
aining Here

Languages

English and Dutch

Professional History

2012- Present
AECOM - Senior Botanist

2011 - 2012
Cardno (WA) Pty Ltd - Principal Botanist

2007 - 2010
Mattiske Consulting Pty Ltd - Graduate to Botanical Team Leader

Lyn Van Gorp Environmental Scientist

Qualifications

Bachelor of Environmental Science (Honours)
Majoring in Natural Resource Science
University of Queensland

Affiliations

Golden Key International Honour Society

Awards

University Medallist, University of QLD

Professional History

Aug 2009 – Jul 2012; Jun 2014 - Present
AECOM
Environmental Scientist

Aug 2013 – Jun 2014
Department of Environment Regulation
Environmental Officer

Jul 2012 – Aug 2013
Perth Airport Pty Ltd
Environment & Conservation Advisor

Mar 2009 – Aug 2009
Swan River Trust, Department of Environment &
Conservation, WA
Environmental Officer, Statutory Planning

Nov 2007 – Feb 2008
Rio Tinto, Hunter Valley Operations, NSW
Environmental Services Vacation Student

Feb 2007 – Oct 2007
SunWater, QLD
Volunteer/casual work in Environment Department

Career History

Lyn Van Gorp has more than seven years' experience in environmental management in Australia. Predominantly this work has focused on environmental approvals as well as site environmental management and field operations. Lyn has previously studied the effects of topsoil management on restoration success in mine site rehabilitation at the CRL sand mine on North Stradbroke Island.

Lyn worked in AECOM's environment team from 2009 to 2012 and re-joined the organisation in 2014 after gaining additional experience in the industry and government sectors. She has particular skills in report writing, investigation of environment and heritage issues, and statutory approvals. She also has experience in assessment of environmental risk, community consultation, cultural heritage assessments as well as field environmental assessments and interpretation.

Lyn's field experience is predominantly in flora and vegetation surveys. Additional site and field environmental experience has involved:

- fauna surveys
- groundwater and surface water monitoring
- noise and blast monitoring
- air quality monitoring
- Aboriginal heritage surveys and engagement
- community engagement.

In particular, Lyn possesses site environmental experience gained primarily from her time working at Perth Airport as well as on various construction and operational mine and other sites.

Detailed Experience -*Main Roads Western Australia Great Northern Highway Upgrade, 2016*

Lyn has written the EIA/EMP, PCIA/VMP and Revegetation Plan for upgrade of Great Northern Highway between SLK 2922 and 2930 and associated materials extraction. She is currently preparing the same documents for SLK 2934-2940 and SLK 2941-2950.

Main Roads Western Australia Roe 8 Highway Extension, 2016

Lyn is currently working on the environmental approvals documentation for the Roe 8 Highway Extension project.

Department of Defence rehabilitation and weed monitoring – Cultana Training Area Expansion: Eyre Peninsula, South Australia 2016

Lyn was involved in surveys for the Carrion Flower weed and also monitoring of rehabilitated areas.

Stirling Defence Base Flora and Vegetation survey and Environmental Report, 2016

Lyn undertook vegetation community and condition mapping on Garden Island and contributed to preparation of the Environmental Report for proposed development on the island.

Department of Defence Muehea Bombing Range Environmental Management Plan review, 2015

Lyn undertook a site visit to undertake assessment of current management practices on site.

Ellenbrook Bus Rapid Transit Flora and Vegetation Survey, 2015

Lyn undertook the Level 1 Flora and Vegetation survey for Department of Transport including data analysis and production of report.

Main Roads Western Australia Toodyay Road widening Flora and Vegetation surveys, 2015.

Lyn participated in the Flora and Vegetation survey and Black cockatoo habitat assessment for proposed widening of 52km of Toodyay Road.

Stirling Defence Base Targeted flora surveys, 2015

Lyn undertook targeted searches for priority flora species at the Defence Base.

Department of Transport Woodman Point Flora and Vegetation assessment, 2015

Lyn participated in the flora and vegetation assessment for the Department of Transport Woodman Point boating precinct.

Water Corporation Caddadup Flora and Vegetation assessment and Targeted surveys, 2015

The Water Corporation proposes to duplicate the existing Caddadup water tank. Lyn assisted with the flora and vegetation assessment and targeted threatened and priority flora species searches.

Main Roads Western Australia Victoria Highway Material Pits Revegetation Plan, 2015

Lyn developed the Revegetation Plan for two Material Pits required for submission to the Department of Environment Regulation.

Main Roads Western Australia Roe and Tonkin Highway Interchanges Preliminary Environmental Impact Assessments (PEIAs) and Biological Surveys, 2014-2015

Lyn assisted with the site inspections at five intersections in order to identify the key environmental values that may be impacted by upgrading of these intersections. The results of these site inspections informed the PEIAs for both the Roe and Tonkin Highway intersection upgrade projects.

Lyn has also been involved with data analysis and development of the Biological Survey reports for both of these projects. In 2015, she undertook targeted orchid surveys for both projects.

Main Roads Western Australia Great Northern Highway Rehabilitation Monitoring, 2015

Lyn participated in rehabilitation monitoring at various quarry pits, seeding trial locations and photo monitoring points along Great Northern Highway.

Main Roads Western Australia Pardelup Bridge (502) Vegetation Impact Assessment and EIA/EMP, 2015

Lyn wrote the VIA including assessment against the ten clearing principles and assisted with preparation of the EIA/EMP for replacement of Pardelup Bridge and associated roadworks.

Holcim Gosnells Quarry Targeted Orchid Surveys, 2014 & 2015 and Flora and Vegetation Survey 2015

Lyn undertook targeted surveys for orchids at the Holcim Gosnells Quarry site to assist with approvals for planned extension to the quarry activities. In 2015, she also assisted with the Flora and Vegetation assessment undertaken for a proposed expansion area.

Main Roads Western Australia Yallingup Bridge Desktop Environmental and Heritage Constraints Assessment, 2014

Lyn undertook a desktop assessment of environmental and heritage constraints associated with proposed replacement of Yallingup Bridge.

Main Roads Western Australia, FRCAH Targeted Flora Surveys, Black Cockatoo assessment and EIA, 2014-2015

The Fremantle to Rockingham Controlled Access Highway (FRCAH) has been planned as part of a strategic north-south transport corridor to provide high standard connectivity between important commercial and industrial centres in the Perth South West Metropolitan Corridor.

As part of the biological assessment of the project, Lyn conducted a number of targeted flora surveys within the proposed road corridor including targeted orchid surveys. In addition, Lyn participated in the black cockatoo habitat assessment and assisted with writing of the EIA document for the project.

University of Western Australia Tree Survey, 2014

The University of Western Australia proposes to develop part of their property for university residential land use purposes. Lyn participated in a tree survey to characterise the vegetation located at the site and to identify any potential implications for future development opportunities at the site.

Main Roads Western Australia, Northam-Pithara Road Targeted Flora Survey, 2014

Main Roads are proposing to upgrade a section of the Northam Pithara Road, approximately 24 km in length, to comply with road safety standards and improve site lines. Lyn undertook a targeted flora survey for a number of Commonwealth and State listed species which were identified in previous environmental assessments as potentially occurring within the project area. These species included several salt-lake tolerant orchid species.

In addition to the targeted flora survey, Lyn also assisted with the Level 2 flora and vegetation survey of a section of the road requiring realignment which was not included in previous flora surveys for the project.

Department of Industry, Square Kilometre Array Flora and Vegetation Survey, 2014

The Square Kilometre Array (SKA) Project is the largest ever international radio telescope project, which has been designed to answer key cosmological questions. Lyn participated in the biological survey of the proposed SKA Survey Telescope and Low Frequency Aperture Arrays. The biological assessment consisted of a Level 2 flora and vegetation survey and targeted searches for conservation significant flora species.

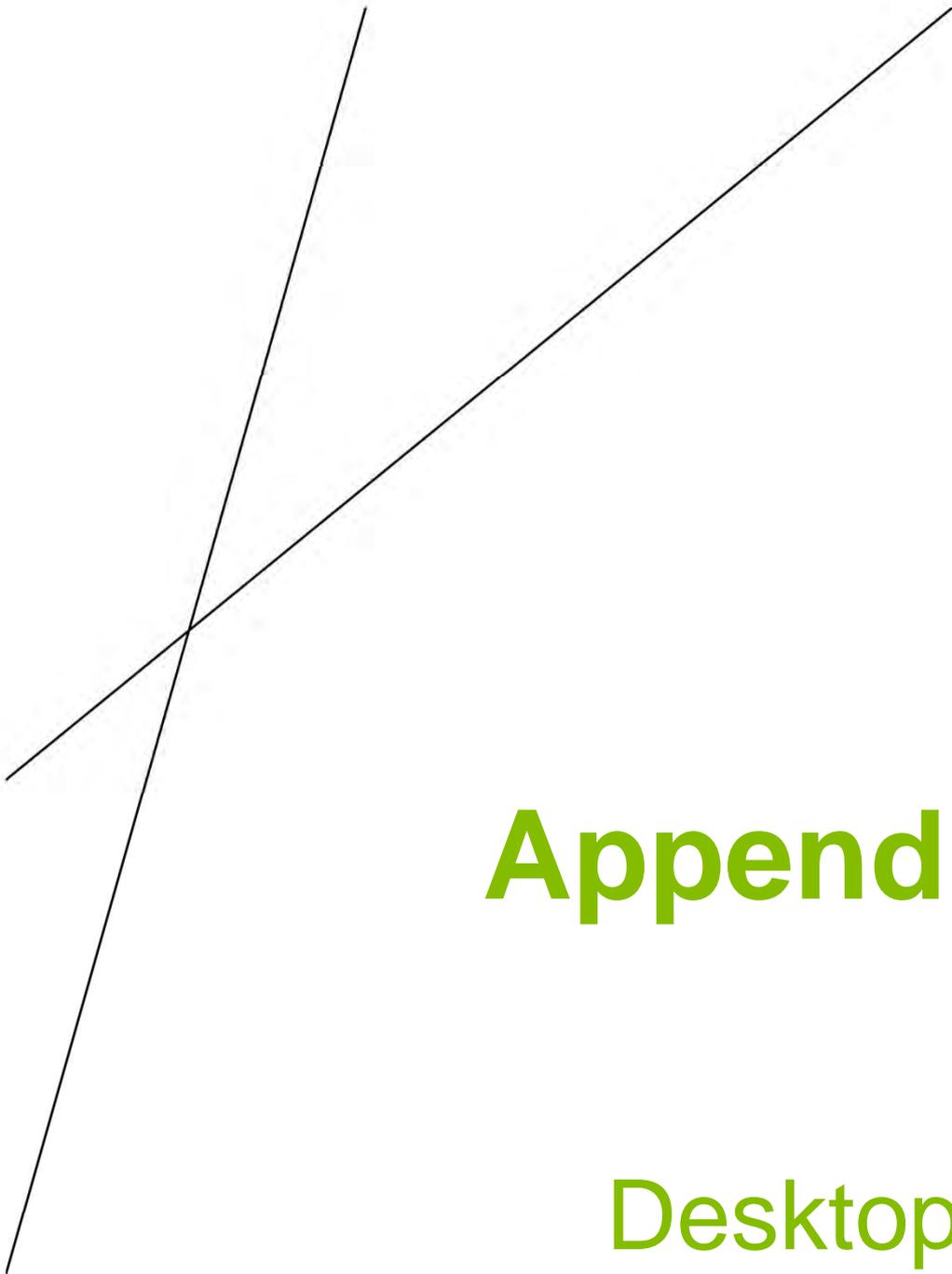
Lyn also conducted a land system assessment of the Sherwood land system, which assessed the condition and severity of erosion using the Landscape Function Analysis methodology.

Fortescue Metals Group Solomon Life of Mine Public Environmental Review, 2014

Lyn has assisted with writing the Public Environmental Review document for the proposed extension to the Fortescue Metals Group Solomon mine in the Pilbara.

Roe Highway Extension Property Offset Assessment – Environmental Scientist, Client: Main Roads, 2014

Lyn prepared the Property Offset Assessment report for the proposed Roe Highway Extension, which involved characterisation and comparison of a number of proposed sites to determine suitability as offsets for the environmental impacts of the project. The report enabled Main Roads to identify which proposed properties would be suitable as individual or grouped offsets.



Appendix D

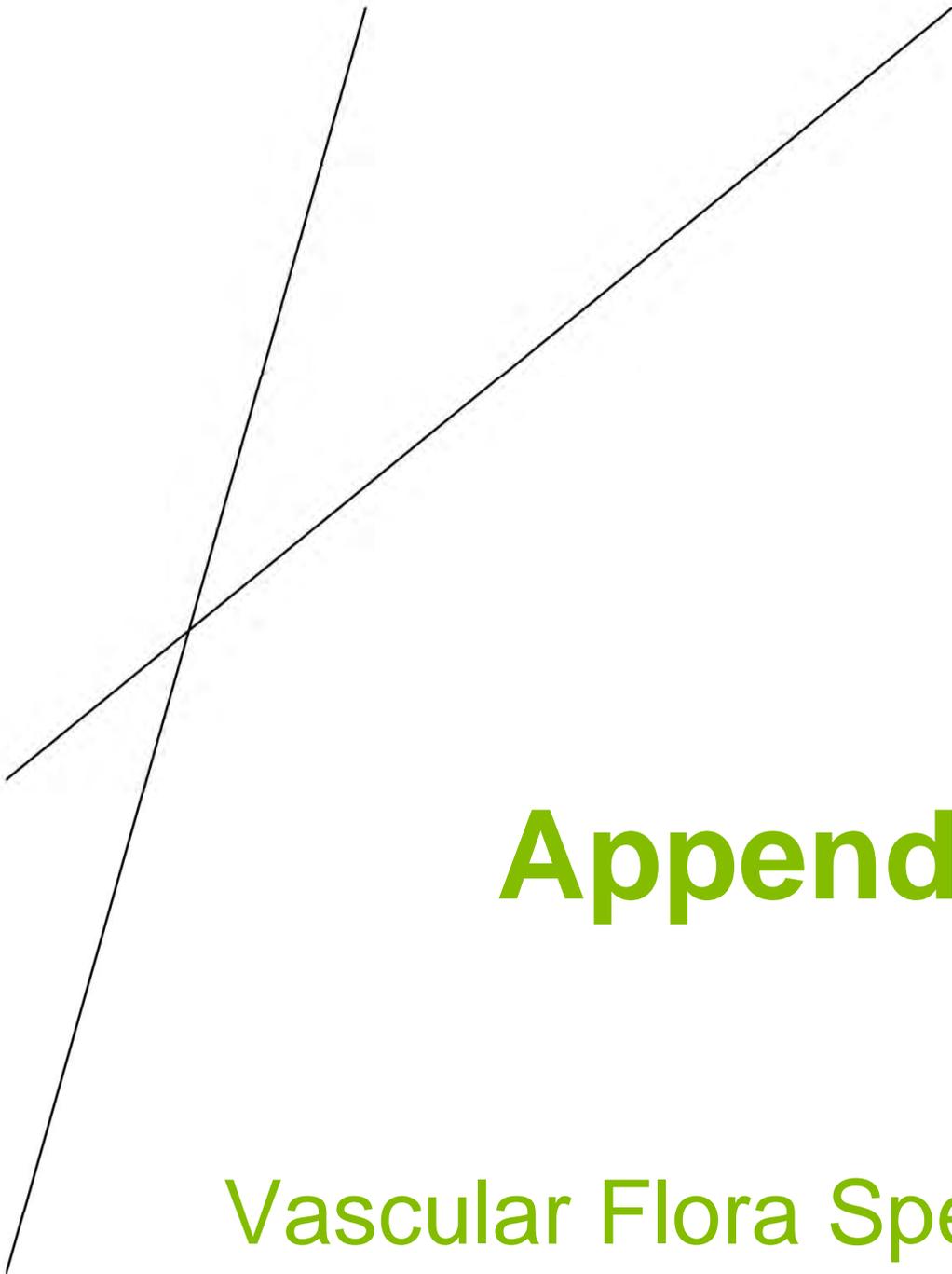
Desktop Fauna Assessment

Appendix D Desktop Fauna Assessment

Name	Common Name	Conservation Code		DPaW Records		Likelihood
		Commonwealth	State	Year	Number	
Birds						
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory / Marine	IA	-	-	May fly over
<i>Ardea alba</i>	Great Egret	Marine	-	-	-	May occur
<i>Ardea ibis</i>	Cattle Egret	Marine	-	-	-	May occur
<i>Arenaria interpres</i>	Ruddy Turnstone	Migratory / Marine	IA	-	-	May occur
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	EN	-	-	May occur
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Migratory / Marine	IA	2011	3	May occur
<i>Calidris canutus</i>	Red Knot	E	VU	-	-	May occur
<i>Calidris alba</i>	Sanderling	Migratory / Marine	IA	-	-	May occur
<i>Calidris canutus</i>	Red Knot	E / Migratory / Marine	IA	-	-	May occur
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE / Migratory / Marine	VU / IA	2004	8	May occur
<i>Calidris melanotos</i>	Pectoral Sandpiper	Migratory / Marine	IA	-	-	Unlikely
<i>Calidris ruficollis</i>	Red-necked Stint	Migratory / Marine	IA	2013	72	Likely
<i>Calidris subminuta</i>	Long-toed Stint	Migratory / Marine	IA	-	-	May occur
<i>Calidris tenuirostris</i>	Great Knot	CE / Migratory / Marine	VU / IA	-	-	May occur
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black Cockatoo	V	VU	2003	6	May occur
<i>Calyptorhynchus baudinii</i>	Baudin's Black Cockatoo	V	EN	1998	1	May occur
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	E	EN	2005	11	Likely
<i>Charadrius leschenaultii</i>	Greater Sand Plover	V	IA	2009	2	May occur
<i>Charadrius mongolus</i>	Lesser Sand Plover, Mongolian Plover	E / Migratory / Marine	EN / IA	-	-	Unlikely
<i>Charadrius rubricollis</i>	Hooded Plover	Marine	P4	2006	1,549	Likely
<i>Charadrius ruficapillus</i>	Red-capped Plover	Marine	-	-	-	Likely
<i>Diomedea epomophora (sensu stricto)</i>	Southern Royal Albatross	V / Migratory / Marine	IA	-	-	Unlikely

Name	Common Name	Conservation Code		DPaW Records		Likelihood
		Commonwealth	State	Year	Number	
<i>Diomedea sanfordi</i>	Northern Royal Albatross	E / Migratory / Marine	EN / IA	-	-	Unlikely
<i>Gallinago megala</i>	Swinhoe's Snipe	Migratory / Marine	IA	-	-	Unlikely
<i>Gallinago stenura</i>	Pin-tailed Snipe	Migratory / Marine	IA	-	-	May occur
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M	-	-	-	Likely
<i>Himantopus himantopus</i>	Black-winged Stilt	Marine	-	-	-	May occur
<i>Leipoa ocellata</i>	Malleefowl	V	VU	-	-	Unlikely
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	Migratory / Marine	IA	-	-	Unlikely
<i>Limosa lapponica</i>	Bar-tailed Godwit	V	VU	-	-	Unlikely
<i>Limosa limosa</i>	Black-tailed Godwit	Migratory / Marine	-	-	-	Unlikely
<i>Merops ornatus</i>	Rainbow Bee-eater	Marine	-	2012	5	Likely
<i>Motacilla cinerea</i>	Grey Wagtail	Migratory / Marine	IA	-	-	May occur
<i>Natator depressus</i>	Flatback Turtle	V	VU	-	-	Unlikely
<i>Numenius madagascariensis</i>	Eastern Curlew	CE	VU & IA	1998	30	Likely
<i>Numenius minutus</i>	Little Curlew	Migratory / Marine	IA	-	-	May occur
<i>Numenius phaeopus</i>	Whimbrel	Migratory / Marine	IA	-	-	May occur
<i>Pachyptila turtur subantarctica</i>	Fairy Prion (southern)	V	-	-	-	Unlikely
<i>Pandion cristatus</i>	Osprey	Migratory / Marine	IA	-	-	May occur
<i>Philomachus pugnax</i>	Ruff (Reeve)	Migratory / Marine	IA	-	-	May occur
<i>Phascogale tapoatafa subsp. (WAM M434)</i>	South-western Brush-tailed Phascogale	-	VU	1991	1	May occur
<i>Pluvialis fulva</i>	Pacific Golden Plover	Migratory / Marine	-	-	-	Unlikely
<i>Pluvialis squatarola</i>	Grey Plover	Migratory / Marine	IA	2011	3	May occur
<i>Puffinus carneipes</i>	Flesh-footed Shearwater	Migratory / Marine	IA / VU	-	-	Unlikely
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	Marine	-	-	-	May occur
<i>Rostratula australis</i>	Australian Painted Snipe	E / Marine	EN	-	-	May occur

Name	Common Name	Conservation Code		DPaW Records		Likelihood
		Commonwealth	State	Year	Number	
<i>Sternula nereis nereis</i>	Australian Fairy Tern	V	VU	-	-	May occur
<i>Thalassarche cauta cauta</i>	Shy Albatross	V / Marine	VU	-	-	Unlikely
<i>Thalassarche cauta steadi</i>	White-capped Albatross	V / Marine	VU	-	-	Unlikely
<i>Tringa brevipes</i>	Grey-tailed Tattler	Migratory / Marine	IA / P4	-	-	Unlikely
<i>Tringa glareola</i>	Wood Sandpiper	Migratory / Marine	IA	-	-	May occur
<i>Tringa nebularia</i>	Common Greenshank	Migratory / Marine	IA	2011	16	Likely
<i>Tringa stagnatilis</i>	Marsh Sandpiper, Little Greenshank	Migratory / Marine	IA			May occur
<i>Tringa totanus</i>	Common Redshank	Migratory / Marine	IA	-	-	May occur
Mammals						
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	V	VU	1996	2	May occur
<i>Isoodon obesulus fusciventer</i>	Quenda, Southern Brown Bandicoot	-	P4	2007	6	Likely
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	V	EN	2011	3	Likely
Reptiles						
<i>Caretta caretta</i>	Loggerhead Turtle	E / Migratory / Marine	EN / IA	-	-	Unlikely
<i>Chelonia mydas</i>	Green Turtle	V / Migratory / Marine	VU / IA	-	-	Unlikely
<i>Ctenotus ora</i>	Coastal Plains Skink	-	P3	1980	2	Unlikely
<i>Dermochelys coriacea</i>	Leatherback Turtle	E / Migratory / Marine	VU / IA	-	-	Unlikely
<i>Lerista lineata</i>	Lined Skink	-	P3	2007	3	Likely
Invertebrates						
<i>Synemon gratiosa</i>	Graceful Sunmoth	-	P4	2011	27	Likely



Appendix E

Vascular Flora Species by
Community Recorded,
Lake Clifton 2016

Appendix E Vascular Species by Vegetation Community Recorded at Lake Clifton, 2016

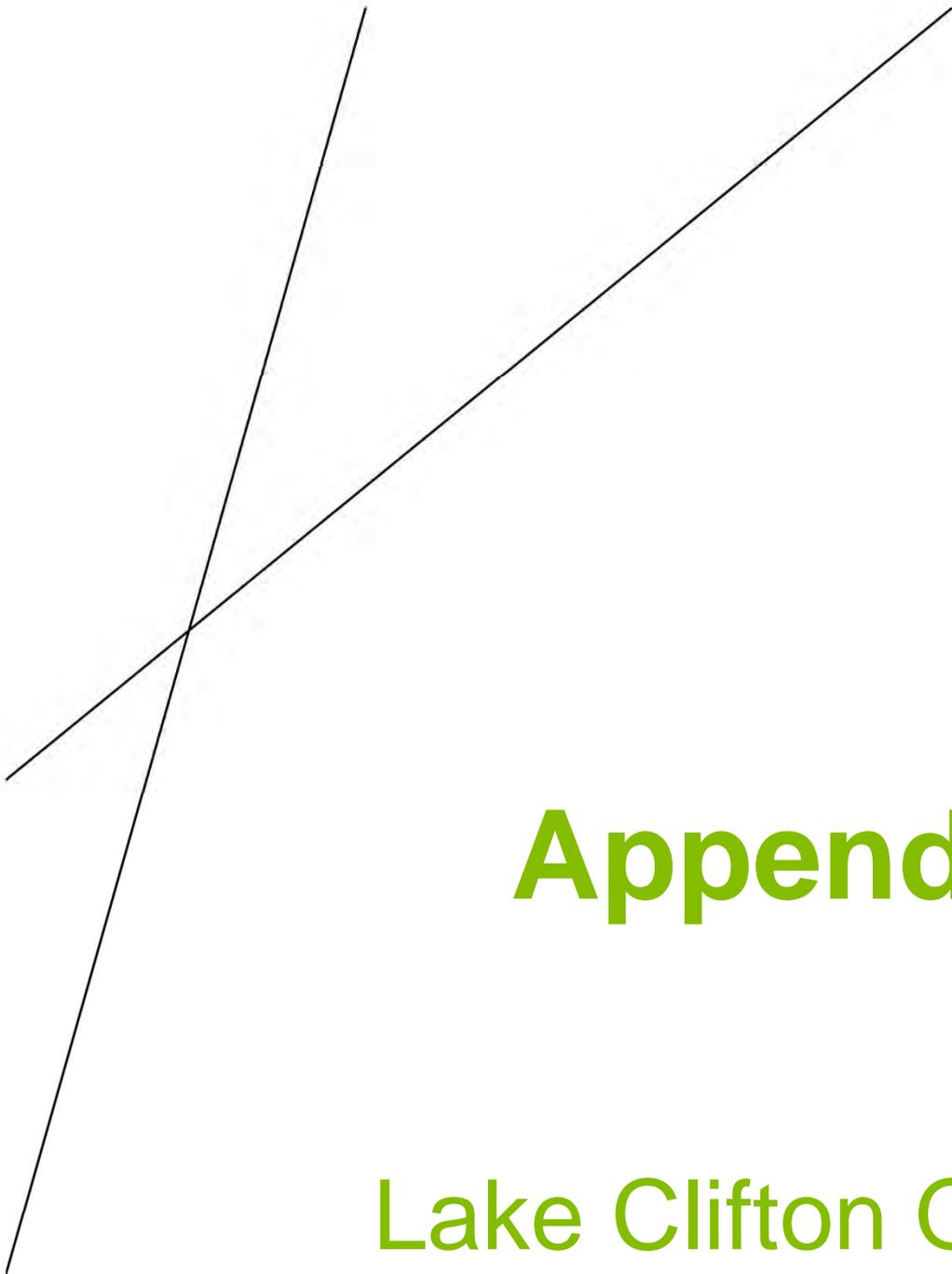
Row Labels	AfDdLg	AfHcEp	AfSgTd	AfXpHh	AfXpHg	ArMsTd	EdArTd	EdRbTd	EgMhAp	EgMsTd	EgXpTd	MrGtHg	MrGtTd	MsTd	Xp
Weeds															
<i>?Daucus glochidiatus</i>						X									
<i>Arctotheca calendula</i>		X		X		X				X		X		X	X
<i>Avena barbata</i>														X	
<i>Brassica tournefortii</i>			X							X		X		X	X
<i>Dittrichia graveolens</i>												X		X	X
<i>Euphorbia peplus</i>	X	X							X	X		X		X	
<i>Euphorbia terracina</i>		X													
<i>Geranium molle</i>	X	X		X	X	X		X	X	X	X	X	X	X	X
<i>Hypochaeris glabra</i>		X		X	X	X				X	X	X	X	X	X
<i>Lotus subbiflorus</i>		X			X									X	
<i>Lupinus sp.</i>					X									X	
<i>Lysimachia arvensis</i>		X		X	X	X	X			X	X	X	X	X	X
Poaceae sp.										X					
<i>Solanum nigrum</i>	X	X	X	X		X	X	X	X	X	X	X		X	
<i>Sonchus oleraceus</i>		X													
<i>Trachyandra divaricata</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Trifolium campestre</i>		X	X	X		X	X			X	X	X	X	X	X
<i>Ursinia anthemoides</i>		X													
Declared Pests															
<i>Gomphocarpus fruticosus</i>		X		X						X		X		X	X
<i>Solanum linnaeanum</i>										X					
<i>Zantedeschia aethiopica</i>	X			X									X'		
Conservation Significant															
<i>Stylidium maritimum</i> (P3)						X								X	
<i>Eucalyptus argutifolia</i> (T)														X	
Other															
<i>?Hibbertia cuneiformis</i>						X									
<i>?Threlkeldia diffusa</i>													X		
<i>Acacia cochlearis</i>						X								X	
<i>Acacia cyclops</i>				X										X	X
<i>Acacia littorea</i>			X			X								X	
<i>Acacia pulchella</i>				X										X	
<i>Acacia rostellifera</i>			X	X		X	X	X	X	X				X	
<i>Acacia saligna</i>			X	X		X							X	X	
<i>Acacia truncata</i>			X												
<i>Acanthocarpus preissii</i>	X		X	X		X		X	X	X				X	
<i>Acrotriche cordata</i>			X			X									
<i>Agonis flexuosa</i>	X	X	X	X	X	X	X		X	X	X	X	X	X	X

Appendix E Vascular Species by Vegetation Community Recorded at Lake Clifton, 2016

Row Labels	AfDdLg	AfHcEp	AfSgTd	AfXpHh	AfXpHg	ArMsTd	EdArTd	EdRbTd	EgMhAp	EgMsTd	EgXpTd	MrGtHg	MrGtTd	MsTd	Xp
<i>Hibbertia cuneiformis</i>	x	x	x	x	x	x	x		x	x	x	x		x	
<i>Hibbertia hypericoides</i>				x	x									x	
<i>Hibbertia racemosa</i>				x										x	x
<i>Jacksonia furcellata</i>				x		x								x	
<i>Juncus kraussii</i> subsp. <i>australiensis</i>								x					x		
<i>Kennedia coccinea</i>													x		
<i>Lagenophora huegelii</i>				x									x	x	
<i>Lepidosperma gladiatum</i>	x														
<i>Lepidosperma squamatum</i>						x									
<i>Lepyrodia drummondiana</i>				x									x		
<i>Leucopogon nutans</i>				x		x									
<i>Leucopogon parviflorus</i>	x		x			x	x	x		x	x		x	x	
<i>Leucopogon propinquus</i>				x	x									x	x
<i>Lomandra maritima</i>						x	x							x	
<i>Lomandra micrantha</i>				x	x										x
<i>Loxocarya cinerea</i>														x	
<i>Macrozamia riedlei</i>				x	x						x				
<i>Melaleuca cuticularis</i>													x		
<i>Melaleuca huegelii</i>								x							
<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>			x	x		x	x		x	x			x	x	
<i>Melaleuca lanceolata</i>							x	x				x			
<i>Melaleuca rhapsiophylla</i>								x				x	x		
<i>Melaleuca</i> sp. (<i>huegelii</i> x <i>rhapsiophylla</i>)			x												
<i>Melaleuca systema</i>				x	x	x	x	x		x	x		x	x	x
<i>Melaleuca teretifolia</i>												x			
<i>Nuytsia floribunda</i>				x										x	
<i>Olearia axillaris</i>			x			x							x	x	
<i>Opercularia hispidula</i>				x		x							x		
<i>Orchid</i> sp.			x	x	x	x				x	x		x	x	
<i>Patersonia occidentalis</i>				x											
<i>Pentapeltis peltigera</i>		x													
<i>Phyllanthus calycinus</i>		x	x	x	x	x		x	x	x				x	x
<i>Pimelea ferruginea</i>						x									
<i>Pimelea</i> sp.														x	
Planted <i>Callistemon</i>		x												x	
<i>Poaceae</i> sp.			x	x	x	x								x	
<i>Pterostylis sanguinea</i>				x											
<i>Pyrorchis nigricans</i>				x											
<i>Rhagodia baccata</i> subsp. <i>baccata</i>						x		x		x					

Appendix E Vascular Species by Vegetation Community Recorded at Lake Clifton, 2016

Row Labels	AfDdLg	AfHcEp	AfSgTd	AfXpHh	AfXpHg	ArMsTd	EdArTd	EdRbTd	EgMhAp	EgMsTd	EgXpTd	MrGtHg	MrGtTd	MsTd	Xp
<i>Santalum acuminatum</i>									x	x					
<i>Sarcocornia blackiana</i>													x		
<i>Scaevola crassifolia</i>			x												
<i>Scaevola nitida</i>						x									
<i>Senecio diaschides</i>					x	x				x					x
<i>Solanum symonii</i>	x														x
<i>Spyridium globulosum</i>	x	x	x	x	x	x	x	x		x			x	x	
<i>Stackhousia</i> sp.					x										
<i>Templetonia retusa</i>				x		x		x		x	x		x	x	
<i>Tetragia octandra</i>				x		x									
<i>Threlkeldia diffusa</i>						x									
<i>Thysanotus manglesianus</i>				x	x	x				x			x	x	
<i>Trachymene pilosa</i>			x	x	x	x				x			x	x	
<i>Trymalium ledifolium</i> var. <i>ledifolium</i>						x									
<i>Typha</i> sp.							x	x							
<i>Veronica distans</i>			x			x									
<i>Xanthorrhoea preissii</i>		x		x	x	x	x		x	x	x		x	x	x



Appendix F

Lake Clifton Quadrat
Data

Appendix F Lake Clifton Quadrat Data

Site	1	Location	115.657, -32.814
Observers	LvG and FdW		
Date	21/06/2016		

Topography	Ls	Soil Colour	Dark brown
Bare Ground	15	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Weeds, evidence of human presence

Photos:

No Photos

Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus marginata</i>	2000	6	T
	<i>Agonis flexuosa</i>	1200	10	T
	<i>Spyridium globulosum</i>	300	0.5	TS
	<i>Xanthorrhoea preissii</i>	200	7	TS
	<i>Hakea lissocarpha</i>	180	3	TS
	<i>Hibbertia cuneiformis</i>	110	0.5	S
	<i>Leucopogon propinquus</i>	100	0.1	S
	<i>Hakea ruscifolia</i>	50	0.1	S
	<i>Macrozamia riedlei</i>	50	1	S
	<i>Desmocladius flexuosus</i>	40	0.1	H
	<i>Hibbertia hypericoides</i>	40	7	S
	<i>Phyllanthus calycinus</i>	40	0.1	S
	<i>Lomandra micrantha</i>	30	0.1	H
	<i>Stackhousia sp.</i>	30	0.1	H
	<i>Thysanotus manglesianus</i>	20	0.1	H
*	<i>Trachyandra divaricata</i>	20	0.1	W
*	<i>Lupinus sp.</i>	10	0.01	W
*	<i>Lysimachia arvensis</i>	4	0.1	W
	<i>Trachymene pilosa</i>	3	0.2	H
*	<i>Lotus subbiflorus</i>	2	0.5	W
*	<i>Hypochaeris glabra</i>	1	2	W
	<i>Drosera erythrorhiza</i>	0.5	0.01	H
	<i>Clematis pubescens</i>	0	0.1	V
	<i>Hardenbergia comptoniana</i>	0	0.1	V

Site	2	Location	115.652, -32.809
Observers	FdW & LvG		
Date	21/06/2016		

Topography	Ls-ms	Soil Colour	Brown
Bare Ground	2	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	G

Additional notes:

Understorey weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1600	2	T
	<i>Agonis flexuosa</i>	1200	40	T
	<i>Hibbertia cuneiformis</i>	200	3	TS
	<i>Xanthorrhoea preissii</i>	150	2	TS
*	<i>Trachyandra divaricata</i>	40	15	W
*	<i>Euphorbia terracina</i>	20	0.1	W

Site	3	Location	115.654, -32.806
Observers	LvG and FdW		
Date	21/06/2016		

Topography	Ls	Soil Colour	Brown
Bare Ground	5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	G

Additional notes:

Understorey weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	2200	6	T
	<i>Agonis flexuosa</i>	1000	4	T
	<i>Spyridium globulosum</i>	200	1	TS
	<i>Hibbertia cuneiformis</i>	100	3	TS
	<i>Xanthorrhoea preissii</i>	100	2	S
	<i>Phyllanthus calycinus</i>	40	0.4	S
*	<i>Trachyandra divaricata</i>	30	20	W
*	<i>Ursinia anthemoides</i>	10	1	W
*	<i>Euphorbia peplus</i>	5	40	W
*	<i>Lysimachia arvensis</i>	5	1	W
*	<i>Solanum nigrum</i>	5	10	W
*	<i>Sonchus oleraceus</i>	5	2	W
	<i>Clematis linearifolia</i>	0	0.1	V

Site	4	Location	115.652, -32.806
Observers	LvG and FdW		
Date	21/06/2016		

Topography	Ls	Soil Colour	Brown
Bare Ground	4	Condition	Moist
Cryptogram	Yes	Fire	10+
Soil Type	Sand	Condition	G

Additional notes:

Understorey weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	3000	1	T
	<i>Agonis flexuosa</i>	1200	40	T
	<i>Hibbertia cuneiformis</i>	200	6	TS
	<i>Xanthorrhoea preissii</i>	100	0.5	S
*	<i>Arctotheca calendula</i>	10	0.1	W
*	<i>Lotus subbiflorus</i>	10	2	W
*	<i>Euphorbia peplus</i>	5	20	W
*	<i>Geranium molle</i>	5	60	W
*	<i>Lysimachia arvensis</i>	5	1	W
	<i>Pentapeltis peltigera</i>	5	5	H
*	<i>Sonchus oleraceus</i>	5	2	W
	<i>Clematis linearifolia</i>	0	0.5	V

Site	5	Location	115.657, -32.799
Observers	LvG and FdW		
Date	21/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	VG

Additional notes:

Weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	400	0.1	TS
	<i>Hakea prostrata</i>	250	3	TS
	<i>Spyridium globulosum</i>	220	0.2	TS
	<i>Hakea trifurcata</i>	200	0.5	TS
* DP	<i>Gomphocarpus fruticosus</i>	170	1.5	W
	<i>Xanthorrhoea preissii</i>	150	1	S
	<i>Templetonia retusa</i>	120	1	S
	<i>Melaleuca systema</i>	60	40	S
	<i>Leucopogon parviflorus</i>	50	1	S
	<i>Hibbertia cuneiformis</i>	40	0.1	S
*	<i>Trachyandra divaricata</i>	30	60	W
*	<i>Geranium molle</i>	2	1	W
*	<i>Hypochaeris glabra</i>	1	0.5	W
	<i>Cassytha racemosa</i>	0	0.1	V
	<i>Clematis linearifolia</i>	0	0.2	V

Site	6	Location	115.657, -32.799
Observers	LvG and FdW		
Date	21/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	10	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	VG

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus decipiens</i>	800	30	T
	<i>Eucalyptus petrensis</i>	350	10	T
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	300	0.5	TS
	<i>Spyridium globulosum</i>	230	1	TS
	<i>Agonis flexuosa</i>	200	0.5	TS
	<i>Melaleuca systema</i>	200	1	TS
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	200	0.2	TS
	<i>Templetonia retusa</i>	180	1	TS
	<i>Xanthorrhoea preissii</i>	160	3	S
	<i>Hibbertia cuneiformis</i>	100	0.5	S
	<i>Hibbertia hypericoides</i>	80	0.1	S
	<i>Melaleuca systema</i>	70	0.2	S
	<i>Senecio diaschides</i>	30	0.1	H
*	<i>Trachyandra divaricata</i>	30	5	W
*	<i>Lotus subbiflorus</i>	10	0.5	W
*	<i>Geranium molle</i>	2	2	W
	<i>Clematis linearifolia</i>	0	0.3	V

Site	7	Location	115.657, -32.796
Observers	LvG and FdW		
Date	21/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	.5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	VG

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	250	10	TS
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	240	3	TS
	<i>Spyridium globulosum</i>	240	8	TS
	<i>Hakea prostrata</i>	220	0.1	TS
* DP	<i>Gomphocarpus fruticosus</i>	120	0.1	W
	<i>Hibbertia cuneiformis</i>	80	1	S
	<i>Melaleuca systema</i>	80	40	S
	<i>Leucopogon propinquus</i>	60	0.1	S
	<i>Templetonia retusa</i>	60	1	S
	<i>Grevillea preissii</i> subsp. <i>preissii</i>	50	0.2	S
	<i>Leucopogon parviflorus</i>	40	1	S
	<i>Drosera macrantha</i>	30	0.1	H
*	<i>Trachyandra divaricata</i>	30	5	W
	<i>Hibbertia racemosa</i>	20	0.1	S
	<i>Banksia dallanneyi</i>	10	0.1	S
*	<i>Solanum nigrum</i>	10	1	W
*	<i>Geranium molle</i>	2	2	W
*	<i>Lysimachia arvensis</i>	2	1	W

Cons	Taxon	Ht/cm	%A	Form
*	<i>Hypochaeris glabra</i>	1	0.4	W
*	<i>Lotus subbiflorus</i>	1	0.5	W
	<i>Clematis linearifolia</i>	0	1	V

Site	8	Location	115.650, -32.768
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Ls	Soil Colour	White to brown
Bare Ground	0	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	E

Additional notes:

Low intensity weeds, rabbits

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	900	5	T
	<i>Agonis flexuosa</i>	700	40	T
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	400	6	TS
dead	<i>Banksia grandis</i>	300	0.5	T
	<i>Xanthorrhoea preissii</i>	250	2	TS
	<i>Spyridium globulosum</i>	230	2	TS
	<i>Melaleuca systema</i>	220	0.5	TS
	<i>Hakea ruscifolia</i>	160	0.1	S
	<i>Hakea lissocarpha</i>	140	0.2	S
	<i>Templetonia retusa</i>	100	3	S
	<i>Hibbertia hypericoides</i>	40	20	S
	<i>Macrozamia riedlei</i>	40	0.2	S
	<i>Acanthocarpus preissii</i>	30	0.1	H
	<i>Leucopogon propinquus</i>	30	0.1	S
	<i>Lomandra micrantha</i>	30	0.2	H
	<i>Opercularia hispidula</i>	30	0.1	H
	<i>Drosera macrantha</i>	20	0.01	H
	<i>Hibbertia racemosa</i>	20	0.1	S

Cons	Taxon	Ht/cm	%A	Form
	<i>Desmodium flexuosus</i>	15	0.1	H
*	<i>Lysimachia arvensis</i>	5	0.1	W
	<i>Trachymene pilosa</i>	5	0.1	H
	<i>Lagenophora huegelii</i>	1	0.1	H
	<i>Orchid sp.</i>	1	0.01	H
	<i>Drosera erythrorhiza</i>	0.5	0.2	H
	<i>Cassytha racemosa</i>	0	0.1	V
	<i>Hardenbergia comptoniana</i>	0	0.1	V

Site	9	Location	115.649, -32.768
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Ls to ms	Soil Colour	Brown to white
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	E

Additional notes:

Rabbits

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	700	20	T
	<i>Agonis flexuosa</i>	600	50	T
	<i>Eucalyptus petrensis</i>	600	2	T
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	250	10	TS
	<i>Jacksonia furcellata</i>	250	0.2	S
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	240	4	TS
	<i>Templetonia retusa</i>	240	8	TS
	<i>Melaleuca systema</i>	200	1	TS
	<i>Xanthorrhoea preissii</i>	200	0.5	TS
	<i>Hakea lissocarpha</i>	100	0.1	S
	<i>Acacia pulchella</i>	50	0.1	S
	<i>Hibbertia hypericoides</i>	50	25	S
	<i>Macrozamia riedlei</i>	50	0.2	S
	<i>Grevillea preissii</i> subsp. <i>preissii</i>	40	0.1	S
Juvenile	<i>Hibbertia cuneiformis</i>	40	0.1	S
	<i>Leucopogon propinquus</i>	40	0.2	S
	<i>Pyrorchis nigricans</i>	40	0.01	H
	<i>Acacia cyclops</i>	30	0.1	S

Cons	Taxon	Ht/cm	%A	Form
	<i>Desmocladius flexuosus</i>	20	0.1	H
	<i>Lomandra micrantha</i>	20	0.1	H
dead	<i>Banksia dallanneyi</i>	10	0.1	S
	<i>Orchid sp.</i>	6	0.01	H
	<i>Trachymene pilosa</i>	5	0.1	H
	<i>Lagenophora huegelii</i>	1	0.1	H
	<i>Drosera erythrorhiza</i>	0.5	0.2	H

Site	10	Location	115.650, -32.770
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Ls	Soil Colour	Grey
Bare Ground	5	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	E

Additional notes:

Rabbits, low intensity weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1400	10	T
	<i>Agonis flexuosa</i>	900	35	T
	<i>Xanthorrhoea preissii</i>	250	10	TS
	<i>Banksia littoralis</i>	240	2	T
	<i>Templetonia retusa</i>	230	5	TS
	<i>Jacksonia furcellata</i>	220	0.1	TS
	<i>Acacia saligna</i>	200	0.1	TS
	Planted urn	180	0.1	S
	<i>Goodenia pulchella</i>	100	0.1	?W
	<i>Acacia pulchella</i>	80	0.1	S
	<i>Hakea lissocarpha</i>	60	0.1	S
	<i>Hibbertia hypericoides</i>	60	3	S
	<i>Macrozamia riedlei</i>	50	0.2	S
	<i>Drosera macrantha</i>	30	0.2	H
	<i>Lepyrodia drummondiana</i>	30	0.1	Sedge
	<i>Leucopogon propinquus</i>	30	0.1	S
	<i>Lomandra micrantha</i>	30	0.2	H
	<i>Patersonia occidentalis</i>	30	0.1	H

Cons	Taxon	Ht/cm	%A	Form
Juvenile	<i>Spyridium globulosum</i>	30	0.1	S
	<i>Drosera macrantha</i>	20	0.01	H
	<i>Opercularia hispidula</i>	15	0.1	H
*	<i>Lysimachia arvensis</i>	2	0.1	W
	<i>Trachymene pilosa</i>	2	0.2	H
	<i>Lagenophora huegelii</i>	1	0.1	H
	<i>Drosera erythrorhiza</i>	0.5	0.1	H
*	<i>Hypochaeris glabra</i>	0.5	0.1	W
	<i>Cassutha racemosa</i>	0	0.01	V
	<i>Hardenbergia comptoniana</i>	0	0.1	V

Site	11	Location	115.646, -32.770
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Flat	Soil Colour	Light brown
Bare Ground	N/A	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	E

Additional notes:

Barely any weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1500	20	T
	<i>Agonis flexuosa</i>	1400	30	T
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	300	1	TS
	<i>Xanthorrhoea preissii</i>	300	10	TS
	<i>Melaleuca systema</i>	200	5	TS
	<i>Hemiandra pungens</i>	200	0.1	S
	<i>Templetonia retusa</i>	150	5	TS
	<i>Acacia pulchella</i>	80	0.1	S
	<i>Drosera macrantha</i>	80	0.01	H
	<i>Hibbertia hypericoides</i>	80	10	S
	<i>Macrozamia riedlei</i>	80	0.5	S
	<i>Hakea lissocarpha</i>	60	0.2	S
	<i>Lomandra micrantha</i>	30	0.1	H
	<i>Desmocladius flexuosus</i>	15	0.02	H
	<i>Opercularia hispidula</i>	10	0.1	H
	<i>Orchid</i> sp.	10	0.01	H
	<i>Spyridium globulosum</i>	10	0.1	S
	<i>Lagenophora huegelii</i>	5	0.1	H

Cons	Taxon	Ht/cm	%A	Form
*	<i>Lysimachia arvensis</i>	5	0.02	W
	<i>Trachymene pilosa</i>	5	0.02	H
*	<i>Hypochaeris glabra</i>	1	0.02	W
	<i>Drosera erythrorhiza</i>	0.5	0.1	H
	<i>Cassytha racemosa</i>	0	0.01	V
	<i>Hardenbergia comptoniana</i>	0	0.02	V

Site	12	Location	115.646, -32.779
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Wetland	Soil Colour	Black
Bare Ground	0	Condition	Waterlogged
Cryptogram	N/A	Fire	10+
Soil Type	Clay loam	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1600	5	T
	<i>Eucalyptus petrensis</i>	1500	30	T
	<i>Melaleuca cuticularis</i>	550	80	T
	<i>Banksia littoralis</i>	500	2	T
	<i>Melaleuca raphiophylla</i>	500	10	T
	<i>Melaleuca systema</i>	200	5	TS
	<i>Templetonia retusa</i>	180	5	TS
	<i>Xanthorrhoea preissii</i>	170	8	TS
	<i>Juncus kraussii subsp. australiensis</i>	130	15	Sedge

Cons	Taxon	Ht/cm	%A	Form
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	130	2	S
	<i>Gahnia trifida</i>	120	30	Sedge
	<i>Opercularia hispidula</i>	40	0.1	H
	<i>Lepyrodia drummondiana</i>	30	0.5	Sedge
*	<i>Trachyandra divaricata</i>	30	0.1	W
DP	<i>Zantedeschia aethiopica</i>	20	0.1	W
	<i>Sarcocornia blackiana</i>	20	15	H
	<i>Thysanotus manglesianus</i>	20	0.01	H
	<i>Agonis flexuosa</i>	10	30	T
*	<i>Geranium molle</i>	10	0.1	W
*	<i>Lysimachia arvensis</i>	10	0.02	W
	<i>Orchid</i> sp.	7	0.01	H
	<i>Trachymene pilosa</i>	7	0.02	H
*	<i>Trifolium campestre</i>	5	0.01	W
	<i>Lagenophora huegelii</i>	5	0.1	H
	? <i>Threlkeldia diffusa</i>	5	20	H
	<i>Clematis linearifolia</i>	0	0.1	H
	<i>Clematis pubescens</i>	0	2	V
	<i>Kennedia coccinea</i>	0	0.2	H

Site	13	Location	115.638, -32.769
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Hilltop	Soil Colour	Brown
Bare Ground	5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	G

Additional notes:

Rabbits, weeds, no understorey

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	800	35	T
	<i>Planted Callistemon</i>	300	0.1	S
* DP	<i>Gomphocarpus fruticosus</i>	190	0.5	W
	<i>Xanthorrhoea preissii</i>	130	0.5	S
	<i>Hibbertia cuneiformis</i>	120	3	S
*	<i>Trachyandra divaricata</i>	40	20	W
*	<i>Solanum nigrum</i>	15	0.1	W
*	<i>Trifolium campestre</i>	5	0	W
*	<i>Geranium molle</i>	5	5	W
*	<i>Arctotheca calendula</i>	2	0.01	W
	<i>Clematis linearifolia</i>	0	0.5	V

Site	14	Location	115.636, -32.773
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	4	Condition	Moist
Cryptogram	Yes	Fire	10+
Soil Type	Sandy loam	Condition	G

Additional notes:

Weeds, maybe missing all trees

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus platypus</i>	500	0.1	T
	<i>Acacia cyclops</i>	400	1	TS
	<i>Agonis flexuosa</i>	400	5	T
	<i>Xanthorrhoea preissii</i>	250	50	TS
* DP	<i>Gomphocarpus fruticosus</i>	100	0.1	W
	<i>Melaleuca systema</i>	70	25	S
	<i>Leucopogon propinquus</i>	60	0.1	S
	<i>Hakea prostrata</i>	50	5	S
*	<i>Trachyandra divaricata</i>	40	5	W
	<i>Phyllanthus calycinus</i>	20	0.2	S
*	<i>Arctotheca calendula</i>	5	0.01	W
*	<i>Trifolium campestre</i>	5	0.2	W
*	<i>Geranium molle</i>	2	1	W
*	<i>Hypochaeris glabra</i>	2	0.2	W
*	<i>Lysimachia arvensis</i>	2	0.02	W
*	<i>Brassica tournefortii</i>	0.1	0.01	W

Site	15	Location	115.639, -32.777
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	N/A	Condition	Moist
Cryptogram	N/A	Fire	N/A
Soil Type	Sandy loamy	Condition	VG

Additional notes:

Vg to excellent, weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	2700	20	T
	<i>Agonis flexuosa</i>	900	20	T
	<i>Xanthorrhoea preissii</i>	250	35	TS
	<i>Hibbertia cuneiformis</i>	150	1	S
	<i>Macrozamia riedlei</i>	100	2	S
*	<i>Trachyandra divaricata</i>	30	0.05	W
*	<i>Solanum nigrum</i>	20	0.05	W
	<i>Orchid sp.</i>	10	0.01	H
	<i>Banksia attenuata</i>	8	20	T
*	<i>Trifolium campestre</i>	5	0.02	W
*	<i>Geranium molle</i>	5	0.02	W
*	<i>Lysimachia arvensis</i>	5	0.01	W
*	<i>Hypochaeris glabra</i>	1	0.02	W
	<i>Drosera erythrorhiza</i>	0.5	0.01	H
	<i>Hardenbergia comptoniana</i>	0	1	V

Site	16	Location	115.636, -32.780
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	1	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	G

Additional notes:

Lacking tree stratum

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Xanthorrhoea preissii</i>	200	50	TS
	<i>Lomandra micrantha</i>	50	0.02	H
*	<i>Dittrichia graveolens</i>	45	0	W
	<i>Melaleuca systema</i>	30	0.1	S
*	<i>Trachyandra divaricata</i>	30	1	W
	<i>Hibbertia racemosa</i>	15	0	S
*	<i>Trifolium campestre</i>	5	0.01	W
*	<i>Lysimachia arvensis</i>	5	0.02	W
*	<i>Geranium molle</i>	2	0.02	W
*	<i>Hypochaeris glabra</i>	1	0.5	W
*	<i>Brassica tournefortii</i>	0.1	0.01	W

Site	17	Location	115.639, -32.781
Observers	LvG and FdW		
Date	22/06/2016		

Topography	Ms	Soil Colour	Black brown
Bare Ground	N/A	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	G

Additional notes:

Weeds, declared pests

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Melaleuca huegelii subsp. huegelii</i>	250	2	TS
	<i>Xanthorrhoea preissii</i>	200	7	TS
* DP	<i>Gomphocarpus fruticosus</i>	170	5	W
	<i>Hibbertia cuneiformis</i>	100	3	S
	<i>Melaleuca systema</i>	100	75	S
	<i>Templetonia retusa</i>	80	2	S
	<i>Pimelea sp.</i>	70	0.01	H
*	<i>Trachyandra divaricata</i>	40	5	W
	<i>Leucopogon propinquus</i>	20	0.01	S
*	<i>Arctotheca calendula</i>	2	0.01	W
*	<i>Geranium molle</i>	2	0.02	W
*	<i>Hypochaeris glabra</i>	1	1	W
	<i>Clematis linearifolia</i>	0	1	V

Site	18	Location	115.642, -32.791
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Dune crest	Soil Colour	Brown
Bare Ground	0	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam with lots of organic matter	Condition	G

Additional notes:

Weeds, low diversity and missing understorey stratum

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Acacia rostellifera</i>	600	10	TS
	<i>Agonis flexuosa</i>	600	10	T
	<i>Santalum acuminatum</i>	300	1	T
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	250	20	TS
	<i>Xanthorrhoea preissii</i>	200	0.2	S
	<i>Acanthocarpus preissii</i>	80	20	H
	<i>Hibbertia cuneiformis</i>	80	4	S
	<i>Phyllanthus calycinus</i>	50	0.1	S

Cons	Taxon	Ht/cm	%A	Form
*	<i>Trachyandra divaricata</i>	50	30	W
*	<i>Euphorbia peplus</i>	20	7	W
*	<i>Solanum nigrum</i>	20	2	W
	<i>Eucalyptus gomphocephala</i>	15	5	T
*	<i>Geranium molle</i>	10	1	W
	<i>Clematis linearifolia</i>	0	40	V

Site	19	Location	115.643, -32.790
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Ls	Soil Colour	Grey
Bare Ground	0	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	VG

Additional notes:

Ground stratum all weeds

Can hear cockatoos

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus foecunda</i>	500	50	T
	<i>Spyridium globulosum</i>	400	5	TS
	<i>Hakea prostrata</i>	250	0.1	TS
* DP	<i>Gomphocarpus fruticosus</i>	200	0.1	W
	<i>Xanthorrhoea preissii</i>	200	7	TS
	<i>Planted Callistemon</i>	170	0.01	S
	<i>Melaleuca systema</i>	160	10	TS
	<i>Hibbertia cuneiformis</i>	100	3	S

Cons	Taxon	Ht/cm	%A	Form
	<i>Hibbertia hypericoides</i>	90	5	S
	<i>Leucopogon parviflorus</i>	60	0.1	S
	<i>Templetonia retusa</i>	60	3	S
*	<i>Trachyandra divaricata</i>	50	0.2	W
	<i>Senecio diaschides</i>	15	1	H
	<i>Loxocarya cinerea</i>	10	0.01	H
	<i>Orchid sp.</i>	10	0.01	H
*	<i>Solanum nigrum</i>	7	0.2	W
*	<i>Lysimachia arvensis</i>	5	0.02	W
*	<i>Geranium molle</i>	2	0.2	W
	<i>Trachymene pilosa</i>	2	0.2	H
*	<i>Hypochaeris glabra</i>	1	1	W
	<i>Lagenophora huegelii</i>	1	0.01	H
*	<i>Arctotheca calendula</i>	0.5	0.1	W
	<i>Clematis linearifolia</i>	0	15	V
	<i>Hardenbergia comptoniana</i>	0	0.1	V

Site	20	Location	115.639, -32.785
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	5	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	G

Additional notes:

Weeds no native understorey

Euc gomph over xanth preissii over weeds

Photos:



Site	21	Location	115.636, -32.788
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Dune swale	Soil Colour	Brown to white
Bare Ground	N/A	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	G

Additional notes:

Weed understorey

21a is wetland with types surrounded by euc decipiens and callitris over xanth

Photos:



Wetland Taxon

Cons	Taxon	Ht/cm	%A	Form
	<i>Allocasuarina fraseriana</i>	800	1	T
	<i>Eucalyptus decipiens</i>	700	25	T
	<i>Callitris preissii</i>	600	15	T
	<i>Acacia rostellifera</i>	350	30	TS
	<i>Xanthorrhoea preissii</i>	300	20	TS
	<i>Agonis flexuosa</i>	200	2	TS
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	200	1	TS
	<i>Hibbertia cuneiformis</i>	130	0.1	S

Cons	Taxon	Ht/cm	%A	Form
	<i>Melaleuca systema</i>	100	1	S
	<i>Leucopogon parviflorus</i>	50	0.1	S
*	<i>Trachyandra divaricata</i>	50	20	W
	<i>Lomandra maritima</i>	30	5	H
	<i>Spyridium globulosum</i>	20	0.05	S
*	<i>Solanum nigrum</i>	15	0.05	W
*	<i>Trifolium campestre</i>	5	0.05	W
*	<i>Lysimachia arvensis</i>	5	0.02	W
	<i>Clematis linearifolia</i>	0	0.2	V

Adjacent Vegetation

Cons	Taxon	Ht/cm	%A	Form
	<i>Acacia rostellifera</i>	500	10	TS
	<i>Melaleuca lanceolata</i>	500	8	TS
	<i>Eucalyptus sp. (planted)</i>	400	5	T
	<i>Agonis flexuosa</i>	300	1	TS
	<i>Typha sp.</i>	200	80	Sedge
	<i>Baumea juncea</i>	180	10	Sedge
	<i>Leucopogon parviflorus</i>	80	0.02	S

Site	22	Location	115.646, -32.790
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Ms	Soil Colour	Light brown
Bare Ground	0	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	VG

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	2500	15	T
	<i>Xanthorrhoea preissii</i>	250	75	TS
	<i>Leucopogon parviflorus</i>	150	0	S
	<i>Templetonia retusa</i>	100	0	S
	<i>Melaleuca systema</i>	60	0	S
*	<i>Trachyandra divaricata</i>	40	0.5	W
*	<i>Solanum nigrum</i>	15	0.5	W
*	<i>Geranium molle</i>	10	1	W
*	<i>Trifolium campestre</i>	5	0.02	W
*	<i>Lysimachia arvensis</i>	5	0.05	W
*	<i>Hypochaeris glabra</i>	1	1	W

Site	23	Location	115.656, -32.787
Observers	LvG and FdW		
Date	27/06/2016		

Topography	Ls	Soil Colour	Brown
Bare Ground	0	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	VG

Additional notes:

Understorey weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	2000	15	T
	<i>Banksia grandis</i>	900	2	T
	<i>Banksia attenuata</i>	700	5	T
	<i>Eucalyptus petrensis</i>	700	5	T
	<i>Nuytsia floribunda</i>	600	0	T
	<i>Agonis flexuosa</i>	500	40	T
* DP	<i>Gomphocarpus fruticosus</i>	300	6	W
	<i>Xanthorrhoea preissii</i>	250	7	TS
	<i>Hibbertia cuneiformis</i>	150	0.1	S
	<i>Macrozamia riedlei</i>	100	2	S
*	<i>Trachyandra divaricata</i>	60	5	W
*	<i>Solanum nigrum</i>	15	0.2	W
	<i>Orchid sp.</i>	10	0.01	H
*	<i>Trifolium campestre</i>	5	0.1	W
*	<i>Geranium molle</i>	5	0.2	W
*	<i>Lysimachia arvensis</i>	5	0.2	W
	<i>Trachymene pilosa</i>	5	0.1	H
*	<i>Hypochaeris glabra</i>	1	0.1	W

Cons	Taxon	Ht/cm	%A	Form
	<i>Cassutha racemosa</i>	0	0.02	V
	<i>Clematis pubescens</i>	0	2	V
	<i>Hardenbergia comptoniana</i>	0	0.05	V

Site	24	Location	115.652, -32.782
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Flat	Soil Colour	Black, dark brown
Bare Ground	N/A	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand, loamy	Condition	VG

Additional notes:

Weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1500	20	T
	<i>Agonis flexuosa</i>	900	60	T
	<i>Banksia grandis</i>	400	0.05	T
	<i>Xanthorrhoea preissii</i>	150	4	S
	<i>Templetonia retusa</i>	120	0.2	S
* DP	<i>Gomphocarpus fruticosus</i>	110	1	W
	<i>Macrozamia riedlei</i>	90	2	S
	<i>Hibbertia cuneiformis</i>	60	0.1	S
	<i>Poaceae sp.</i>	15	0.02	W
	<i>Orchid sp.</i>	10	0.01	H
	<i>Thysanotus manglesianus</i>	10	0.01	H
*	<i>Trifolium campestre</i>	5	0.1	W
*	<i>Geranium molle</i>	5	0.02	W
*	<i>Lysimachia arvensis</i>	5	0.1	W
	<i>Orchid sp.</i>	5	0.01	H
	<i>Trachymene pilosa</i>	5	0.1	H
*	<i>Hypochaeris glabra</i>	1	0.1	W
	<i>Lagenophora huegelii</i>	1	0.05	H

Cons	Taxon	Ht/cm	%A	Form
	<i>Drosera erythrorhiza</i>	0.5	0.01	H
	<i>Clematis pubescens</i>	0	10	V

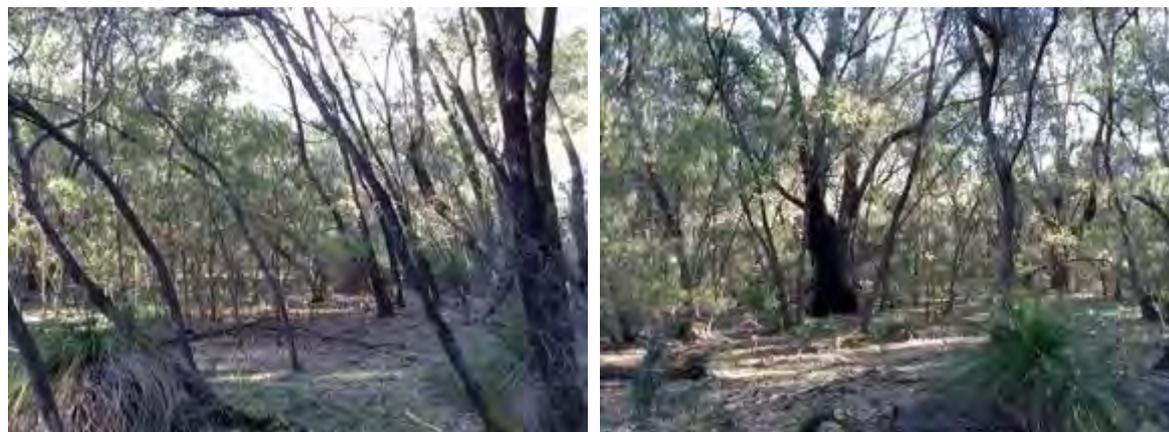
Site	25	Location	115.652, -32.780
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Flat	Soil Colour	Dark brown, grey
Bare Ground	N/A	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loamy	Condition	VG

Additional notes:

Weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1500	15	T
	<i>Agonis flexuosa</i>	1200	60	T
	<i>Banksia grandis</i>	800	0	T
	<i>Xanthorrhoea preissii</i>	220	10	TS
	<i>Macrozamia riedlei</i>	150	7	S
	<i>Templetonia retusa</i>	120	0.5	S
DP	<i>Zantedeschia aethiopica</i>	30	0.02	W
	<i>Orchid sp.</i>	10	0.01	H
	<i>Poaceae sp.</i>	10	0.01	W
*	<i>Solanum nigrum</i>	10	0.05	W
	<i>Thysanotus manglesianus</i>	10	0.02	H
	<i>Trachymene pilosa</i>	10	0.1	H
*	<i>Lysimachia arvensis</i>	5	0.1	W
*	<i>Hypochaeris glabra</i>	1	0.05	W
	<i>Lagenophora huegelii</i>	1	0.01	H
	<i>Clematis pubescens</i>	0	7	V
	<i>Hardenbergia comptoniana</i>	0	0.02	V

Site	26	Location	115.656, -32.808
Observers	LvG and FdW		
Date	23/06/2016		

Topography	Wetlad	Soil Colour	Black
Bare Ground	N/A	Condition	N/A
Cryptogram	N/A	Fire	10+
Soil Type	Loam	Condition	D

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1900	2	T
	<i>Agonis flexuosa</i>	400	2	TS
	<i>Melaleuca teretifolia</i>	300	25	TS
	<i>Melaleuca raphiophylla</i>	300	10	TS
* DP	<i>Gomphocarpus fruticosus</i>	200	2	W
	<i>Gahnia trifida</i>	150	25	Sedge
*	<i>Dittrichia graveolens</i>	30	5	W
	<i>Hibbertia cuneiformis</i>	30	0.1	S
*	<i>Trachyandra divaricata</i>	2	1	W
*	<i>Arctotheca calendula</i>	2	2	W
*	<i>Brassica tournefortii</i>	2	2	W
*	<i>Trifolium campestre</i>	2	2	W
*	<i>Euphorbia peplus</i>	2	2	W
*	<i>Geranium molle</i>	2	2	W
*	<i>Hypochaeris glabra</i>	2	2	W
*	<i>Lysimachia arvensis</i>	2	2	W
*	<i>Solanum nigrum</i>	2	2	W

Site	27	Location	115.653, -32.798
Observers	LvG and FdW		
Date	24/06/2016		

Topography	Ls	Soil Colour	Dark brown
Bare Ground	0	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Loam sand	Condition	G

Additional notes:

Weeds, lacks native understorey

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1600	20	T
	<i>Santalum acuminatum</i>	450	0	T
	<i>Spyridium globulosum</i>	350	0	TS
	<i>Xanthorrhoea preissii</i>	250	25	TS
	<i>Hakea prostrata</i>	200	1	TS
	<i>Melaleuca systema</i>	150	5	S
*	<i>Poaceae sp.</i>	80	0.02	W
*	<i>Trachyandra divaricata</i>	60	60	W
*	<i>Lysimachia arvensis</i>	10	0.05	W
*	<i>Trifolium campestre</i>	5	0.1	W
*	<i>Geranium molle</i>	5	0.1	W
	<i>Trachymene pilosa</i>	5	0.02	H
*	<i>Hypochaeris glabra</i>	1	0.02	W
*	<i>Arctotheca calendula</i>	0.5	0.02	W
*	<i>Brassica tournefortii</i>	0.1	0.01	W
	<i>Cassytha racemosa</i>	0	0.02	V
	<i>Clematis linearifolia</i>	0	7	V

Site	28	Location	115.647, -32.804
Observers	LvG and FdW		
Date	24/06/2016		

Topography	Ls	Soil Colour	Dark brown
Bare Ground	N/A	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	VG

Additional notes:

Weed understorey lacking native trees and shrubs

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1600	20	T
	<i>Acacia rostellifera</i>	400	20	TS
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	350	0.01	TS
	<i>Agonis flexuosa</i>	300	0	T
	<i>Melaleuca systema</i>	250	30	TS
* DP	<i>Gomphocarpus fruticosus</i>	200	0.02	W
	<i>Hibbertia cuneiformis</i>	200	7	TS
	<i>Xanthorrhoea preissii</i>	170	2	TS
DP	<i>Solanum linnaeanum</i>	100	1	W
	<i>Templetonia retusa</i>	100	0.2	S
*	<i>Trachyandra divaricata</i>	70	10	W
*	<i>Arctotheca calendula</i>	10	2	W
*	<i>Brassica tournefortii</i>	10	2	W
*	<i>Trifolium campestre</i>	10	2	W
*	<i>Euphorbia peplus</i>	10	2	W
*	<i>Geranium molle</i>	10	2	W
*	<i>Hypochaeris glabra</i>	10	2	W
*	<i>Lysimachia arvensis</i>	10	2	W

Cons	Taxon	Ht/cm	%A	Form
*	<i>Solanum nigrum</i>	10	2	W
	<i>Clematis linearifolia</i>	0	30	V

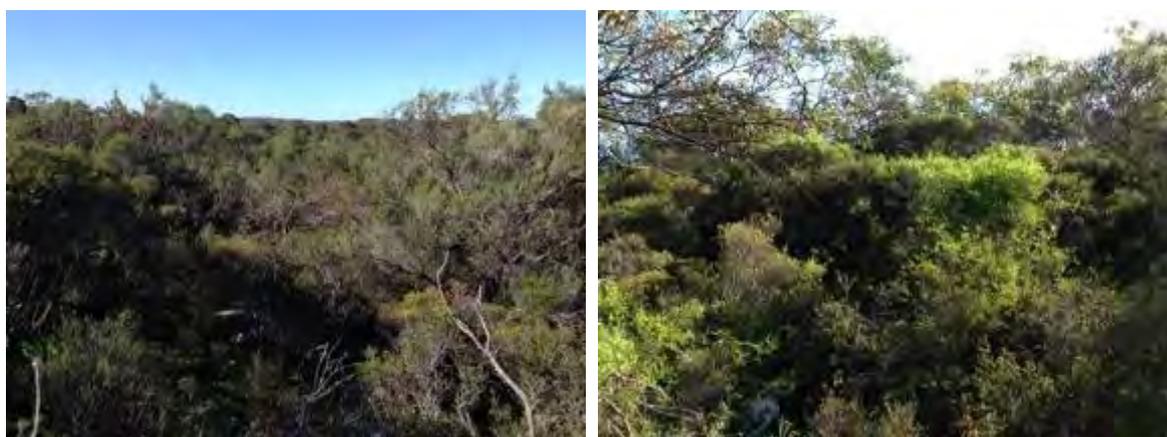
Site	29	Location	115.656, -32.796
Observers	LvG and FdW		
Date	27/06/2016		

Topography	Us sand dunes with limestone	Soil Colour	Brown
Bare Ground	1	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	VG

Additional notes:

Ground cover weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
T	<i>Eucalyptus argutifolia</i>	500	7	T
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	300	5	TS
	<i>Eucalyptus foecunda</i>	250	2	T
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	250	20	TS
	<i>Spyridium globulosum</i>	200	1	TS
	<i>Hakea prostrata</i>	150	0.5	S
	<i>Melaleuca systema</i>	150	50	TS
	<i>Templetonia retusa</i>	150	5	TS
	<i>Hibbertia cuneiformis</i>	130	5	S
	<i>Leucopogon parviflorus</i>	70	0	S
*	<i>Trachyandra divaricata</i>	70	1	W
	<i>Grevillea preissii</i> subsp. <i>preissii</i>	60	2	S
	<i>Banksia dallanneyi</i>	20	0.02	S
*	<i>Geranium molle</i>	15	5	W
*	<i>Solanum nigrum</i>	15	10	W
*	<i>Trifolium campestre</i>	10	0.5	W
*	<i>Lysimachia arvensis</i>	10	20	W
	<i>Orchid</i> sp.	10	0.01	H

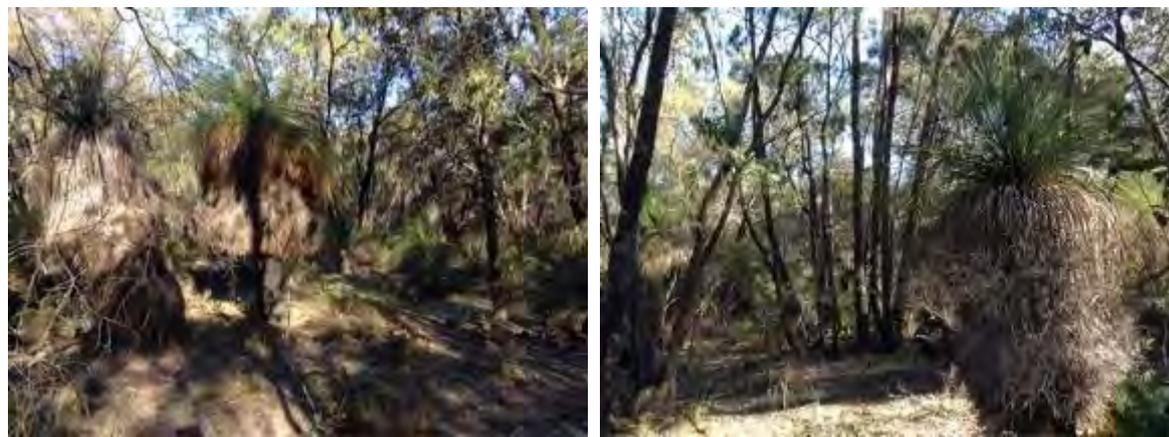
Cons	Taxon	Ht/cm	%A	Form
*	<i>Arctotheca calendula</i>	5	5	W
	<i>Trachymene pilosa</i>	5	0.02	H
*	<i>Hypochaeris glabra</i>	1	2	W
	<i>Clematis linearifolia</i>	0	7	V
	<i>Hardenbergia comptoniana</i>	0	0.2	V

Site	30	Location	115.654, -32.779
Observers	LvG and FdW		
Date	27/06/2016		

Topography	Ls	Soil Colour	Orange to brown
Bare Ground	2	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand some loam	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	800	10	T
	<i>Agonis flexuosa</i>	700	60	T
	<i>Banksia grandis</i>	400	0	T
	<i>Acacia rostellifera</i>	300	0	TS
	<i>Xanthorrhoea preissii</i>	250	8	TS
	<i>Acacia pulchella</i>	170	0.1	S
* DP	<i>Gomphocarpus fruticosus</i>	170	0	W
	<i>Hakea ruscifolia</i>	160	0	S
	<i>Templetonia retusa</i>	150	6	S
	<i>Macrozamia riedlei</i>	100	1	S
	<i>Hibbertia hypericoides</i>	90	12	S
	<i>Phyllanthus calycinus</i>	50	0	S
	<i>Lomandra micrantha</i>	40	0.01	S
	<i>Tetraria octandra</i>	40	0.01	Sedge
	<i>Hibbertia racemosa</i>	30	0.02	S
	<i>Leucopogon propinquus</i>	30	0.01	S
	<i>Leucopogon nutans</i>	20	0	S
	<i>Pterostylis sanguinea</i>	20	0	H

Cons	Taxon	Ht/cm	%A	Form
*	<i>Lysimachia arvensis</i>	10	0.2	W
	<i>Thysanotus manglesianus</i>	10	0	H
*DP	<i>Zantedeschia aethiopica</i>	10	0	W
	<i>Trachymene pilosa</i>	5	0.2	H
*	<i>Hypochaeris glabra</i>	1	0.2	W
*	<i>Arctotheca calendula</i>	0.5	0	W
	<i>Drosera erythrorhiza</i>	0.5	0.02	V
	<i>Clematis pubescens</i>	0	0	V
	<i>Hardenbergia comptoniana</i>	0	0	V
	<i>Drosera macrantha</i>		0.01	V

Site	31	Location	115.634, -32.766
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Sand dune	Soil Colour	Light brown, yellowy
Bare Ground	5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Weeds some are patches

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus sp. (planted)</i>	400	1	T
	<i>Eucalyptus platypus</i>	400	1	T
	<i>Acacia rostellifera</i>	300	20	TS
	<i>Melaleuca huegelii subsp. huegelii</i>	240	18	TS
	<i>Banksia sessilis var. cygnorum</i>	200	1	TS
	<i>Hakea prostrata</i>	150	0	TS
	<i>Melaleuca systema</i>	100	15	S
	<i>Hibbertia cuneiformis</i>	70	4	S
	<i>Phyllanthus calycinus</i>	70	0.5	S

Cons	Taxon	Ht/cm	%A	Form
*	<i>Trachyandra divaricata</i>	50	80	W
	<i>Leucopogon parviflorus</i>	40	0.5	S
	<i>Templetonia retusa</i>	40	0.5	S
	<i>Acanthocarpus preissii</i>	30	3	S
*	<i>Geranium molle</i>	20	0.2	W
*	<i>Solanum nigrum</i>	10	5	W
	<i>Clematis linearifolia</i>	0	10	V

Site	32	Location	115.632, -32.768
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Sand dune	Soil Colour	Brown
Bare Ground	2	Condition	Dry
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Ground cover weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Acacia rostellifera</i>	350	35	TS
	<i>Spyridium globulosum</i>	200	2	TS
	<i>Melaleuca systema</i>	150	20	S
*	<i>Trachyandra divaricata</i>	70	5	W
	<i>Hibbertia cuneiformis</i>	60	0.1	S
	<i>Acanthocarpus preissii</i>	50	20	S
	<i>Phyllanthus calycinus</i>	50	2	S
	<i>Leucopogon parviflorus</i>	40	0.5	S
	<i>Lomandra maritima</i>	40	20	H
	<i>Tetraria octandra</i>	20	0.02	Sedge
*	? <i>Daucus glochidiatus</i>	15	5	W
	<i>Senecio diaschides</i>	15	0.01	H
*	<i>Solanum nigrum</i>	10	0.01	W
*	<i>Trifolium campestre</i>	7	0.02	W
	<i>Orchid sp.</i>	7	0.02	H
	<i>Trachymene pilosa</i>	3	0.01	H
	<i>Clematis linearifolia</i>	0	20	V
	<i>Veronica distans</i>	0	0.01	V

Site	33	Location	115.629, -32.771
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Wetland swale	Soil Colour	Yellow white grey
Bare Ground	5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus decipiens</i>	600	30	T
	<i>Allocasuarina fraseriana</i>	500	0.2	T
	<i>Callitris preissii</i>	400	15	T
	<i>Eucalyptus sp. (planted)</i>	400	5	T
	<i>Melaleuca lanceolata</i>	400	5	T
	<i>Melaleuca raphiophylla</i>	400	1	T
	<i>Acacia rostelifera</i>	300	1	TS
	<i>Eucalyptus sp. (planted)</i>	300	1	T
	<i>Acacia rostelifera</i>	250	10	TS

Cons	Taxon	Ht/cm	%A	Form
	<i>Melaleuca huegelii</i>	250	8	TS
	<i>Templetonia retusa</i>	230	0.5	S
	<i>Spyridium globulosum</i>	200	4	TS
	<i>Typha sp.</i>	200	80	Sedge
	<i>Alyxia buxifolia</i>	100	0.2	S
	<i>Juncus kraussii subsp. australiensis</i>	100	2	Sedge
	<i>Rhagodia baccata subsp. baccata</i>	100	15	V
	<i>Melaleuca systema</i>	80	1	S
	<i>Leucopogon parviflorus</i>	60	0.2	S
	<i>Acanthocarpus preissii</i>	50	3	S
	<i>Phyllanthus calycinus</i>	50	1	S
*	<i>Trachyandra divaricata</i>	30	50	W
*	<i>Solanum nigrum</i>	10	2	W
*	<i>Geranium molle</i>	5	0.5	W

Site	34	Location	115.625, -32.767
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Sand dune	Soil Colour	Cream
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Ground cover weeds

Done from car, torrential rain

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	350	15	TS
	<i>Acacia rostellifera</i>	300	20	TS
	<i>Spyridium globulosum</i>	300	20	TS
	<i>Acacia saligna</i>	200	0	TS
	<i>Olearia axillaris</i>	160	0.5	S
	<i>Anthocercis littorea</i>	150	0	S
	<i>Melaleuca systema</i>	150	0	S
	<i>Phyllanthus calycinus</i>	80	13	S
	<i>Acanthocarpus preissii</i>	40	30	S
*	<i>Trachyandra divaricata</i>	40	5	W
*	<i>Solanum nigrum</i>	5	0.2	W
	<i>Trachymene pilosa</i>	5	0.5	H

Site	35	Location	115.626, -32.772
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Sand dune crest and upper slope	Soil Colour	Cream
Bare Ground	10	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	400	40	T
	<i>Spyridium globulosum</i>	300	10	TS
	<i>Alyxia buxifolia</i>	200	10	S
	<i>Acacia rostelifera</i>	170	15	TS
	<i>Olearia axillaris</i>	150	5	S
	<i>Acanthocarpus preissii</i>	100	10	S
	<i>Diplolaena dampieri</i>	100	7	S
	<i>Hibbertia cuneiformis</i>	80	2	S
*	<i>Trachyandra divaricata</i>	70	7	W
	<i>Scaevola nitida</i>	40	0.5	S
	<i>Phyllanthus calycinus</i>	30	0.5	S
*	<i>Solanum nigrum</i>	15	0.5	W
	<i>Senecio diaschides</i>	10	0.1	H
	<i>Trachymene pilosa</i>	5	0.05	H
	<i>Clematis pubescens</i>	0	0.1	V

Site	36	Location	115.626, -32.773
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Sand dune Swale	Soil Colour	Cream
Bare Ground	10	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Less *Trachyandra divaricata*

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	450	2	T
	<i>Eucalyptus lehmannii</i>	400	2	T
	<i>Melaleuca sp. (huegelii x raphiophylla)</i>	320	1	TS
	<i>Spyridium globulosum</i>	270	15	TS
	<i>Olearia axillaris</i>	250	3	TS
	<i>Alyxia buxifolia</i>	200	5	S
	<i>Acacia rostellifera</i>	100	4	TS
	<i>Diplolaena dampieri</i>	100	4	S
*	<i>Trachyandra divaricata</i>	80	6	W
	<i>Acacia truncata</i>	70	0	S
	<i>Eucalyptus decipiens</i>	70	2	T
	<i>Leucopogon parviflorus</i>	70	1	S
	<i>Acanthocarpus preissii</i>	60	10	S
	<i>Acrotriche cordata</i>	60	0	S
	<i>Phyllanthus calycinus</i>	60	1	S
	<i>Acacia littorea</i>	50	3	S
	<i>Melaleuca huegelii subsp. huegelii</i>	50	1	S
	<i>Carpobrotus virescens</i>	10	2	H
*	<i>Brassica tournefortii</i>	0.1	0.01	W

Site	37	Location	115.629, -32.773
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Sand dune swale	Soil Colour	Cream
Bare Ground	5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Photos:

No Photos

Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	450	3	T
	<i>Acacia saligna</i>	400	1	TS
	<i>Olearia axillaris</i>	300	0.5	TS
	<i>Spyridium globulosum</i>	250	3	TS
	<i>Alyxia buxifolia</i>	200	30	S
	<i>Hibbertia cuneiformis</i>	190	5	S
	<i>Hemiandra pungens</i>	150	0.5	S
	<i>Acacia littorea</i>	100	3	S
	<i>Acanthocarpus preissii</i>	70	3	S
*	<i>Trachyandra divaricata</i>	70	1	W
	<i>Acrotriche cordata</i>	60	5	S
	<i>Leucopogon parviflorus</i>	60	5	S
	<i>Scaevola crassifolia</i>	40	0.1	S
	<i>Veronica distans</i>	35	0.02	V
	<i>Poaceae sp.</i>	15	0.01	W
	<i>Orchid sp.</i>	10	0.01	H
*	<i>Solanum nigrum</i>	10	0.1	W
*	<i>Trifolium campestre</i>	7	0.02	W
	<i>Trachymene pilosa</i>	5	0.01	H
	<i>Clematis pubescens</i>	0	0	V
	<i>Hardenbergia comptoniana</i>	0	0.01	V

Site	38	Location	115.632, -32.773
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Dune Swale and drainage	Soil Colour	Cream
Bare Ground	0	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Understorey weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1300	3	T
	<i>Agonis flexuosa</i>	1000	20	T
	<i>Spyridium globulosum</i>	320	1	TS
	<i>Solanum symonii</i>	220	1	TS
	<i>Alyxia buxifolia</i>	170	4	S
	<i>Lepidosperma gladiatum</i>	120	50	Sedge
	<i>Diplolaena dampieri</i>	100	10	S
	<i>Hibbertia cuneiformis</i>	100	3	S
	<i>Leucopogon parviflorus</i>	80	0.5	S
*	<i>Trachyandra divaricata</i>	80	20	W
	<i>Acanthocarpus preissii</i>	50	1	S
*DP	<i>Zantedeschia aethiopica</i>	30	0.01	W
*	<i>Geranium molle</i>	20	1	W
*	<i>Euphorbia peplus</i>	15	0.5	W
*	<i>Euphorbia peplus</i>	10	0.2	W
*	<i>Solanum nigrum</i>	10	0.02	W
	<i>Clematis linearifolia</i>	0	7	V

Site	39	Location	115.636, -32.772
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Flat	Soil Colour	Brown
Bare Ground	4	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	G

Additional notes:

Understorey weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus sp. (planted)</i>	600	3	T
	<i>Agonis flexuosa</i>	500	20	T
	<i>Xanthorrhoea preissii</i>	300	4	TS
	<i>Hibbertia cuneiformis</i>	120	4	S
*	<i>Trachyandra divaricata</i>	80	10	W
*	<i>Euphorbia peplus</i>	20	3	W
*	<i>Geranium molle</i>	15	3	W
*	<i>Solanum nigrum</i>	15	0.5	W
*	<i>Hypochaeris glabra</i>	1	0.2	W

Site	40	Location	115.644, -32.774
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Wetland	Soil Colour	Black with grey
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	650	2	T
	<i>Agonis flexuosa</i>	600	85	T
	<i>Melaleuca raphiophylla</i>	250	1	T
	<i>Acacia saligna</i>	220	1	TS
	<i>Gahnia trifida</i>	150	2	Sedge
	<i>Juncus kraussii subsp. australiensis</i>	130	95	Sedge
	<i>Olearia axillaris</i>	120	0.5	H
	<i>Haemodorum sp.</i>	120	0.01	S
	<i>Leucopogon parviflorus</i>	100	1	S
	<i>Spyridium globulosum</i>	100	1	S
*	<i>Trachyandra divaricata</i>	70	0.5	W
*	<i>Geranium molle</i>	15	0.05	W
*	<i>Lysimachia arvensis</i>	10	0.05	W
	<i>Orchid sp.</i>	10	0.02	H
	<i>Trachymene pilosa</i>	5	0.02	H
*	<i>Hypochoeris glabra</i>	1	0.02	W
	<i>Hardenbergia comptoniana</i>	0	0.02	V

Site	41	Location	115.645, -32.780
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	500	3	TS
	<i>Eucalyptus foecunda</i>	350	5	T
	<i>Acacia rostelifera</i>	300	0	TS
	<i>Xanthorrhoea preissii</i>	300	3	TS
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	270	60	S
* DP	<i>Gomphocarpus fruticosus</i>	250	0.8	W
	<i>Melaleuca systena</i>	170	15	S
	<i>Templetonia retusa</i>	170	15	S
	<i>Leucopogon parviflorus</i>	90	0.2	S

Cons	Taxon	Ht/cm	%A	Form
*	<i>Trachyandra divaricata</i>	70	7	W
	<i>Hibbertia cuneiformis</i>	30	0.1	S
	<i>Thysanotus manglesianus</i>	20	0.01	H
	<i>Poaceae sp.</i>	15	0	W
*	<i>Arctotheca calendula</i>	10	0.2	W
*	<i>Euphorbia peplus</i>	10	0.2	W
*	<i>Geranium molle</i>	10	0.5	W
*	<i>Solanum nigrum</i>	10	0.5	W
*	<i>Trifolium campestre</i>	5	0.1	W
*	<i>Lysimachia arvensis</i>	5	0.5	W
	<i>Orchid sp.</i>	5	0	H
*	<i>Hypochaeris glabra</i>	1	0.2	W
	<i>Clematis linearifolia</i>	0	0.2	V
	<i>Clematis pubescens</i>	0	0.2	V
	<i>Hardenbergia comptoniana</i>	0	0.2	V

Site	42a	Location	115.652, -32.793
Observers	LvG and FdW		
Date	28/06/2016		

Topography	Hilltop	Soil Colour	Brown
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	VG

Additional notes:

Still weeds present

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	400	0.5	T
	<i>Melaleuca huegelii subsp. huegelii</i>	250	7	TS
	<i>Xanthorrhoea preissii</i>	200	0.2	TS
* DP	<i>Gomphocarpus fruticosus</i>	170	1	W
	<i>Hakea prostrata</i>	150	1	S
	<i>Templetonia retusa</i>	150	3	S
	<i>Melaleuca systema</i>	120	7	S
	<i>Melaleuca systema</i>	100	55	S
*	<i>Trachyandra divaricata</i>	80	3	W
	<i>Pimelea sp.</i>	40	0.01	S
	<i>Hibbertia racemosa</i>	30	0.01	S
*	<i>Trifolium campestre</i>	10	0.5	W
*	<i>Geranium molle</i>	10	0.1	W
*	<i>Hypochaeris glabra</i>	1	0.1	W
	<i>Lagenophora huegelii</i>	1	0.1	H
	<i>Clematis linearifolia</i>	0	0.5	V

Site	42b	Location	115.652, -32.794
Observers	LvG and FdW		
Date	28/06/2016		

Topography	N/A	Soil Colour	N/A
Bare Ground	N/A	Condition	N/A
Cryptogram	N/A	Fire	N/A
Soil Type	N/A	Condition	N/A

Additional notes:

Isolated stands of *Euc foecunda*

Photos:



Site	43	Location	115.633, -32.778
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune us	Soil Colour	Brown
Bare Ground	4	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Some weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Acacia rostellifera</i>	350	30	TS
	<i>Melaleuca systema</i>	130	6	S
	<i>Xanthorrhoea preissii</i>	130	2	S
	<i>Hibbertia cuneiformis</i>	120	1	S
	<i>Acanthocarpus preissii</i>	80	0.1	S
	<i>Spyridium globulosum</i>	80	0.01	S
	<i>Leucopogon parviflorus</i>	70	0.5	S
	<i>Phyllanthus calycinus</i>	70	7	S
*	<i>Trachyandra divaricata</i>	70	2	W
	<i>Lomandra maritima</i>	30	6	H
*	<i>Arctotheca calendula</i>	10	0.1	W
	<i>Orchid sp.</i>	10	0.01	H
*	<i>Solanum nigrum</i>	10	0.2	W
	<i>Thysanotus manglesianus</i>	10	0.1	H
*	<i>Lysimachia arvensis</i>	5	0.5	W
	<i>Trachymene pilosa</i>	5	0.1	H
*	<i>Hypochoeris glabra</i>	1	0.1	W
	<i>Clematis linearifolia</i>	0	4	V
	<i>Hardenbergia comptoniana</i>	0	0.1	V

Site	44	Location	115.629, -32.777
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Wetland	Soil Colour	N/A
Bare Ground	N/A	Condition	N/A
Cryptogram	N/A	Fire	10+
Soil Type	N/A	Condition	VG

Additional notes:

Planted and weeds dominate ground cover. Drainage line, planted Eucalypts, Grevillea and Acacia over *Trachyandra divaricata*. Some natives (*Hibbertia cuneiformis*, *Acanthocarpus preissii*, *Xanthorrhoea preissii*).

Photos:



Site	45	Location	115.628, -32.769
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Dune Swale	Soil Colour	Brown
Bare Ground	10	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Weeds, eucalypts are planted

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	800	30	T
	<i>Eucalyptus platypus</i>	800	1	T
	<i>Acacia rostellifera</i>	210	1	TS
	<i>Spyridium globulosum</i>	150	3	TS
	<i>Hibbertia cuneiformis</i>	120	0.5	S
	<i>Melaleuca systema</i>	100	10	S
	<i>Rhagodia baccata subsp. baccata</i>	100	5	V
*	<i>Trachyandra divaricata</i>	70	20	W
	<i>Leucopogon parviflorus</i>	40	0.5	S

Cons	Taxon	Ht/cm	%A	Form
	<i>Phyllanthus calycinus</i>	40	0.1	S
	<i>Acanthocarpus preissii</i>	20	0.1	S
*	<i>Geranium molle</i>	15	0.1	W
	<i>Orchid sp.</i>	10	0.01	H
	<i>Senecio diaschides</i>	10	0.01	H
	<i>Thysanotus manglesianus</i>	10	0.05	H
*	<i>Trifolium campestre</i>	5	0.05	W
	<i>Trachymene pilosa</i>	3	0.05	H
	<i>Cassutha racemosa</i>	0	0.01	V
	<i>Clematis linearifolia</i>	0	1	V

Site	46	Location	115.628, -32.768
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune us	Soil Colour	Cream
Bare Ground	2	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Dark green is dense spyridium. More open is more diverse understorey

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	400	5	T
	<i>Eucalyptus platypus</i>	400	8	T
	<i>Spyridium globulosum</i>	250	60	TS
	<i>Leucopogon parviflorus</i>	150	1	S
	<i>Olearia axillaris</i>	120	1	S
	<i>Acrotriche cordata</i>	100	1	S
	<i>Comesperma ?flavum</i>	90	0.02	S
	<i>Trymalium ledifolium var. ledifolium</i>	90	0.1	S
	<i>Acacia littorea</i>	80	0.5	S

Cons	Taxon	Ht/cm	%A	Form
	<i>Alyxia buxifolia</i>	80	1	S
	<i>Templetonia retusa</i>	80	0.5	S
	<i>Lomandra maritima</i>	70	30	H
	<i>Acanthocarpus preissii</i>	60	3	S
	<i>Melaleuca systema</i>	60	1	S
	<i>Lepidosperma squamatum</i>	50	0.1	Sedge
	<i>Phyllanthus calycinus</i>	50	0.5	S
P3	<i>Stylidium maritimum</i>	30	0.05	H
	<i>Desmocladius flexuosus</i>	20	0.05	H
*	<i>Trifolium campestre</i>	5	0.1	W
	<i>Trachymene pilosa</i>	5	10	H
	<i>Cassutha racemosa</i>	0	0.1	V

Site	47	Location	115.627, -32.768
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune crest	Soil Colour	Cream
Bare Ground	15	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	200	2	TS
	<i>Spyridium globulosum</i>	100	4	TS
	<i>Templetonia retusa</i>	100	5	S
	<i>Jacksonia furcellata</i>	90	0.1	S
	<i>Acrotriche cordata</i>	80	5	S
	<i>Leucopogon parviflorus</i>	70	1	S
	<i>Melaleuca systema</i>	70	5	S
	<i>Acacia cochlearis</i>	60	5	S
	<i>Acanthocarpus preissii</i>	60	10	S
	<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	50	0.1	S
	<i>Hemiandra pungens</i>	30	4	S
	<i>Pimelea ferruginea</i>	30	0.8	S
P3	<i>Stylidium maritimum</i>	30	0.1	H
	<i>Acacia littorea</i>	20	0.5	S
	<i>Veronica distans</i>	20	0.01	V
	<i>Lomandra maritima</i>	20	9	H
	<i>Cryptandra mutila</i>	5	0.01	S
	<i>Cassytha racemosa</i>	0	0.5	V

Site	48	Location	115.627, -32.778
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Dune swale	Soil Colour	Cream
Bare Ground	3	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	400	6	T
	<i>Acacia rostellifera</i>	300	5	TS
	<i>Acacia rostellifera</i>	200	15	TS
	<i>Alyxia buxifolia</i>	200	1	TS
	<i>Spyridium globulosum</i>	200	1	TS
	<i>Diplolaena dampieri</i>	170	50	S
	<i>Leucopogon parviflorus</i>	150	0.5	S
	<i>Acanthocarpus preissii</i>	100	30	S
	<i>Opercularia hispidula</i>	100	0.2	S

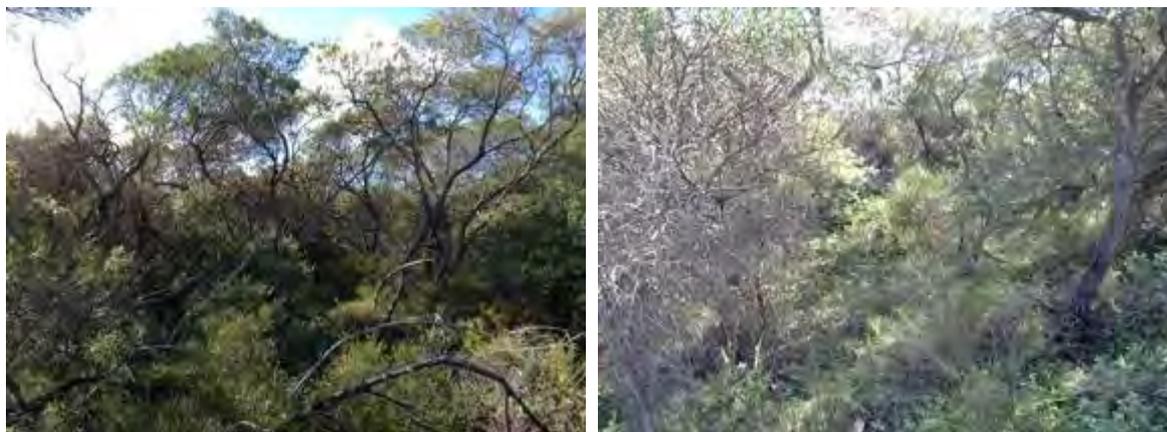
Cons	Taxon	Ht/cm	%A	Form
	<i>Rhagodia baccata subsp. baccata</i>	90	2	S
	<i>Phyllanthus calycinus</i>	80	1	S
*	<i>Trachyandra divaricata</i>	80	10	W
	<i>Lepidosperma squamatum</i>	40	0.01	Sedge
*	<i>Solanum nigrum</i>	15	5	W
	<i>Orchid sp.</i>	10	0.01	H
	<i>Senecio diaschides</i>	10	0.1	H
	<i>Trachymene pilosa</i>	5	0.1	H
	<i>Clematis linearifolia</i>	0	2	V
	<i>Clematis pubescens</i>	0	1	V

Site	49	Location	115.629, -32.781
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune ms	Soil Colour	Cream
Bare Ground	2	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	450	2	T
	<i>Acacia rostellifera</i>	400	30	TS
	<i>Spyridium globulosum</i>	300	30	TS
	<i>Acacia rostellifera</i>	200	0.2	TS
	<i>Acanthocarpus preissii</i>	120	25	S
	<i>Melaleuca systema</i>	120	5	S
	<i>Leucopogon parviflorus</i>	100	3	S
	<i>Phyllanthus calycinus</i>	90	8	S
*	<i>Trachyandra divaricata</i>	80	4	W
	<i>Tetraria octandra</i>	40	0.1	Sedge
	<i>Hibbertia cuneiformis</i>	20	0.2	S
	<i>Leucopogon nutans</i>	20	0.1	S
	<i>Lomandra maritima</i>	20	0.1	H
*	<i>Solanum nigrum</i>	15	1	W
	<i>Orchid sp.</i>	10	0.01	H
	<i>Poaceae sp.</i>	10	0.02	G
	<i>Senecio diaschides</i>	10	0.02	H
*	<i>Trifolium campestre</i>	5	0.01	W

Cons	Taxon	Ht/cm	%A	Form
	<i>Trachymene pilosa</i>	5	0.02	H
	<i>Hardenbergia comptoniana</i>	0	0.1	V

Site	50	Location	115.628, -32.782
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune us	Soil Colour	Cream
Bare Ground	4	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Spyridium globulosum</i>	300	20	TS
	<i>Acacia rostellifera</i>	250	0	TS
	<i>Olearia axillaris</i>	250	2	TS
	<i>Alyxia buxifolia</i>	230	3	S
	<i>Rhagodia baccata subsp. baccata</i>	210	2	V
	<i>Diplolaena dampieri</i>	190	20	S
	<i>Threlkeldia diffusa</i>	160	0.5	H
	<i>Acanthocarpus preissii</i>	100	1	S
	<i>Melaleuca systema</i>	90	0.5	S
*	<i>Trachyandra divaricata</i>	70	0.1	W
	<i>Phyllanthus calycinus</i>	60	0.2	S
	<i>Leucopogon parviflorus</i>	50	0	S
	<i>Tetraria octandra</i>	40	0.1	Sedge
*	<i>Geranium molle</i>	15	0.02	W
	<i>Senecio diaschides</i>	15	0.02	H
*	<i>Solanum nigrum</i>	15	0.8	W
	<i>Trachymene pilosa</i>	5	0.02	H
	<i>Cassytha racemosa</i>	0	0.5	V
	<i>Hardenbergia comptoniana</i>	0	1.5	V

Site	51	Location	115.629, -32.785
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune crest	Soil Colour	Cream
Bare Ground	40	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Rabbits

Photos:



Site	52	Location	115.629, -32.790
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune ms	Soil Colour	Brown
Bare Ground	5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Acacia rostellifera</i>	350	25	TS
	<i>Spyridium globulosum</i>	275	10	TS
	<i>Alyxia buxifolia</i>	170	0.5	S
	<i>Olearia axillaris</i>	170	1	S
	<i>Rhagodia baccata subsp. baccata</i>	120	8	V
	<i>Acanthocarpus preissii</i>	80	5	SS
	<i>Hibbertia cuneiformis</i>	80	0.2	S
	<i>Phyllanthus calycinus</i>	80	6	S
*	<i>Trachyandra divaricata</i>	70	8	W
	<i>Melaleuca systena</i>	60	1	S
	<i>Leucopogon parviflorus</i>	50	1	S
	<i>Tetraria octandra</i>	30	0.02	Sedge
	<i>Veronica distans</i>	25	0.01	V
	<i>Threlkeldia diffusa</i>	20	0.1	H
	<i>Opercularia hispidula</i>	20	0.1	H
	<i>Orchid sp.</i>	15	0.01	H
	<i>Senecio diaschides</i>	15	0.02	H
*	<i>Lysimachia arvensis</i>	5	0	W
*	<i>Solanum nigrum</i>	5	0.1	W

Cons	Taxon	Ht/cm	%A	Form
	<i>Trachymene pilosa</i>	5	0.01	H
	<i>Clematis linearifolia</i>	0	2	V

Site	53	Location	115.632, -32.793
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune ms	Soil Colour	Brown
Bare Ground	3	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Some weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	500	15	T
	<i>Spyridium globulosum</i>	240	8	TS
	<i>Acacia rostellifera</i>	220	8	TS
	<i>Acacia saligna</i>	200	0.5	TS
	<i>Rhagodia baccata subsp. baccata</i>	160	1	V
	<i>Hibbertia cuneiformis</i>	130	8	S
	<i>Melaleuca systena</i>	100	10	S
	<i>Acanthocarpus preissii</i>	80	5	S
*	<i>Trachyandra divaricata</i>	70	10	W

Cons	Taxon	Ht/cm	%A	Form
	<i>Leucopogon parviflorus</i>	60	0.1	S
	<i>Phyllanthus calycinus</i>	50	7	S
	<i>Lomandra maritima</i>	30	0.2	H
*	<i>Arctotheca calendula</i>	15	0.1	W
*	<i>Geranium molle</i>	15	0.1	W
	<i>Orchid sp.</i>	10	0.01	H
*	<i>Solanum nigrum</i>	10	1	W
*	<i>Trifolium campestre</i>	5	0.02	W
*	<i>Lysimachia arvensis</i>	5	0.05	W
	<i>Trachymene pilosa</i>	5	0.02	H
	<i>Cassytha racemosa</i>	0	0.1	V
	<i>Clematis linearifolia</i>	0	0.5	V
	<i>Hardenbergia comptoniana</i>	0	1	V

Site	54	Location	115.637, -32.793
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Sand dune ms	Soil Colour	Cream
Bare Ground	7	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	E

Additional notes:

Bare areas of weeds only in sight

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Agonis flexuosa</i>	350	0.5	T
	<i>Acacia rostellifera</i>	300	25	TS
	<i>Acanthocarpus preissii</i>	80	3	S
	<i>Cryptandra mutila</i>	80	0.02	S
	<i>Templetonia retusa</i>	60	2	S
	<i>Leucopogon parviflorus</i>	50	0.1	S
	<i>Melaleuca systema</i>	50	30	S
	<i>Phyllanthus calycinus</i>	50	8	S
	<i>Lepidosperma squamatum</i>	40	0	Sedge
*	<i>Trachyandra divaricata</i>	40	1	W
	<i>Lomandra maritima</i>	30	20	H
	<i>Orchid sp.</i>	10	0.01	H
*	<i>Arctotheca calendula</i>	5	0.2	W
*	<i>Trifolium campestre</i>	5	0.2	W
*	<i>Lysimachia arvensis</i>	5	0.2	W
	<i>Trachymene pilosa</i>	5	0.2	H
	<i>Clematis linearifolia</i>	0	2	V

Site	55	Location	115.657, -32.807
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Wetland	Soil Colour	Black brown
Bare Ground	3	Condition	Waterlogged
Cryptogram	N/A	Fire	10+
Soil Type	Loam	Condition	VG

Additional notes:

Weeds, lacking structure

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Melaleuca teretifolia</i>	230	10	TS
	<i>Melaleuca raphiophylla</i>	230	30	TS
	<i>Melaleuca lanceolata</i>	200	3	TS
	<i>Gahnia trifida</i>	160	60	Sedge
*	<i>Trachyandra divaricata</i>	50	2	W
*	<i>Dittrichia graveolens</i>	30	2	W
*	<i>Arctotheca calendula</i>	5	2	W
*	<i>Trifolium campestre</i>	5	3	W
*	<i>Geranium molle</i>	5	1	W
*	<i>Hypochaeris glabra</i>	5	5	W
*	<i>Lysimachia arvensis</i>	5	3	W
*	<i>Brassica tournefortii</i>	0.1	1	W
	<i>Clematis linearifolia</i>	0	1	V

Site	56	Location	115.654, -32.811
Observers	LvG and FdW		
Date	29/06/2016		

Topography	Ms	Soil Colour	Light brown
Bare Ground	5	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	VG

Additional notes:

Rows of cleared veg

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Acacia cyclops</i>	500	5	TS
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	500	8	TS
	<i>Hakea prostrata</i>	300	10	S
	<i>Xanthorrhoea preissii</i>	200	30	TS
	<i>Hakea ruscifolia</i>	180	1	S
	<i>Spyridium globulosum</i>	180	2	TS
	<i>Solanum symonii</i>	160	1	TS
	<i>Hibbertia cuneiformis</i>	100	5	S
	<i>Templetonia retusa</i>	100	15	S
	<i>Acacia pulchella</i>	80	0.05	S
	<i>Melaleuca systema</i>	80	15	S
*	<i>Trachyandra divaricata</i>	70	1	W
	<i>Desmocladius flexuosus</i>	50	0.01	H
	<i>Phyllanthus calycinus</i>	50	0.5	S
	<i>Hibbertia hypericoides</i>	40	4	S
	<i>Astroloma pallidum</i>	30	0.02	S
*	<i>Avena barbata</i>	30	0.1	W
	<i>Hibbertia racemosa</i>	30	0.1	S

Cons	Taxon	Ht/cm	%A	Form
*	<i>Geranium molle</i>	20	1	W
*	<i>Euphorbia peplus</i>	10	1	W
*	<i>Solanum nigrum</i>	10	0.2	W
*	<i>Arctotheca calendula</i>	5	0.5	W
*	<i>Lysimachia arvensis</i>	5	1	W
*	<i>Hypochaeris glabra</i>	1	4	W
*	<i>Brassica tournefortii</i>	0.1	1	W
	<i>Clematis linearifolia</i>	0	2	V

Site	57	Location	115.648, -32.804
Observers	LvG and FdW		
Date	30/06/2016		

Topography	Secondary dune crest	Soil Colour	Orange
Bare Ground	4	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Altered structure from linear row clearing

Photos:



Cons	Taxon	Ht/cm	%A	Form
	Acacia saligna	500	1	TS
	Agonis flexuosa	450	5	T
	Agonis flexuosa	300	3	T
	Banksia sessilis var. cygnorum	270	0.2	TS
	Acacia littorea	200	2	S
	Hakea prostrata	200	0.2	TS
	Spyridium globulosum	200	15	TS
	Templetonia retusa	200	4	TS
	Hibbertia cuneiformis	180	8	S
	Hibbertia cuneiformis	180	8	S
	Olearia axillaris	170	4	S
	Xanthorrhoea preissii	170	0.5	S
	Alyxia buxifolia	130	1	S
* DP	Gomphocarpus fruticosus	120	0.01	W
	Melaleuca systema	120	50	S
	Jacksonia furcellata	110	0.5	S
	Acacia cochlearis	80	8	S
	Melaleuca systema	80	4	S

Cons	Taxon	Ht/cm	%A	Form
	<i>Leucopogon parviflorus</i>	70	2	S
	<i>Phyllanthus calycinus</i>	70	1	S
	<i>Phyllanthus calycinus</i>	70	4	S
*	<i>Trachyandra divaricata</i>	70	0.4	W
*	<i>Trachyandra divaricata</i>	70	7	W
	<i>Acanthocarpus preissii</i>	60	3	S
	<i>Acacia cyclops</i>	40	0	S
	<i>Lomandra maritima</i>	20	0.5	H
P3	<i>Stylidium maritimum</i>	20	0.5	H
	<i>Carpobrotus virescens</i>	15	0.5	H
	<i>Desmodium flexuosus</i>	15	0.2	H
*	<i>Euphorbia peplus</i>	15	1	W
	Poaceae sp.	15	0.1	G
*	<i>Geranium molle</i>	10	1	W
	<i>Hibbertia racemosa</i>	10	0	S
	<i>Senecio diaschides</i>	10	0.01	H
*	<i>Solanum nigrum</i>	10	0.2	W
*	<i>Arctotheca calendula</i>	5	0.5	W
*	<i>Lysimachia arvensis</i>	5	0.2	W
*	<i>Solanum nigrum</i>	5	0.2	W
*	<i>Hypochaeris glabra</i>	1	1	W
*	<i>Brassica tournefortii</i>	0.1	0.5	W
	<i>Clematis linearifolia</i>	0	2	V
	<i>Hardenbergia comptoniana</i>	0	0.5	V

Site	58	Location	115.648, -32.802
Observers	LvG and FdW		
Date	30/06/2016		

Topography	Ms	Soil Colour	Orange
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand	Condition	VG

Additional notes:

Clearing of rows

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Acacia saligna</i>	500	1	TS
	<i>Nuytsia floribunda</i>	450	4	T
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	270	0.2	TS
	<i>Hakea prostrata</i>	200	0.2	TS
	<i>Templetonia retusa</i>	200	4	TS
	<i>Hibbertia cuneiformis</i>	180	8	S
	<i>Xanthorrhoea preissii</i>	170	0.5	S
* DP	<i>Gomphocarpus fruticosus</i>	120	0.01	W
	<i>Melaleuca systena</i>	120	50	S
	<i>Phyllanthus calycinus</i>	70	4	S
*	<i>Trachyandra divaricata</i>	70	7	W
	<i>Acacia cyclops</i>	40	0	S
*	<i>Euphorbia peplus</i>	15	1	W
	<i>Poaceae</i> sp.	15	0.1	G
*	<i>Geranium molle</i>	10	1	W
	<i>Hibbertia racemosa</i>	10	0	S
*	<i>Solanum nigrum</i>	10	0.2	W
*	<i>Arctotheca calendula</i>	5	0.5	W

Cons	Taxon	Ht/cm	%A	Form
*	<i>Lysimachia arvensis</i>	5	0.2	W
*	<i>Hypochaeris glabra</i>	1	1	W
*	<i>Brassica tournefortii</i>	0.1	0.5	W
	<i>Clematis linearifolia</i>	0	2	V

Site	59	Location	115.651, -32.813
Observers	LvG and FdW		
Date	30/06/2016		

Topography	Ms	Soil Colour	Brown
Bare Ground	1	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sand loam	Condition	VG

Additional notes:

Row clearing, weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus decipiens</i>	800	0.1	T
	<i>Agonis flexuosa</i>	500	5	T
	<i>Nuytsia floribunda</i>	450	0	T
	<i>Banksia sessilis var. cygnorum</i>	350	5	TS
	<i>Hakea prostrata</i>	350	4	TS
* DP	<i>Gomphocarpus fruticosus</i>	200	2	W
	<i>Templetonia retusa</i>	200	10	TS
	<i>Xanthorrhoea preissii</i>	200	10	TS
	<i>Hibbertia cuneiformis</i>	170	15	S
	<i>Melaleuca systema</i>	130	30	S
	<i>Leucopogon parviflorus</i>	120	0.2	
*	<i>Trachyandra divaricata</i>	70	30	W
*	<i>Solanum nigrum</i>	60	3	W
	<i>Hibbertia racemosa</i>	40	0.2	S
*	<i>Euphorbia peplus</i>	10	10	W
*	<i>Euphorbia peplus</i>	10	10	W
*	<i>Lupinus sp.</i>	10	0	W
*	<i>Brassica tournefortii</i>	1	0	W

Cons	Taxon	Ht/cm	%A	Form
*	<i>Hypochaeris glabra</i>	1	1	W
	<i>Trachymene pilosa</i>	1	0.01	H
*	<i>Arctotheca calendula</i>	0.5	1	W
	<i>Clematis linearifolia</i>	0	0.5	V

Site	60	Location	
Observers	LvG and FdW		
Date	30/06/2016		

Topography		Soil Colour	
Bare Ground		Condition	
Cryptogram		Fire	
Soil Type		Condition	

Additional notes:

Photos:

Cons	Taxon	Ht/cm	%A	Form
	<i>Hakea prostrata</i>	270	6	TS
	<i>Templetonia retusa</i>	220	10	TS
	<i>Banksia sessilis var. cygnorum</i>	200		TS
	<i>Acacia cochlearis</i>	170	0.5	S
* DP	<i>Gomphocarpus fruticosus</i>	150	0.2	W
	<i>Hibbertia cuneiformis</i>	150	10	S
	<i>Melaleuca systema</i>	120	40	S
*	<i>Trachyandra divaricata</i>	70	7	W
	<i>Phyllanthus calycinus</i>	60	0.2	S
	<i>Hibbertia racemosa</i>	50	0.2	S
*	<i>Dittrichia graveolens</i>	30	0	W
*	<i>Euphorbia peplus</i>	10	1	W
*	<i>Lupinus sp.</i>	10	0.1	W
*	<i>Brassica tournefortii</i>	1	0	W
*	<i>Hypochaeris glabra</i>	1	1	W
	<i>Trachymene pilosa</i>	1	0.01	H
*	<i>Arctotheca calendula</i>	0.5	1	W

Site	61	Location	115.653, -32.817
Observers	LvG and FdW		
Date	30/06/2016		

Topography	Us	Soil Colour	Brown
Bare Ground	0	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	VG

Additional notes:

Cleared rows, weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus decipiens</i>	600	0	T
	<i>Agonis flexuosa</i>	350	1	T
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	270	4	TS
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	220	3	TS
	<i>Spyridium globulosum</i>	200	0	TS
	<i>Templetonia retusa</i>	200	10	TS
* DP	<i>Gomphocarpus fruticosus</i>	150	0.2	W
	<i>Hibbertia cuneiformis</i>	120	8	S
	<i>Melaleuca systena</i>	120	50	S
	<i>Xanthorrhoea preissii</i>	110	0.5	S
* DP	<i>Gomphocarpus fruticosus</i>	100	0.1	W
	<i>Leucopogon parviflorus</i>	100	0.5	
	<i>Phyllanthus calycinus</i>	80	1	S
*	<i>Trachyandra divaricata</i>	60	7	W
	<i>Grevillea preissii</i> subsp. <i>preissii</i>	40	0.1	S
*	<i>Dittrichia graveolens</i>	30	0	W
	<i>Hibbertia racemosa</i>	30	0	S
	<i>Senecio diaschides</i>	15	0.01	H

Cons	Taxon	Ht/cm	%A	Form
	<i>Hakea prostrata</i>	10	0.02	S
	<i>Poaceae sp.</i>	10	0.02	G
*	<i>Geranium molle</i>	5	0.5	W
*	<i>Hypochaeris glabra</i>	5	0.5	W
*	<i>Lysimachia arvensis</i>	5	0.5	W
*	<i>Arctotheca calendula</i>	0.5	0.05	W
*	<i>Brassica tournefortii</i>	0.1	0.1	W

Site	62	Location	115.655, -32.815
Observers	LvG and FdW		
Date	30/06/2016		

Topography	Ls	Soil Colour	Dark brown
Bare Ground	0	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Loam sand	Condition	VG

Additional notes:

Cleared rows, weeds

Photos:



Cons	Taxon	Ht/cm	%A	Form
	<i>Eucalyptus gomphocephala</i>	1800	2	T
	<i>Agonis flexuosa</i>	1100	40	T
	<i>Eucalyptus marginata</i>	700	20	T
	<i>Xanthorrhoea preissii</i>	190	5	S
	<i>Hibbertia cuneiformis</i>	140	8	S
	<i>Macrozamia riedlei</i>	100	1	S
	<i>Melaleuca systema</i>	100	0.2	S
	<i>Hibbertia hypericoides</i>	80	3	
	<i>Hakea lissocarpha</i>	60	1	S
	<i>Senecio diaschides</i>	30	0.01	H
*	<i>Geranium molle</i>	10	0.02	W
	<i>Orchid sp.</i>	10	0.01	H
	<i>Poaceae sp.</i>	10	0.02	G
*	<i>Lysimachia arvensis</i>	5	0.05	W
*	<i>Hypochaeris glabra</i>	1	0.02	W
	<i>Hardenbergia comptoniana</i>	0	2	V

Site	63	Location	115.653, -32.813
Observers	LvG and FdW		
Date	30/06/2016		

Topography	Us to ms	Soil Colour	Brown
Bare Ground	N/A	Condition	Moist
Cryptogram	N/A	Fire	10+
Soil Type	Sandy loam	Condition	VG

Additional notes:

Cleared rows

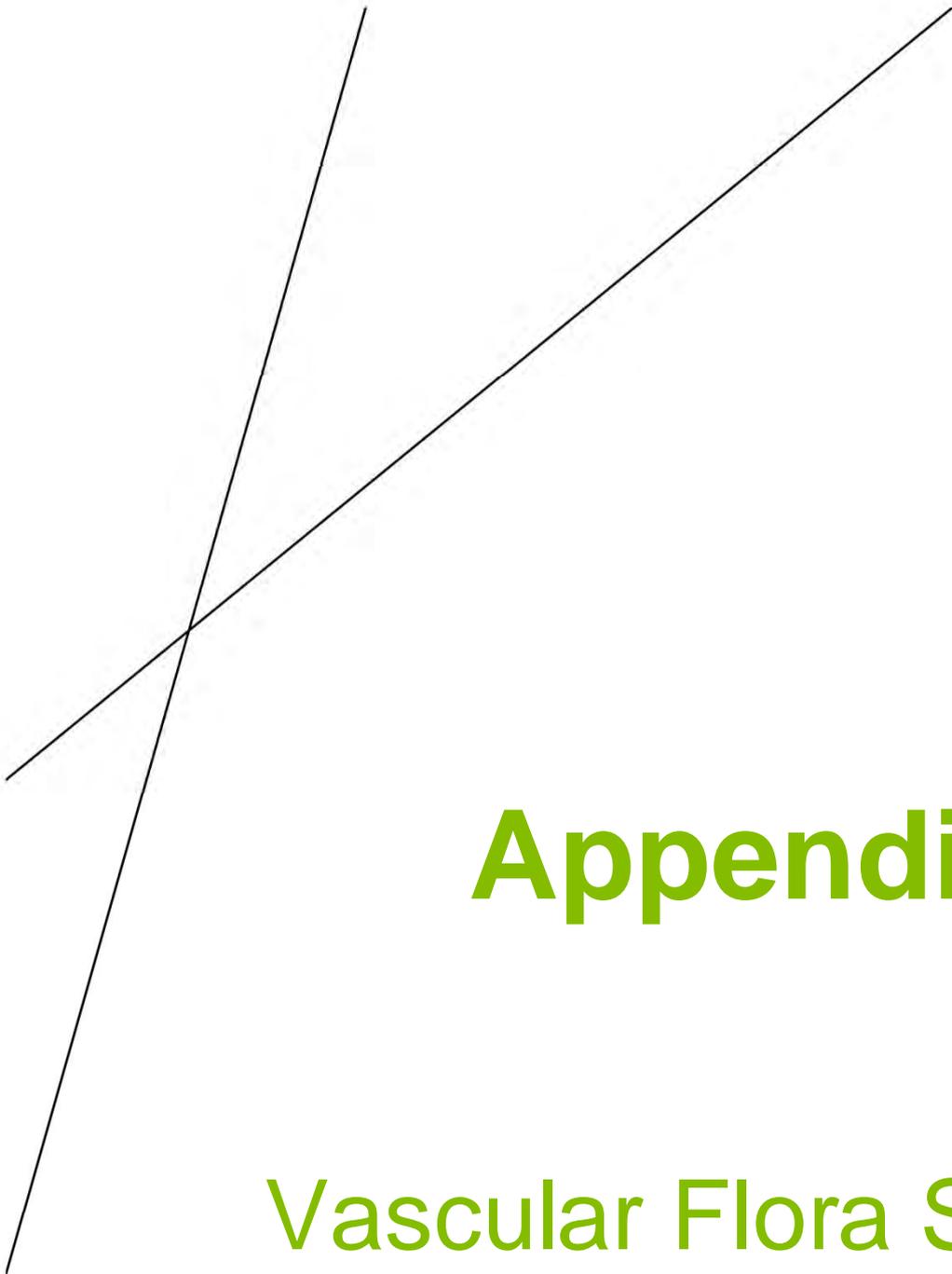
Mosaic of varying densities of species captured in this site. Trees often clustered or isolated single occurrences. Mel huegelii on crests, xanth pressii on lower slopes.

Photos:



Cons	Taxon	Ht/cm	%A	Form
*	<i>Trifolium campestre</i>	5		W
*	<i>Brassica tournefortii</i>	0.1		W
	<i>Clematis linearifolia</i>	0		V
	<i>Agonis flexuosa</i>			T
*	<i>Arctotheca calendula</i>			W
	<i>Banksia sessilis var. cygnorum</i>			TS
*	<i>Dittrichia graveolens</i>			W
*	<i>Euphorbia peplus</i>			W
*	<i>Geranium molle</i>			W
* DP	<i>Gomphocarpus fruticosus</i>			W
	<i>Grevillea preissii subsp. preissii</i>			S
	<i>Hakea prostrata</i>			S
	<i>Hibbertia racemosa</i>			S
	<i>Hibbertia cuneiformis</i>			S
*	<i>Hypochaeris glabra</i>			W
	<i>Leucopogon parviflorus</i>			
*	<i>Lysimachia arvensis</i>			W

Cons	Taxon	Ht/cm	%A	Form
	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>			TS
	<i>Melaleuca systema</i>			S
	<i>Phyllanthus calycinus</i>			S
	<i>Poaceae</i> sp.			G
	<i>Lepidosperma squamatum</i>			Sedge
	<i>Spyridium globulosum</i>			TS
	<i>Templetonia retusa</i>			S
*	<i>Trachyandra divaricata</i>			W
	<i>Xanthorrhoea preissii</i>			TS



Appendix G

Vascular Flora Species
List, 2016

Appendix G Vascular Flora Species List for Lake Clifton including ENV (2009) and the 2016 Survey

Family	Weed	Taxon	AECOM	ENV (2009)
Aizoaceae		* <i>Carpobrotus edulis</i>		X
		<i>Carpobrotus virescens</i>	X	
		<i>Tetragonia decumbens</i>		X
Anthericaceae		<i>Dichopogon</i> sp.		X
Apiaceae		? <i>Daucus glochidiatus</i>	X	
		<i>Daucus glochidiatus</i>		X
		<i>Hydrocotyle tetragonocarpa</i>		X
		<i>Pentapeltis peltigera</i>	X	
Apocynaceae		<i>Alyxia buxifolia</i>	X	X
		* <i>Gomphocarpus fruticosus</i>	X	X
Araceae		* <i>Zantedeschia aethiopica</i>	X	
Araliaceae		<i>Trachymene pilosa</i>	X	X
Asparagaceae		<i>Acanthocarpus preissii</i>	X	X
		<i>Lomandra maritima</i>	X	X
		<i>Lomandra micrantha</i>	X	
		<i>Lomandra suaveolens</i>		X
		<i>Thysanotus manglesianus</i>	X	
Asphodelaceae		* <i>Trachyandra divaricata</i>	X	X
Asteraceae		? <i>Senecio pinnatifolius</i> var. <i>latilobus</i>		X
		* <i>Arctotheca calendula</i>	X	X
		<i>Asteridea pulverulenta</i>		X
		* <i>Cirsium vulgare</i>		X
		* <i>Conyza</i> sp.		X
		* <i>Dittrichia graveolens</i>	X	
		* <i>Hypochaeris glabra</i>	X	X
		<i>Lagenophora huegelii</i>	X	
		<i>Leptorhynchos scaber</i>		X
		<i>Olearia axillaris</i>	X	X
		<i>Podolepis gracilis</i>		X
		<i>Senecio diaschides</i>	X	
		<i>Senecio pinnatifolius</i> var. <i>latilobus</i>		X
		<i>Senecio pinnatifolius</i> var. <i>pinnatifolius</i>		X
		* <i>Sonchus asper</i>		X
		* <i>Sonchus oleraceus</i>	X	X
		* <i>Ursinia anthemoides</i>	X	
Brassicaceae		* <i>Brassica tournefortii</i>	X	
		* <i>Cakile maritima</i>		X
		* <i>Heliophila pusilla</i>		X
Campanulaceae		* <i>Wahlenbergia capensis</i>		X
Caryophyllaceae		* <i>Cerastium glomeratum</i>		X
		* <i>Petrorhagia dubia</i>		X
		* <i>Polycarpon tetraphyllum</i>		X
Casuarinaceae		<i>Allocasuarina fraseriana</i>	X	X
Celastraceae		<i>Stackhousia</i> sp.	X	
Chenopodiaceae		<i>Rhagodia baccata</i> subsp. <i>baccata</i>	X	X
		<i>Sarcocornia blackiana</i>	X	

Appendix G Vascular Flora Species List for Lake Clifton including ENV (2009) and the 2016 Survey

Family	Weed	Taxon	AECOM	ENV (2009)
		<i>Threlkeldia diffusa</i>	X	X
Crassulaceae		<i>Crassula colorata</i>		X
		<i>Crassula colorata</i> var. <i>acuminata</i>		X
	*	<i>Crassula glomerata</i>		X
		<i>Crassula</i> sp.		X
Cupressaceae		<i>Callitris preissii</i>	X	
Cyperaceae		<i>Baumea articulata</i>		X
		<i>Baumea juncea</i>	X	
		<i>Baumea vaginalis</i>		X
		<i>Ficinia nodosa</i>		X
		<i>Gahnia trifida</i>	X	X
	*	<i>Isolepis marginata</i>		X
		<i>Lepidosperma ?pubisquameum</i>		X
		<i>Lepidosperma gladiatum</i>	X	X
		<i>Lepidosperma squamatum</i>	X	
		<i>Lepyrodia drummondiana</i>	X	
		<i>Tetraria octandra</i>	X	X
Dilleniaceae		<i>Hibbertia cuneiformis</i>	X	X
		<i>Hibbertia huegelii</i>		X
		<i>Hibbertia hypericoides</i>	X	X
		<i>Hibbertia racemosa</i>	X	X
Droseraceae		<i>Drosera erythrorhiza</i>	X	
		<i>Drosera macrantha</i>	X	
Ericaceae		<i>Acrotriche cordata</i>	X	X
		<i>Astroloma pallidum</i>	X	
		<i>Conostephium pendulum</i>		X
		<i>Leucopogon nutans</i>	X	
		<i>Leucopogon parviflorus</i>	X	X
		<i>Leucopogon propinquus</i>	X	X
Euphorbiaceae		* <i>Euphorbia paralias</i>		X
	*	<i>Euphorbia peplus</i>	X	
	*	<i>Euphorbia terracina</i>	X	
		? <i>Monotaxis</i> sp.		X
Fabaceae		<i>Acacia cochlearis</i>	X	X
		<i>Acacia cyclops</i>	X	X
		<i>Acacia littorea</i>	X	
		<i>Acacia pulchella</i>	X	X
		<i>Acacia rostellifera</i>	X	X
		<i>Acacia saligna</i>	X	X
		<i>Acacia truncata</i>	X	X
		<i>Hardenbergia comptoniana</i>	X	X
		<i>Jacksonia furcellata</i>	X	X
		<i>Kennedia coccinea</i>	X	
	*	<i>Lotus angustissimus</i>		X
	*	<i>Lotus subbiflorus</i>	X	X
	*	<i>Lupinus</i> sp.	X	
		<i>Mellilotus albus</i>		X
		<i>Mellilotus indicus</i>		X
		<i>Templetonia retusa</i>	X	X
	*	<i>Trifolium campestre</i>	X	X
	*	<i>Trifolium campestre</i> var. <i>campestre</i>		X
	*	<i>Trifolium fragiferum</i> var. <i>fragiferum</i>		X
	*	<i>Trifolium</i> sp.		X

Appendix G Vascular Flora Species List for Lake Clifton including ENV (2009) and the 2016 Survey

Family	Weed	Taxon	AECOM	ENV (2009)
Fumariaceae		* <i>Fumaria</i> sp.		X
Geraniaceae		* <i>Geranium molle</i>	X	X
		<i>Geranium retrorsum</i>		X
Goodeniaceae		<i>Goodenia pulchella</i>	X	
		<i>Scaevola crassifolia</i>	X	X
		<i>Scaevola nitida</i>	X	
Haemodoraceae		<i>Conostylis candidans</i> subsp. <i>calcicola</i>		X
		<i>Haemodorum</i> sp.	X	
Iridaceae		<i>Patersonia occidentalis</i>	X	
Juncaceae		<i>Juncus kraussii</i> subsp. <i>australiensis</i>	X	X
		<i>Juncus pallidus</i>		X
Lamiaceae		<i>Hemiandra pungens</i>	X	X
Lauraceae		<i>Cassytha racemosa</i>	X	
		<i>Cassytha</i> sp.		X
Lobeliaceae		<i>Isotoma hypocrateriformis</i>		X
		<i>Isotoma hypocrateriformis</i> var. <i>hypocrateriformis</i>		X
		<i>Lobelia tenuior</i>		X
Loranthaceae		<i>Nuytsia floribunda</i>	X	X
Myrtaceae		<i>Agonis flexuosa</i>	X	X
		<i>Eucalyptus argutifolia</i> (T)	X	X
		<i>Eucalyptus decipiens</i>	X	X
		<i>Eucalyptus foecunda</i>	X	X
		<i>Eucalyptus gomphocephala</i>	X	X
		<i>Eucalyptus lehmannii</i>	X	
		<i>Eucalyptus ?marginata</i>		X
		<i>Eucalyptus marginata</i>	X	
		<i>Eucalyptus marginata</i> subsp. <i>marginata</i>		X
		<i>Eucalyptus ?petrensis</i>		X
		<i>Eucalyptus petrensis</i>	X	X
		<i>Eucalyptus platypus</i>	X	X
		* <i>Eucalyptus</i> sp. (planted)	X	X
		<i>Melaleuca cuticularis</i>	X	X
		<i>Melaleuca huegelii</i>	X	X
		<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>	X	
		<i>Melaleuca lanceolata</i>	X	
		<i>Melaleuca raphiophylla</i>	X	X
		<i>Melaleuca</i> sp. (<i>huegelii</i> x <i>raphiophylla</i>)	X	
		<i>Melaleuca systema</i>	X	X
		<i>Melaleuca teretifolia</i>	X	X
		<i>Melaleuca viminea</i> subsp. <i>viminea</i>		X
Oleaceae		* <i>Olea europaea</i>		X
Orchidaceae		<i>Microtis media</i> subsp. <i>media</i>		X
		Orchid sp.	X	
		<i>Pterostylis sanguinea</i>	X	
		<i>Pyrorchis nigricans</i>	X	
		? <i>Thelymitra</i> sp.		X
Orobanchaceae		* <i>Bartsia trixago</i>		X

Appendix G Vascular Flora Species List for Lake Clifton including ENV (2009) and the 2016 Survey

Family	Weed	Taxon	AECOM	ENV (2009)
		* <i>Orobanche minor</i>		X
Oxalidaceae		* <i>Oxalis pes-caprae</i>		X
		* <i>Oxalis</i> sp.		X
Phyllanthaceae		<i>Phyllanthus calycinus</i>	X	X
		<i>Poranthera microphylla</i>		X
Plantaginaceae		<i>Veronica distans</i>	X	
Planted		<i>Planted Callistemon</i>	X	
Poaceae		* <i>Aira caryophyllea</i>		X
		* <i>Aira praecox</i>		X
		* <i>Aira</i> sp.		X
		<i>Austrodanthonia caespitosa</i>		X
		<i>Austrodanthonia</i> sp.		X
		<i>Austrostipa flavescens</i>		X
		* <i>Avena barbata</i>	X	
		* <i>Avena barbata</i>		X
		* <i>Briza minor</i>		X
		<i>Bromus arenarius</i>		X
		* <i>Bromus diandrus</i>		X
		* <i>Bromus hordeaceus</i>		X
		* <i>Cynodon dactylon</i>		X
		* <i>Desmazeria rigida</i>		X
		* <i>Holcus setiger</i>		X
		* <i>Hordeum geniculatum</i>		X
		* <i>Hordeum leporinum</i>		X
		* <i>Lolium rigidum</i>		X
		<i>Poa drummondiana</i>		X
		* Poaceae sp.	X	X
		<i>Spinifex hirsutus</i>		X
		* <i>Vulpia muralis</i>		X
		* <i>Vulpia myuros</i>		X
Polygalaceae		<i>Comesperma ?flavum</i>	X	
Portulacaceae		<i>Calandrinia ?brevipedata</i>		X
Primulaceae		* <i>Lysimachia arvensis</i>	X	X
		<i>Samolus junceus</i>		X
Proteaceae		<i>Banksia attenuata</i>	X	X
		<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>	X	
		<i>Banksia grandis</i>	X	X
		<i>Banksia littoralis</i>	X	X
		<i>Banksia sessilis</i> var. <i>cygnorum</i>	X	X
		<i>Grevillea preissii</i> subsp. <i>preissii</i>	X	X
		<i>Grevillea</i> sp.		X
		<i>Hakea costata</i>		X
		<i>Hakea lissocarpa</i>	X	X
		<i>Hakea prostrata</i>	X	X
		<i>Hakea ruscifolia</i>	X	
		<i>Hakea trifurcata</i>	X	
Ranunculaceae		<i>Clematis linearifolia</i>	X	
		<i>Clematis pubescens</i>	X	X
		<i>Ranunculus</i> sp.		X
Restionaceae		<i>Desmocladus flexuosus</i>	X	

Appendix G Vascular Flora Species List for Lake Clifton including ENV (2009) and the 2016 Survey

Family	Weed	Taxon	AECOM	ENV (2009)
		<i>Loxocarya cinerea</i>	X	
Rhamnaceae		<i>Cryptandra mutila</i>	X	
		<i>Spyridium globulosum</i>	X	X
		<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	X	X
Rubiaceae		* <i>Galium murale</i>		X
		* <i>Sherardia arvensis</i>		X
		<i>Opercularia hispidula</i>	X	X
		<i>Opercularia vaginata</i>		X
Rutaceae		<i>Diplolaena dampieri</i>	X	X
		<i>Diplolaena drummondii</i>		X
Santalaceae		<i>Santalum acuminatum</i>	X	X
Scrophulariaceae		* <i>Dischisma arenarium</i>		X
Solanaceae		<i>Anthocercis littorea</i>	X	
		* <i>Solanum linnaeanum</i>	X	
		* <i>Solanum nigrum</i>	X	X
		<i>Solanum symonii</i>	X	X
Stylidiaceae		<i>Stylidium bulbiferum</i>		X
		<i>Stylidium maritimum</i> (P3)	X	X
Thymelaeaceae		<i>Pimelea ferruginea</i>	X	
		<i>Pimelea</i> sp.	X	
Typhaceae		<i>Typha orientalis</i>		X
		<i>Typha</i> sp.	X	
Utricaceae		<i>Parietaria debilis</i>		X
Xanthorrhoeaceae		<i>Xanthorrhoea preissii</i>	X	X
Zamiaceae		<i>Macrozamia riedlei</i>	X	X
Zygophyllaceae		<i>Zygophyllum ?angustifolium</i>		X
		<i>Zygophyllum fruticosum</i>		X



Appendix H

Weed Species and their
Significance Recorded
at Lake Clifton, 2016

Appendix H Weed Species and their Significance Recorded at Lake Clifton, 2016

Taxon	No. of Occurrences in Sites	EWSWA Rating	Swan Priority Rating
<i>Arctotheca calendula</i>	22	Moderate	H
<i>Asphodelus fistulosus</i>	2	Mild	FAR
<i>Avena barbata</i>	1		VH
<i>Brassica tournefortii</i>	14	High	H
<i>Dittrichia graveolens</i>	6		M
<i>Euphorbia peplus</i>	17	Moderate	H
<i>Euphorbia terracina</i>	1	High	VH
<i>Geranium molle</i>	37	Low	M
<i>Gomphocarpus fruticosus</i>	20	Moderate	M
<i>Hypochaeris glabra</i>	33		H
<i>Lotus subbiflorus</i>	4		U
<i>Lupinus sp.</i>	3	High	U
<i>Lysimachia arvensis</i>	35		FAR
<i>Poaceae sp.</i>	1		
<i>Solanum linnaeanum</i>	1	Moderate	H
<i>Solanum nigrum</i>	33		M
<i>Sonchus oleraceus</i>	3		FAR
<i>Trachyandra divaricata</i>	48	Mild	FAR
<i>Trifolium campestre</i>	24		FAR
<i>Ursinia anthemoides</i>	1		M
<i>Zantedeschia aethiopica</i>	2	High	VH

EWSWA represents the Environmental Weed Strategy for Western Australia CALM 1999)

Swan Rating derived from Swan Environmental Weed Assessment (2008)

Ratings include VH-Very High, H-High, FAR-Further Assessment Required, M-Moderate, U-Unknown



Appendix I

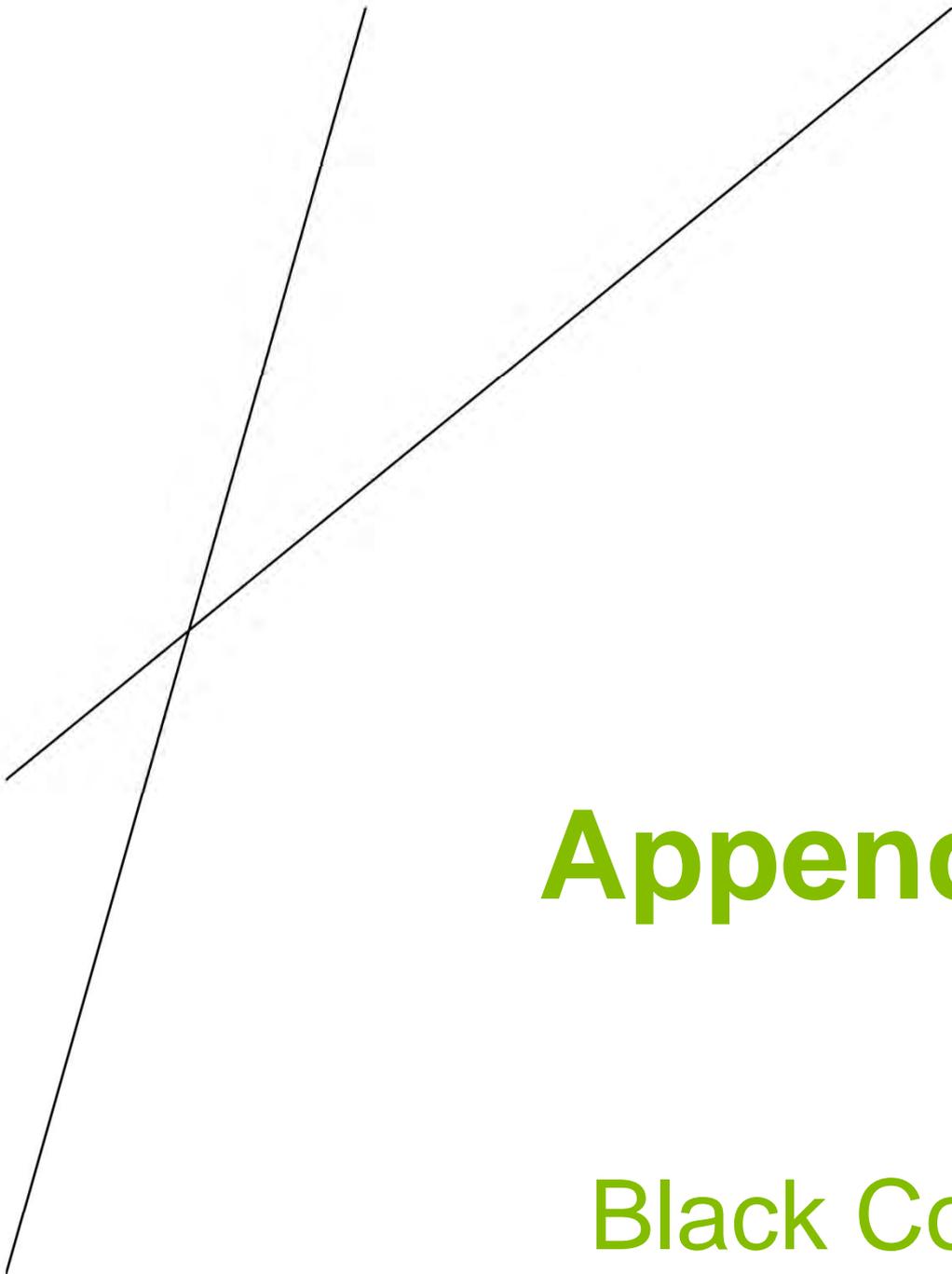
Fauna Species
Recorded during the
Field Survey

Appendix I Fauna Species Recorded During the Field Survey

Name	Common Name	Conservation Status	
		Commonwealth	State
Birds			
<i>Anas superciliosa</i>	Pacific Black Duck	-	-
<i>Anhinga novaehollandiae</i>	Australasian Darter	-	-
<i>Anthochaera carunculata</i>	Red Wattlebird	-	-
<i>Artamus cinereus</i>	Black-faced Woodswallow	-	-
<i>Aquila audax</i>	Wedge-tailed Eagle	-	-
<i>Barnardius zonarius semitorquatus</i>	Twenty-eight Parrot	-	-
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	Marine	-
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	E	EN
<i>Circus approximans</i>	Swamp Harrier	Marine	-
<i>Corvus coronoides</i>	Australian Raven	-	-
<i>Cracticus tibicen</i>	Australian Magpie	-	-
<i>Dacelo novaeguineae</i>	Laughing Kookaburra*	-	-
<i>Dicaeum hirundinaceum</i>	Mistletoebird	-	-
<i>Dromaius novaehollandiae</i>	Emu	-	-
<i>Eolophus roseicapilla</i>	Galah	-	-
<i>Falco cenchroides</i>	Nankeen Kestrel	Marine	-
<i>Fulica atra</i>	Eurasian Coot	-	-
<i>Gerygone fusca</i>	Western Gerygone	-	-
<i>Grallina cyanoleuca</i>	Magpie-lark	Marine	-
<i>Haliastur sphenurus</i>	Whistling Kite	Marine	-
<i>Hieraaetus morphnoides</i>	Little Eagle	-	-
<i>Hirundo neoxena</i>	Welcome Swallow	Marine	-
<i>Microeca fascinans</i>	Jacky Winter	-	-
<i>Ninox novaeseelandiae</i>	Southern Boobook	Marine	-
<i>Pachycephala pectoralis</i>	Golden Whistler	-	-
<i>Petrochelidon nigricans</i>	Tree Martin	Marine	-
<i>Phaps chalcoptera</i>	Common Bronzewing	-	-
<i>Rhipidura albiscapa</i>	Grey Fantail	-	-
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	-
<i>Streptopelia senegalensis</i>	Laughing Turtle-dove*	-	-
<i>Tadorna tadornoides</i>	Australian Shelduck	-	-

Name	Common Name	Conservation Status	
		Commonwealth	State
Mammals			
<i>Canis lupis familiaris</i>	Dog*	-	-
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	-	-
<i>Mus musculus</i>	House Mouse*		
<i>Isoodon obesulus fusciventer</i>	Quenda, Southern Brown Bandicoot	-	P4
<i>Oryctolagus cuniculus</i>	European Wild Rabbit*	-	-
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	V	EN
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	-	-
<i>Vulpes vulpes</i>	Red Fox*	-	-
Reptiles			
<i>Tiliqua rugosa rugosa</i>	Southwestern Bobtail	-	-
Amphibians			
<i>Limnodynastes dorsalis</i>	Banjo Frog	-	-
<i>Litoria adelaidensis</i>	Slender Tree Frog	-	-

Note: Species listed as Marine under the EPBC Act are only considered conservation significant when in a Commonwealth marine reserve.



Appendix J

Black Cockatoo Foraging Assessment

Carnaby's Black Cockatoo Foraging Assessment

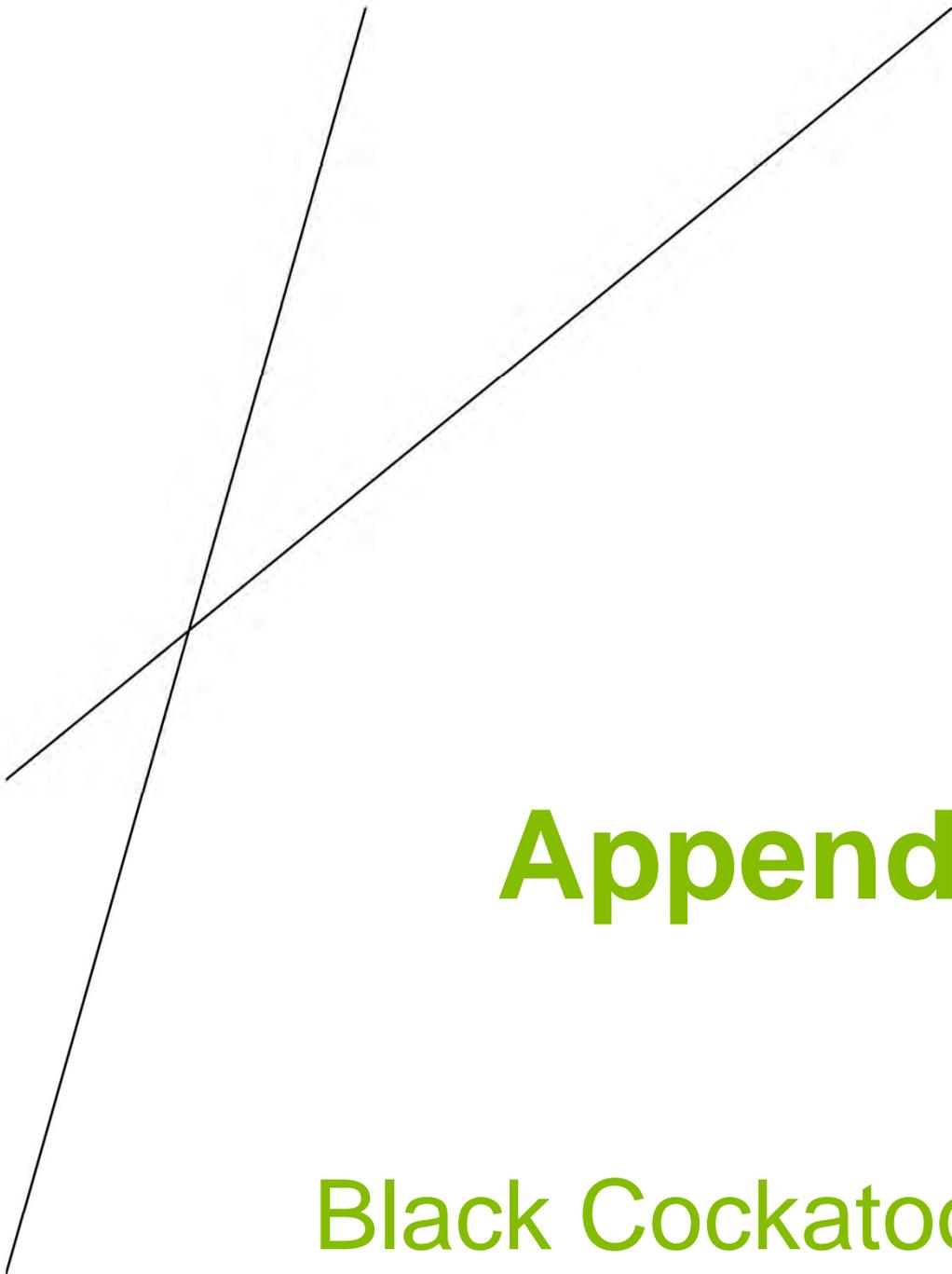
Site	Initial Score	Is within the Swan Coastal Plain	Contains trees known to be used for breeding	Primarily comprise s Marri	Contains trees with breeding potential	Known to be a large or key roosting site	Within 6km of a known night roost	Is <12km from known breeding location	Is <2km from a watering point	Greater than 6km from known roosting site	No other foraging habitat within 6 km	Is >12km from known breeding location	Minimal marri and less than 20% prots cover	More Than 2km from Watering Point	Disease present	Final Score
1	1	3	0	0	0	0	1	1	0	0	0	0	-3	-1	0	2
2	2	3	0	0	0	0	1	1	0	0	0	0	-3	-1	0	3
3	2	3	0	0	2	0	1	1	1	0	0	0	-3	0	0	7
4	2	3	0	0	0	0	0	1	1	-1	0	0	-3	0	0	3
5	2	3	0	0	2	0	1	1	1	0	0	0	-3	0	0	7
6	2	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	5
7	1	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	4
8	1	3	0	0	0	0	1	1	0	0	0	0	-3	-1	0	2
9	1	3	0	0	2	0	1	1	0	0	0	0	-3	-1	0	4
10	1	3	0	0	2	0	1	1	0	0	0	0	-3	-1	0	4
11	1	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	4
12	2	3	0	0	2	0	1	1	1	0	0	0	-3	0	0	7
13	2	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	5
14	7	3	0	0	2	0	0	1	1	-1	0	0	-3	0	0	10
15	1	3	0	0	0	0	0	1	1	-1	0	0	-3	0	0	2
16	2	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	5
17	1	3	0	0	0	0	0	1	1	-1	0	0	-3	0	0	2
18	1	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	4
19	1	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	4
20	2	3	0	0	2	0	0	1	1	-1	0	0	-3	0	0	5
21	2	3	0	0	2	0	0	1	1	-1	0	0	-3	0	0	5
22	1	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	4
23	2	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	5
24	1	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	4
25	2	3	0	0	2	0	1	1	1	0	0	0	-3	0	0	7
26	1	3	0	0	2	0	1	1	0	0	0	0	-3	-1	0	4
27	1	3	0	0	2	0	1	1	0	0	0	0	-3	-1	0	4
28	1	3	0	0	2	0	1	1	0	0	0	0	-3	-1	0	4
29	7	3	0	0	2	0	0	1	1	-1	0	0	-3	0	0	10
30	7	3	0	0	2	0	0	1	1	-1	0	0	-3	0	0	10
31	7	3	0	0	2	0	1	1	1	0	0	0	-3	0	0	12
32	2	3	0	0	2	0	0	1	1	0	0	0	-3	-1	0	5
33	2	3	0	0	0	0	1	1	0	0	0	0	-3	-1	0	3
34	2	3	0	0	0	0	1	1	0	0	0	0	-3	-1	0	3
35	1	3	0	0	0	0	1	1	1	0	0	0	-3	0	0	4

Forest Red-tailed Black Cockatoo Foraging Assessment

Site	Initial Score	Jarrah and/or Marri shows good recruitment	Contains trees known to be used for breeding	Primarily contains Marri and/or Jarrah	Contains trees with breeding potential	Known to be a large or key roosting site	Within 6km of a known night roost	Is <12km from known breeding location	Is <2km from a watering point	Greater than 6km from known roosting site	No other foraging habitat within 6 km	Is >12km from known breeding location	More Than 2km from Watering Point	Minimal marri	Disease present	Final Score
26	10	3	0	2	2	0	0	0	0	-1	0	-1	-1	-3	0	11
27	10	3	0	2	2	0	0	0	0	-1	0	-1	-1	-3	0	11
28	10	3	0	2	2	0	0	0	0	-1	0	-1	-1	-3	0	11

Baudin's Black Cockatoo Foraging Assessment

Site	Initial Score	Is within known foraging area	Contains trees known to be used for breeding	Primarily comprise s Marri	Contains trees with breeding potential	Known to be a large or key roosting site	Within 6km of a known night roost	Is <12km from known breeding location	Is <2km from a watering point	Greater than 6km from known roosting site	No other foraging habitat within 6km	Is >12km from known breeding location	Minimal marri and less than 20% prots cover	More Than 2km from Watering Point	Disease present	Final Score
36	2	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0	-2
9	1	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0	-3
10	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
11	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
12	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
13	7	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
14	2	0	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0
16	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
18	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
19	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
20	7	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
3	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
7	1	0	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0
24	1	0	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0
36	1	0	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0
14	7	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
29	7	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
25	7	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
33	7	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
5	2	0	0	0	0	2	0	0	0	1	-1	0	-1	-3	0	0
6	2	0	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0
8	1	0	0	0	0	0	0	0	0	0	-1	0	-1	-3	-1	0
22	1	0	0	0	0	0	0	0	0	1	-1	0	-1	-3	0	0

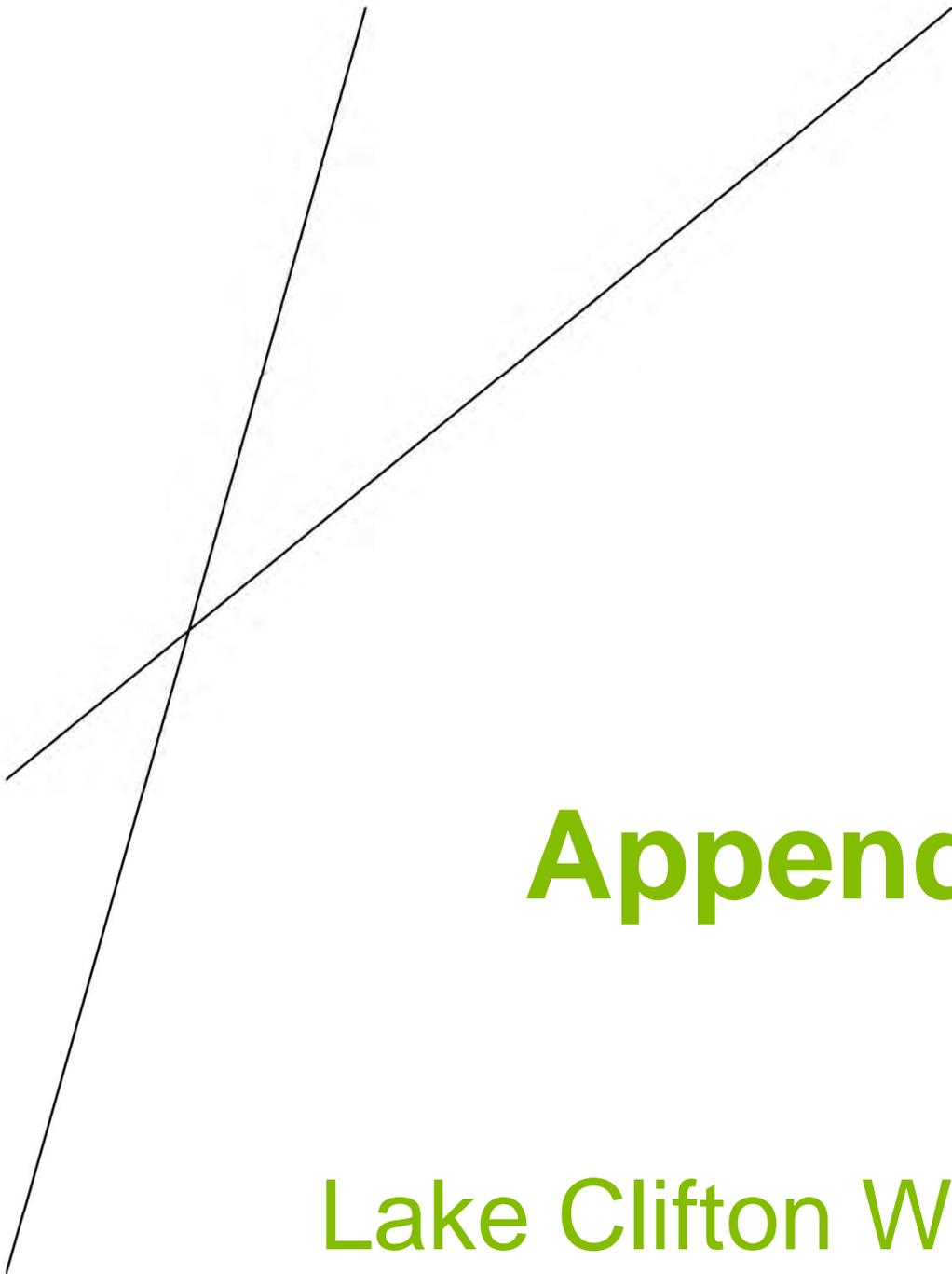


Appendix K

Black Cockatoo Trees
Quadrat Raw Data

Object ID	Quadrat No.	Veg_Unit	No_Trees	Fire_Scarr	Tree_Species	DBH (CM)	Tree_Heig	Occupancy	Evidence of Use	Comments	Easting	Northing
1	1	AfXpHh	0	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	No trees	373550.6	6373562
2	2	AfHcEp	2	No	Eucalyptus gomphocephala (Tuart)	57	1800	<Null>	No	No hollows	373968	6369421
3		AfHcEp		No	Eucalyptus gomphocephala (Tuart)	53	2200	<Null>	No	No hollows	373985.5	6369438
4	3	AfHcEp	1	No	Eucalyptus gomphocephala (Tuart)	50	1800	<Null>	No	No hollows	373793.9	6369090
5	4	Eg	8	No	Eucalyptus gomphocephala (Tuart)	130	26	<Null>	No	1 hollow total - potentially suitable	373713.4	6369415
6		Eg		No	Eucalyptus gomphocephala (Tuart)	102	18	<Null>	No	1 hollow total - unsuitable	373702.2	6369413
7		Eg		No	Eucalyptus gomphocephala (Tuart)	120	1700	<Null>	No	No hollows	373672.7	6369417
8		Eg		No	Eucalyptus gomphocephala (Tuart)	160	2200	<Null>	No	No hollows	373663.7	6369415
9		Eg		No	Eucalyptus gomphocephala (Tuart)	62	2300	<Null>	No	No hollows	373694.7	6369392
10		Eg		No	Eucalyptus gomphocephala (Tuart)	91	1800	<Null>	No	No hollows	373698.6	6369426
11		Eg		No	Eucalyptus gomphocephala (Tuart)	74	25	No	No	2 hollows - 1 potentially suitable	373687.6	6369412
12		Eg		No	Eucalyptus gomphocephala (Tuart)	89	25	<Null>	No	3 hollows - 2 potentially suitable	373689.5	6369408
164	5	EgMsTd	5	No	Stag (old dead tree, unknown species)	50	1800	<Null>	No	No hollows	373848.4	6370282
165		EgMsTd		No	Stag (old dead tree, unknown species)	60	1800	<Null>	No	No hollows	373865.7	6370278
166		EgMsTd		No	Eucalyptus gomphocephala (Tuart)	78	2000	<Null>	No	Two main stems, second stem DBH 50+	373836.8	6370284
167		EgMsTd		No	Eucalyptus gomphocephala (Tuart)	105	1800	<Null>	No	No hollows	373848.4	6370270
168		EgMsTd		No	Eucalyptus gomphocephala (Tuart)	60	1400	<Null>	No	No hollows	373822.6	6370269
131	6	Eg	11	No	Eucalyptus gomphocephala (Tuart)	51	1300	<Null>	No	No hollows	372773.7	6371196
133		Eg		No	Eucalyptus gomphocephala (Tuart)	81	2200	<Null>	No	4 hollows - 1 potentially suitable	372748.3	6371204
134		Eg		No	Eucalyptus gomphocephala (Tuart)	110	2200	<Null>	Honeycomb inside	4 trunk hollows - 1 is potentially suitable but has honeycomb inside.	372745	6371197
136		Eg		No	Eucalyptus gomphocephala (Tuart)	72	1700	<Null>	No	No hollows	372791.4	6371216
137		Eg		No	Eucalyptus gomphocephala (Tuart)	64	1700	<Null>	No	No hollows	372775.9	6371242
139		Eg		No	Eucalyptus gomphocephala (Tuart)	54	1800	<Null>	No	1 spout hollow potentially suitable	372780.4	6371239
141		Eg		No	Eucalyptus gomphocephala (Tuart)	98	15	<Null>	No	2 potentially suitable hollows	372775.4	6371225
142		Eg		No	Eucalyptus gomphocephala (Tuart)	63	12	<Null>	No	2 potentially suitable hollows	372781.1	6371236
143		Eg		No	Eucalyptus gomphocephala (Tuart)	53	20	<Null>	No	No hollows	372767.7	6371213
144		Eg		No	Eucalyptus gomphocephala (Tuart)	102	25	<Null>	No	2 hollows - 1 potentially suitable	372769.5	6371229
145		Eg		No	Eucalyptus gomphocephala (Tuart)	67	20	<Null>	No	Dead tree - 1 small unsuitable hollow	372776.6	6371205
123	7	AfXpHh	6	No	Eucalyptus gomphocephala (Tuart)	95	2200	<Null>	No	No hollows	374106	6371550
146		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	78	2000	<Null>	No	No hollows	374119.7	6371528
147		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	219	2200	<Null>	No	No hollows	374119.9	6371535
148		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	54	2200	<Null>	No	No hollows	374132.6	6371530
149		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	80	2500	<Null>	No	No hollows	374106.5	6371540
150		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	96	1900	<Null>	No	No hollows	374101.8	6371536
17	8	AfXpHh	7	Yes	Eucalyptus gomphocephala (Tuart)	95	1800	<Null>	No	No hollows	373786.9	6372118
18		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	84	1900	<Null>	No	No hollows	373788.1	6372129
19		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	81	1800	<Null>	No	No hollows	373794.4	6372136
20		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	65	2200	<Null>	No	No hollows	373791.9	6372141
21		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	80	2200	<Null>	No	No hollows	373815.6	6372111
22		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	57	1800	<Null>	No	Two main trunks, one dead with 3 hollows	373797	6372120
23		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	78	2000	<Null>	No	No hollows	373801.4	6372136
25	9	AfXpHh	6	No	Eucalyptus gomphocephala (Tuart)	74	2000	<Null>	No	No hollows	373728.2	6372306
26		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	76	1800	<Null>	No	No hollows	373714.8	6372312
27		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	86	2000	<Null>	No	No hollows	373722.5	6372319
28		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	60	1700	<Null>	No	No hollows	373706.6	6372327
30		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	150	1800	<Null>	No	No hollows	373720.7	6372335
31		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	100	1600	<Null>	No	Main trunk broken and burnt, second stem DBH 50+, no hollows	373743.1	6372323
34	10	AfXpHh	6	No	Eucalyptus gomphocephala (Tuart)	53	1300	<Null>	No	No hollows	373185.5	6373366
35		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	50	1100	<Null>	No	No hollows	373186.1	6373378
36		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	73	1300	<Null>	No	No hollows	373182.5	6373395
37		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	60	1200	<Null>	No	No hollows	373184.8	6373396
38		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	63	1500	<Null>	No	2 hollows - none suitable	373176.4	6373377
39		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	63	1600	<Null>	No	2 stems, second stem DBH 50+	373181.4	6373389
42		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	50	1300	<Null>	No	2 hollows, 0 potentially suitable	373210.6	6373391
43	11	AfXpHh	5	Yes	Eucalyptus gomphocephala (Tuart)	106	1400	<Null>	No	No hollows - tree half dead	373571.1	6373425
44		AfXpHh		No	Eucalyptus gomphocephala (Tuart)	57	1500	<Null>	No	1 hollow - unsuitable	373571.1	6373409
45		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	68	800	Bees	No	Dead, 4 hollows - none suitable	373556.4	6373422
46		AfXpHh		Yes	Eucalyptus gomphocephala (Tuart)	62	1100	<Null>	No	1 hollow unsuitable	373540.6	6373403
47		AfXpHh		Yes	Stag (old dead tree, unknown species)	53	1100	<Null>	No	No hollows	373540.5	6373400

51	12	AfHcEp	0	<Null>	<Null>	<Null>	<Null>	<Null>	No	No trees	372434.4	6373464
52	13	EgXpTd	9	No	Eucalyptus gomphocephala (Tuart)	73	1500	<Null>	No	No hollows	372505.5	6372519
53		EgXpTd		Yes	Eucalyptus gomphocephala (Tuart)	74	1600	<Null>	No	No hollows	372513.9	6372516
54		EgXpTd		Yes	Eucalyptus gomphocephala (Tuart)	75	2000	<Null>	No	2 hollows - 0 suitable due to small size	372517.8	6372522
55		EgXpTd		No	Eucalyptus gomphocephala (Tuart)	45	2100	<Null>	No	1 hollow - 0 suitable too small	372520.8	6372536
56		EgXpTd		No	Eucalyptus gomphocephala (Tuart)	105	<Null>	<Null>	No	5 hollows - 2 potentially suitable	372529	6372553
57		EgXpTd		No	Eucalyptus gomphocephala (Tuart)	90	1800	<Null>	No	3 hollows - 2 potentially suitable	372533	6372548
58		EgXpTd		No	Eucalyptus gomphocephala (Tuart)	72	1600	<Null>	No	No hollows	372526.3	6372568
59		EgXpTd		Yes	Eucalyptus gomphocephala (Tuart)	110	2200	<Null>	No	1 hollow, none suitable	372500.8	6372561
60		EgXpTd		No	Eucalyptus gomphocephala (Tuart)	89	1800	<Null>	No	No hollows	372511.4	6372575
173	14	Eg	7	No	Eucalyptus gomphocephala (Tuart)	91	2000	<Null>	No	No hollows	373649.4	6368833
175		Eg		No	Eucalyptus gomphocephala (Tuart)	78	2000	<Null>	No	No hollows	373653.6	6368829
176		Eg		No	Eucalyptus gomphocephala (Tuart)	76	2200	<Null>	No	No hollows	373662.4	6368799
177		Eg		Yes	Stag (old dead tree, unknown species)	61	15	<Null>	No	4 hollows - 3 potentially suitable	373607.5	6368830
178		Eg		No	Eucalyptus gomphocephala (Tuart)	89	1800	<Null>	Being used by owl	No hollows	373643.5	6368799
179		Eg		No	Eucalyptus gomphocephala (Tuart)	95	20	<Null>	No	No hollows	373616.7	6368828
180		Eg		Yes	Eucalyptus gomphocephala (Tuart)	50	15	<Null>	No	2 hollows - none potentially suitable	373626.2	6368827
62	15	AfXpHhHg	1	No	Eucalyptus gomphocephala (Tuart)	62	2500	<Null>	No	No hollows	374229.3	6368439
66	16	AfXpHhHg	3	No	Eucalyptus marginata (jarrah)	58	2000	<Null>	No	No hollows	374212.6	6368556
67		AfXpHhHg		No	Eucalyptus gomphocephala (Tuart)	50	2200	<Null>	No	No hollows	374214.8	6368570
69		AfXpHhHg		No	Eucalyptus marginata (jarrah)	53	1200	<Null>	No	No hollows	374264.1	6368550
70	17	AfXpHh	1	Yes	Eucalyptus gomphocephala (Tuart)	59	11	<Null>	No	No hollows	373554.4	6373673
71	18	AfHcEP	0	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	No trees	373697.9	6369159
72	19	AfHcEp	0	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	No trees	372226.7	6373200



Appendix L

Lake Clifton Wetlands Assessment Forms

Appendix L Lake Clifton Wetland Assessment Forms

1.0 UFI 3096

1.1 General Information

Assessor details	
Name	Floora de Wit and Lyn van Gorp
Date of site visit	27-28 June 2016
Company	AECOM Australia Pty Ltd
Weather during visit	Cloudy, light rains
Landowner	Main Roads Western Australia
Property details	
Location (lot/street)	
Latitude and longitude or Easting northing	
Wetland details	
Name	
UFI	3096
Hill et al. (1996) map sheet number and wetland ID number	
Consanguineous suite	Clifton
Area (ha) of wetland	54 ha
Area (ha) subject to this evaluation	54 ha
Is wetland assessed as portion of wetland with varying degrees of value?	No
Mapped management category	Conservation
Wetland type (see table below)	Sumpland

Water permanence	Host landform				
	Basin	Flat	Slope	Highland	Channel
Permanent inundation	Lake	-	-	-	River*
Seasonal inundation	Sumpland	Floodplain*	-	-	Creek*
Intermittent inundation	Playa*	Barlkarra*	-	-	Wadi*
Seasonal waterlogging	Dampland	Palusplain	Paluslope	Palusmont*	Trough*

*Wetland types not applicable to this evaluation methodology.

1.2 Wetland desktop evaluation

Land uses	
Current ownership of wetland	Main Roads Western Australia
Current land use	Vegetated
Past land use	Agriculture
Surrounding land use	RAMSAR wetland, native vegetation
Existing management	No known management
Fire history/regime	Unknown, no evidence of recent fire

International, national or regional significance	
Indicate whether the wetland is identified (permanent or interim) on one of the following international, national or state registers or listings.	
Conservation Significance	Y/N
Ramsar Convention on Wetlands (Ramsar 1971)	N
Directory of Important Wetlands in Australia (Environment Australia 2001)	N
Register of National Estate (Commonwealth of Australia 2007)	N
Conservation Reserves for Western Australia Systems 1, 2, 3, 5 (Department of Conservation and Environment, 1976)	n/a
Conservation Reserves for Western Australia, The Darling System – System 6 (Department of Conservation and Environment, 1983)	N
A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region (Pen 1997)	N
The Environmental Significance of Wetlands in the Perth to Bunbury Region (Le Provost et al. 1987)	N
Bush Forever (Government of Western Australia 2000)	N
Swan Bioplan (Environmental Protection Authority 2010)	N
Environmental Protection (Swan Coastal Plain Lakes) Policy 1992	N
Environmental Protection (Western Swamp Tortoise Habitat) Policy Approval Order 2002	N
Conservation Estate (e.g. National Park, Nature Reserve, A Class Reserve)	N
Other (list):	Y ESA
Does the wetland retain the values for which it was originally registered or listed, describe: Yes, contains TEC.	

Fauna			
Note the presence (recorded or observed) or evidence of fauna in or surrounding the wetland which is listed by the Commonwealth (e.g. Environment Protection and Biodiversity Conservation Act 1999, CAMBA, RoKAMBA, JAMBA) or State (e.g. Threatened or Specially Protected Fauna under the Wildlife Conservation Act 1950) or Priority Fauna or Priority or Threatened Ecological Communities related to fauna which are listed by DPaW.			
Species / name of ecological community	Significance (e.g. EPBC Act, CAMBA)	Observations (e.g. population size, age, evidence, activities, habitat requirements)	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Scientific value		
List any scientific values including geoheritage or geoconservation values (e.g. important sediments or geological features, fossils, pollen records, stromatolites, thrombolites, evidence of evolutionary processes, evidence of a change in climate, unique flora or fauna adaptations) that the wetland may contain.		
Scientific, geoheritage or geoconservation values	Significance and observations	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Flora				
Use aerial photography and a site visit to determine and confirm the condition of the vegetation within and 50 metres surrounding the wetland. Using the scale outlined in Appendix B, display the locations of the vegetation conditions in the attached map and calculate their total area:				
Vegetation condition	Total area (%) within the wetland	Area (%) 50 metres surrounding the wetland		
Pristine				
Excellent	100%	100%		
Very Good				
Good				
Degraded				
Completely Degraded				
Using this information, is the wetland dominated by vegetation in a good or better condition:		Yes		
What vegetation complex (Hedde et al. 1980) does the wetland belong to:		Yoongarillup complex		
Using the information sources outlined in Appendix B, what extent of the vegetation complex is remaining on the Swan Coastal Plain		38 %		
List any occurrences of Priority and Threatened Ecological Communities related to flora and wetland systems which are known to occur within and 5 kilometres surrounding the wetland. If they are located within or adjacent to the wetland display their boundary in the attached map:				
Name of ecological community	Significance (e.g. priority, threatened)	Observations (e.g. condition, area, habitat type)	Source of information (e.g. observatory, literature, DPaW)	
FCT25 Southern <i>Eucalyptus gomphocephala</i> and <i>Agonis flexuosa</i> woodland	Priority 3	Adjacent to wetland boundary	DPaW, ENV(2009)	
Stromatolite like freshwater microbialite community of coastal brackish lakes	Cth: Critically Endangered State: Critically Endangered	Wetland within buffer of this TEC	DPaW	
List any occurrences of Declared Rare flora or Priority flora known to occur within and 1 kilometre surrounding the wetland and display their location in the attached map:				
Species	Significance (e.g. Declared Rare, Priority 1)	Population measure (number, single record, abundance comment)	Observations (e.g. habitat type, flowering season)	Source of information (e.g., literature, DPaW, surveyed population, Herbarium record)
<i>Lasiopetalum membranaceum</i>	P3	Single record	None	DPaW database record from 1988 located 250 east of wetland boundary.
<i>Eucalyptus argutifolia</i>	Cth: Threatened State: Threatened	One population (no count data available)	None	DPaW database records, ENV (2009) and Weston (2003)

Representativeness	
Using the wetlands data outlined in section 4.3, Appendix D and available on DPaW's website record the corresponding area:	
	% area
What is the % area of wetlands with the same classification assigned a Conservation management category on the Swan Coastal Plain	37.0
What is the % area of wetlands in the same consanguineous suite assigned a Conservation management category	78.1
What is the % area of wetlands with the same classification in the same consanguineous suite assigned a conservation management category	24.7
Is the wetland rare? (e.g. only wetland in its consanguineous suite, best wetland example in its consanguineous suite or region, only Conservation management category wetland in the consanguineous suite or region, primary saline wetland within a consanguineous suite predominated by freshwater):	N

No.	Criteria	Y/N
1	The wetland is currently recognised as internationally or nationally significant for its natural values. Lists/registers include: <ul style="list-style-type: none"> - The Ramsar Convention on Wetlands - State government endorsed candidate sites for the Ramsar Convention on Wetlands - Directory of Important Wetlands in Australia - National Heritage List - Or equivalent. 	N N N N N
2	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is identified as significant for its natural values under one or more of the following: <ul style="list-style-type: none"> - <i>Conservation Reserves for Western Australia Systems 1, 2, 3, 5</i> - <i>Conservation Reserves for Western Australia, The Darling System – System 6</i> - <i>A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region</i> - <i>The Environmental Significance of Wetlands in the Perth to Bunbury Region</i> - <i>Bush Forever, Swan Bioplan or equivalent.</i> 	N N N N N
3	The wetland supports a breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, <i>Environment Protection and Biodiversity Conservation Act 1999</i> , migratory bird agreements such as JAMBA, CAMBA and RoKAMBA) or the State (for example, Threatened and Specially Protected Fauna listed under the Wildlife Conservation Act 1950).	Y
4	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and supports one or more of the following: <ul style="list-style-type: none"> - An occurrence of a Threatened Ecological Community - A confirmed occurrence of a Priority 1 or Priority 2 Ecological Community - A confirmed occurrence of a Declared Rare (Threatened) flora species. 	N Y N
5	Equal to or greater than 90% of the wetland supports vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B.	Y
6	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is known to support internationally, nationally or state-wide scientific values including geoheritage and geoconservation.	N
7	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and meets one of the following: <ul style="list-style-type: none"> - ≤10% of wetlands of the same type are assigned Conservation management category within the Swan Coastal Plain (by area) - ≤10% of all wetlands in the same consanguineous suite are assigned Conservation management category (by area) - ≤10% of wetlands of the same type in its consanguineous suite are assigned Conservation management category (by area) - best representative of its type within its consanguineous suite domain. 	N N N N

1.3 Secondary Assessment Form

No.	General criteria	Criteria	Score
Geomorphology			
1	<i>Representativeness</i>	≤20% of wetlands of the same type are assigned Conservation on the Swan Coastal Plain by area.	H
2		≤20% of wetlands in the same consanguineous suite are assigned Conservation by area.	H
3		≤20% of wetlands of the same type in the same consanguineous suite are assigned Conservation by area.	H
4		The wetland is outstanding in some geomorphic aspect, for example size, origin, height relative to sea level, depth, age.	H
5	<i>Naturalness</i>	Alteration to the wetland's geomorphology by % area: < 25% altered 25-75% altered > 75% altered.	H I L
6	<i>Scarcity</i>	The wetland exhibits unusual geomorphology or unusual internal geomorphic features compared to other wetlands of the same type in the consanguineous suite.	H
7		The wetland is the best example of its type in its consanguineous suite.	H
Wetland processes			
8	<i>Representativeness</i>	The wetland is an important component of the natural hydrological cycle providing natural functions (e.g. flood protection and recharge/discharge). The wetland's vegetation, geomorphology, hydrology or sediments are modified; however, the wetland is still a component of the hydrological cycle providing natural and artificial functions (e.g. flood remediation, recharge/discharge and hydrological storage). The wetland's vegetation, geomorphology, hydrology or sediments are modified to the extent that the wetlands hydrological functions are artificial such as storage, or the wetland has been disconnected from the natural hydrological cycle and no longer provides natural attributes and functions.	H
9		The wetland supports a representative process (e.g. wetland process typical of the wetland's hydrological setting, sediment accretionary process typical of the wetland's geomorphic setting or hydrochemical process typical of the wetland's geological setting).	H
10	<i>Naturalness</i>	The wetland is not subject to altered wetland processes or, is subject to altered wetland processes and the wetland's natural attributes and functions are maintained. The wetland is subject to altered wetland processes and the wetland's natural attributes and functions have been changed; however, they have the potential to be rehabilitated. The wetland is subject to altered wetland processes to the extent that the wetland no longer supports natural attributes and functions.	H
11	<i>Scarcity</i>	The wetland exhibits unusual processes (e.g. hydrological, sedimentological, chemical, biological) compared to other wetlands of the same type in the consanguineous suite.	H

No.	General criteria	Criteria	Score
Linkages			
12	<i>Representativeness</i>	The wetland is a hydrological link in a larger or more complex and intact system.	H
13	<i>Naturalness</i>	The wetland is part of a continuous ecological linkage or wildlife corridor, or a regionally significant ecological linkage or wildlife corridor connecting bushland or wetland areas.	H
		The wetland is part of a fragmented ecological linkage or wildlife corridor.	I
		The wetland is disturbed and isolated, surrounded by either a built or highly disturbed environment with no nearby native vegetation or waterways to support an intact or fragmented ecological linkage or wildlife corridor.	L
14	<i>Scarcity</i>	The wetland has unusual hydrological, hydrochemical or ecological linkages with adjacent wetland or bushland.	I
Habitats			
15	<i>Representativeness</i>	The wetland is isolated from other undisturbed wetlands or bushland and as a result, maintains important ecological or genetic fauna or flora diversity within its consanguineous suite domain.	H
16		The wetland contains evidence of surface water that is vital to maintaining regionally significant populations of native aquatic or terrestrial flora or fauna.	H
17		The wetland provides a nursery for native fauna populations, or maintains fauna populations at a vulnerable stage of their life cycle.	H
18	<i>Naturalness</i>	The wetland supports habitats that are unaltered or the wetland has been altered and its natural habitats are maintained.	H
		The wetland supports habitats that are altered; however, the habitats are still identifiable and have the potential to be rehabilitated.	I
		The wetland is altered and as a result is no longer supporting natural habitats which can be rehabilitated.	L
19	<i>Scarcity</i>	The wetland supports habitats that are unusual compared to other wetlands of the same type on the Swan Coastal Plain.	H
Flora			
20	<i>Representativeness</i>	The wetland's current diversity of native flora is similar to what would be expected in an unaltered state.	H
		The wetland supports a reduced diversity of native flora due to human induced disturbances.	I
		The wetland supports a significantly reduced diversity of native flora species due to human induced disturbances.	L
21		The wetland is identified in a vegetation complex (Heddl et al. 1980) which is represented by: ≤30% of the pre-European extent	H
		30-50% of the pre-European extent.	I
22	<i>Naturalness</i>	Using the vegetation condition scale outlined in Appendix B, the wetland's vegetation condition by area is: ≥ 75% Good, Very Good, Excellent or Pristine	H
		25-75% Good, Very Good, Excellent or Pristine	I
		< 25% Good, Very Good, Excellent or Pristine.	L

No.	General criteria	Criteria	Score
23		The wetland or $\geq 50\%$ of the wetland boundary is surrounded by land dominated by remnant native vegetation.	H
		The wetland or 10-50% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	I
		The wetland or $< 10\%$ of the wetland boundary is surrounded by land dominated by remnant native vegetation.	L
24	<i>Scarcity</i>	The wetland supports an occurrence of Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora, or an occurrence of 3 or more significant flora taxa.	H
25		The wetland is likely to support Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora; however, the occurrence cannot be located or its habitat has been altered and is no longer in a natural state.	I
26		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
27		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community.	I
Fauna			
28	<i>Representativeness</i>	The wetland is an ecological refuge for regionally significant fauna species or fauna assemblages.	H
		The wetland has the potential to be an ecological refuge but is disturbed and its attributes and functions require rehabilitation.	
29		The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regionally significant native fauna.	H
		The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regional or local fauna but only in association with other surrounding natural areas.	I
30	<i>Naturalness</i>	The wetland's current diversity of native fauna is similar to what would be expected in an unaltered state, or the wetland supports diverse fauna compared to other wetlands of the same type.	H
		The wetland supports a reduced diversity of fauna compared to other wetlands of the same type.	I
31		The wetland supports limited attributes and functions for fauna populations due to human induced disturbances.	L
32	<i>Scarcity</i>	The wetland is likely to support a breeding, roosting, refuge or feeding site for populations of fauna listed by the Commonwealth (e.g. <i>EPBC Act 1999</i> , JAMBA, CAMBA, RoKAMBA Agreements) or the State (e.g. Threatened or Specially Protected Fauna listed under the <i>Wildlife Conservation Act 1950</i>).	H
33		The wetland supports a breeding, roosting, refuge or feeding site for Priority 1, Priority 2, Priority 3 or Priority 4 fauna.	H
34		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
35		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community or a breeding, roosting, refuge or feeding site for significant fauna.	I
Cultural			
36	<i>Representativeness</i>	The wetland or its immediate surrounds is identified for its natural values on a national or State heritage list or the wetland supports other known regional heritage values.	H
37		The wetland or its immediate surrounds is identified for its natural values on a municipal heritage list or the wetland supports other known local heritage values.	I

No.	General criteria	Criteria	Score
38		The wetland or its immediate surrounds is identified on a national, State or local list or register for its Aboriginal cultural value (e.g. Department of Aboriginal Affairs register).	H
39		The wetland is important to the local community either nationally or state wide for its natural values.	H
40		The wetland is or has the potential to be a site for public or private based recreation.	I
41		The wetland is likely to support heritage, cultural or social values; however, the value cannot be confirmed or the value has been disturbed and are no longer as important or significant.	I
		The wetland did support heritage, cultural or social values; however, these have been significantly disturbed and are no longer important or the values have been removed.	L
Scientific and educational			
42	<i>Representativeness</i>	The wetland supports known important teaching or research characteristics and for this reason is an existing or potential education or research site. Note, the wetland must still support the relevant teaching or research characteristics.	H
		The wetland has the potential to be used as a study or research site.	I
43		The wetland supports known scientific, geoheritage or geoconservation values.	H
44		The wetland did support scientific or educational values; however, these have been significantly disturbed and are no longer as important or the values have been removed.	L

1.4 Results

Attributes/functions /values	Scores		
	High	Intermediate	Low
Geomorphology	1		
Wetland processes	3		
Linkages	2	1	
Habitats	2		
Flora	3	2	
Fauna	4	1	
Cultural		1	
Scientific and educational			
Total Score	15	5	
Defining attributes/ functions/values	Fauna		
Applicable management category	Conservation		

Appendix A2 Biological Assessments Nirimba

Biological Assessments for Lot 295, 842 and 1262 Nirimba

Biological Assessments for Lot 295, 842 and 1262 Nirimba

Client: Main Roads Western Australia

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Document Biological Assessments for Lot 295, 842 and 1262 Nirimba

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Executive Summary

Main Roads Western Australia (MRWA) required biological assessments for Lots 295, 842 and 1262, Carrabungup Road in Nirimba (the Survey Area) to determine their suitability as offset sites for current and future projects. The objective of the assessment was to identify and map Carnaby's and Forest Red-tailed Black Cockatoo foraging and potential breeding habitat and assess extent of wetland vegetation. To meet this objective a preliminary Flora and Vegetation Assessment, Wetlands Assessment and a Black Cockatoo Assessment were undertaken.

The field survey was undertaken on 1 and 2 August 2016 by two botanists who traversed the Survey Area on foot. Data was collected at 12 sites including floristic and vegetation characteristics and Black Cockatoo foraging and breeding assessment. A Wetlands Assessment was undertaken for three wetlands, including two Conservation Category Wetlands and one group of wetlands of varying classification associated with the Peel-Harvey estuary. Opportunistic observations relevant to the objective were also recorded whilst traversing the offset property.

Six vegetation communities were mapped, including two wetland communities, three forest communities and one woodland community. It is considered unlikely that any of the communities represent a Threatened or Priority community based on a review of inferred Floristic Community Types associated with conservation significant vegetation in that region.

One Priority 4 species, *Eucalyptus rudis* subsp. *cratyantha* was collected during the field survey. This species is characterised by bigger fruits compared to the common *Eucalyptus rudis*. The specimen was submitted to and confirmed by the WA Herbarium due to lack of descriptive materials publicly available to distinguish between the Priority and common species.

The preliminary Black Cockatoo foraging assessment determined that Nirimba contains approximately 171 ha of Carnaby's Black Cockatoo foraging habitat and 140 ha of Forest Red-tailed Black Cockatoo foraging habitat (Table 1). Forest Red-tailed Black Cockatoos were heard during the field survey and evidence of foraging on Marri nuts was observed at two locations within the Survey Area. Nirimba contains a total of 171 ha of potential suitable breeding habitat for Black Cockatoos, with trees recorded in nine of the 12 sites. Density estimates show potential for 1,700 potentially suitable breeding trees to be located at the Nirimba property.

Wetlands mapped in the Geomorphic Wetlands dataset extend over 74 ha (Table 1). This coincides with the wetlands vegetation mapping, extending 75 ha. The Wetlands Assessment showed that the wetlands subject to a Wetlands Assessment met the criteria of a Conservation management category, despite some being mapped in the Resource Enhancement (RE) or Multiple Use (MU) categories.

Table 1 Summary of environmental values recorded within the Nirimba Survey Area

Environmental Value	Lot 295	Lot 842	Lot 1262	Total
Carnaby's Cockatoo Potential Foraging Habitat	69.39	35.1	66.6	171.08
Forest Red-tailed Black Cockatoo Potential Foraging Habitat	52.47	35.04	52.57	140.08
Black Cockatoo Potential Breeding Habitat	69.39	35.10	66.60	171.09
Conservation Category Wetlands	12.61	0.34	10.50	23.45
Resource Enhancement Wetlands	2.85	18.02	2.94	23.81

1.0 Introduction

1.1 Background and scope

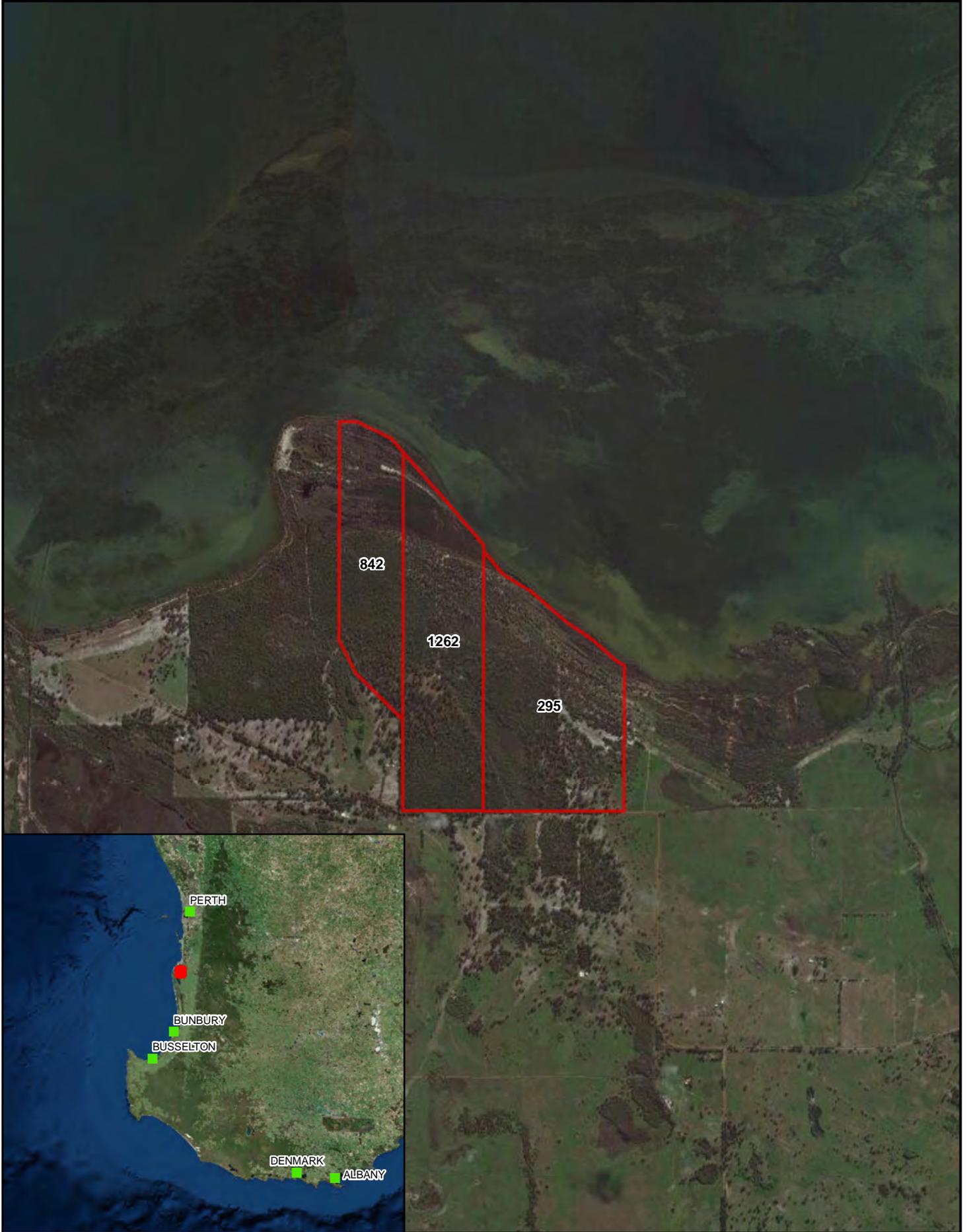
Main Roads Western Australia (MRWA) required biological surveys for Lots 295, 842 and 1262, Carrabungup Road in Nirimba to determine their suitability as offset sites for current and future projects. The properties were subject to three biological investigations including:

- Carnaby's and Forest Red-tailed Black Cockatoo foraging and breeding assessment
- preliminary characterisation of flora and vegetation to inform Black Cockatoo assessment
- Wetland assessment and assessment of wetland boundaries.

This technical report documents the methodology utilised and results gained from undertaking the biological surveys to meet the above scope.

1.2 Location

Lots 295, 842 and 1262 (the Survey Area) are located along Carrabungup Road in Nirimba approximately 80 km south of Perth. The Survey Area lies adjacent to Boggy Bay, in the Shire of Murray (Figure 1).



<p>PROJECT ID 60100953 CREATED BY DGF APPROVED BY FDW LAST MODIFIED 19 AUG 2016</p> <p>AECOM www.aecom.com</p> <p>DATUM GDA 1994, PROJECTION MGA ZONE 50</p> <p>0 230 460 690 920 metres</p> <p>1:30,000 when printed at A4</p>	<p>LEGEND Survey Area</p> <p>Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community</p>	<p>Survey Area</p> <hr/> <p>MAIN ROADS</p> <p><i>NIRIMBA BIOLOGICAL ASSESSMENT</i></p>	<p>Figure 1</p>
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2.0 Existing Environment

2.1 Climate

The Swan Coastal Plain has a warm Mediterranean climate, characterised by hot dry summers and cool to mild wet winters. The closest meteorological recording station with comprehensive data is Pinjarra Refinery (BOM Station 9891), located 20 km east of the Survey Area. The weather station has been collecting data since 1984.

Rainfall in the 12 months preceding the field survey is shown in Figure 2, and shows two months of significantly lower than average rainfall preceding the field survey. For this project, it is unlikely to have affected the outcomes of the assessment.

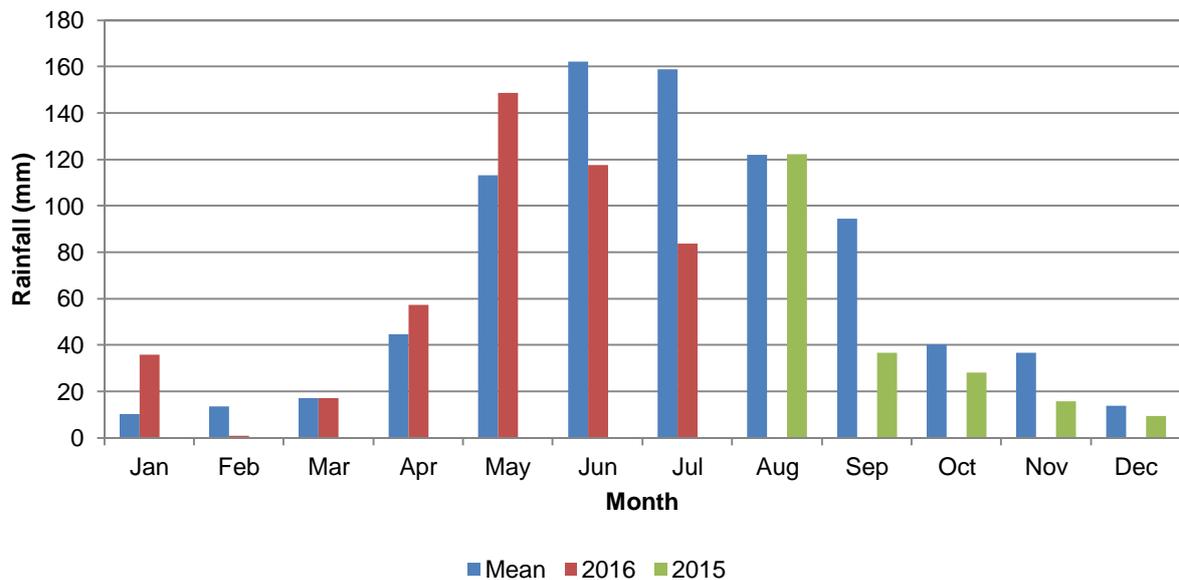


Figure 2 Rainfall graph, data obtained from Pinjarra Refinery Station 9891, BOM (2016)

2.2 IBRA region

The Survey Area is located on the Swan Coastal Plain bioregion described in CALM (2002), including Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain consists of the Dandaragan Plateau and the Perth Coastal Plain and is comprised of a narrow belt less than 30 km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age incorporating a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several offshore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and Jarrah-*Banksia* woodlands are found on the older dune systems.

The Swan Coastal Plain subregion, described by Mitchell *et al.* (2002), is a low-lying coastal plain covered with woodlands dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The area includes a complex series of seasonal wetlands and includes Rottnest, Carnac and Garden Islands. Land use is predominantly cultivation, conservation, urban and rural residential. The area contains a number of rare features including Holocene dunes and wetlands and a large number of threatened species and ecological communities.

2.3 Vegetation

2.3.1 Pre-European vegetation

The Environmental Protection Authority's (EPA) objective is to retain at least 30% of all pre-European Heddle *et al.* (1980) vegetation complexes, which is consistent with recognised retention levels (EPA, 2000; EPA, 2015).

There are two Beard (1981) vegetation associations present within the Survey Area (Table 2) including low and medium woodland. Heddle *et al.* (1980) mapped two vegetation complexes within the Survey Areas (Table 3). The Southern River vegetation complex has been reduced to 18.4% of the original extent remaining (EPA, 2015).

Table 2 Beard (1981) vegetation types mapped within the Survey Area

Vegetation Association	Description
27	Low woodland: Paperbark (<i>Melaleuca</i> species)
968	Medium woodland; Jarrah, Marri and Wandoo

Table 3 Heddle *et al.* (1980) vegetation complexes mapped within the Survey Area and the extent remaining using the Perth @ 3.5 million document (EPA, 2015)

Vegetation association	Description	Extent Remaining
Southern River Complex	Open woodland of <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Banksia</i> species with fringing woodland of <i>E. rudis</i> and <i>Melaleuca raphiophylla</i> along creek beds	18.4%
Vasse Complex	Estuarine and marine deposits	35.9%

2.4 Wetlands

2.4.1 Ramsar Site

The Survey Area is located adjacent to the Peel-Yalgorup Ramsar site. The Peel-Yalgorup site comprises the estuarine Peel Inlet and Harvey Estuary, the freshwater wetlands of lakes McLarty and Mealup, and the Yalgorup National Park (including the saline lakes system with sections of fringing upland). This system stretches for 60 km north to south and approximately 10 km east to west.

The Ramsar site was recognised as a wetland of international importance in 1990 and is considered to be representative of wetlands of the Swan Coastal Plain forming a chain of diverse habitat types which in turn support an array of ecologically important species and communities (Peel-Harvey Catchment Council, 2009).

Less than 0.2 ha of the Ramsar site intersects with the Survey Area, representing the estuarine edge of the site.

2.4.2 Geomorphic Wetlands of the Swan Coastal Plain

There are 14 wetlands assigned unique numbers in the Geomorphic Wetlands of the Swan Coastal Plain dataset within the Survey Area. Of these, seven are associated with the Peel-Yalgorup Ramsar site resembling estuarine vegetation and shallow water.

Wetlands comprise 73.72 ha of the Survey Area, shown in Table 4 and Figure 3. This includes:

- 23.49 ha of CCW
- 23.82 ha of RE wetlands
- 26.41 ha of MU wetlands.

Table 4 Wetlands that intersect with the Survey Area including UFI, classification, extent (ha), consanguineous suite

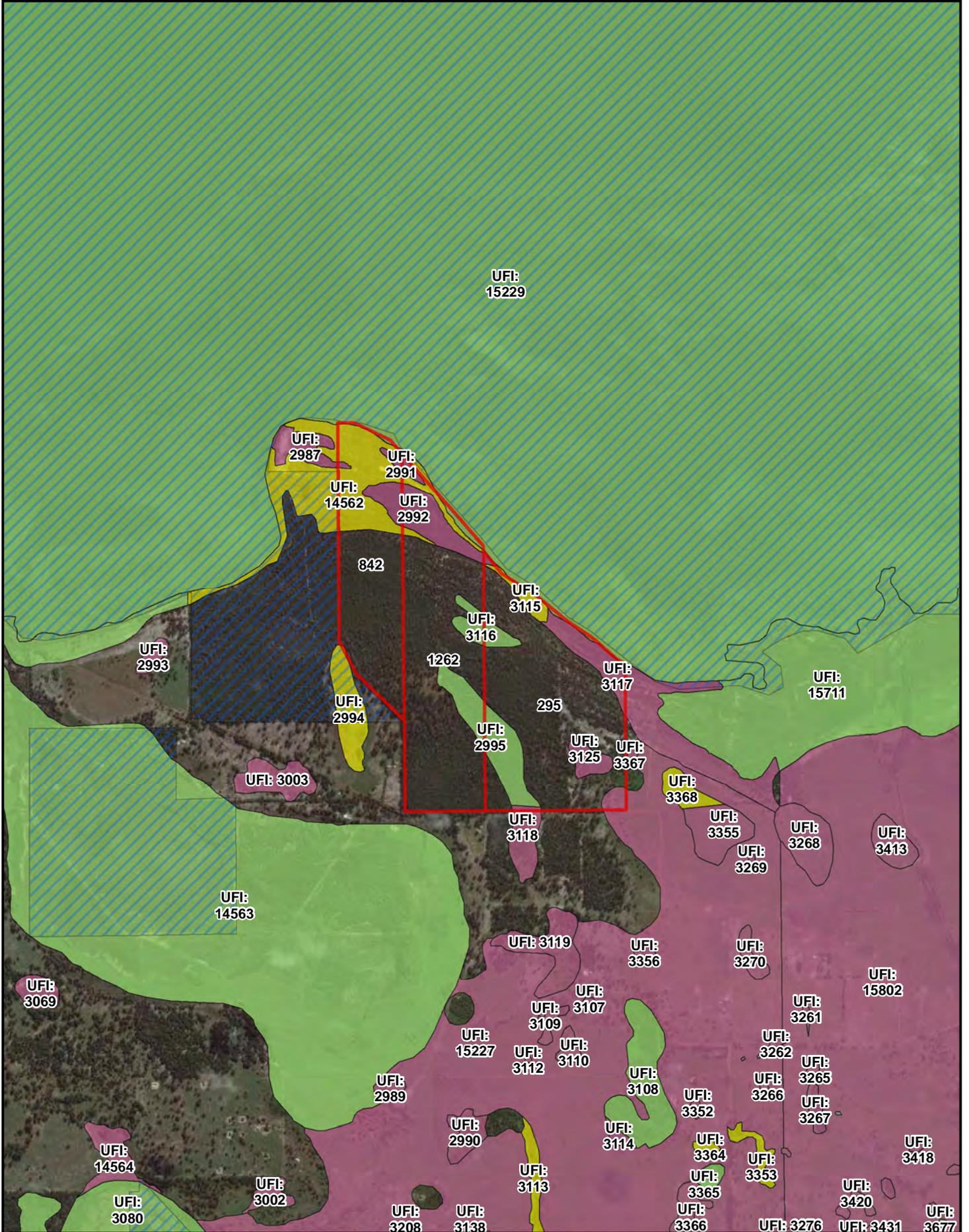
Unique Feature Identifier	Wetland Evaluation	Extent within Survey Area (ha)	Consanguineous Suite	Vegetation Present, Condition and Additional Comments
2987	MU	0.24	Peel-Harvey Estuary	Edge of wetland intersects with Survey Area, represents degraded estuarine vegetation. No access due to inundation.
2991	MU	1.66	Peel-Harvey Estuary	Represents part of the Peel-Harvey estuary group of wetlands. No access due to inundation.
2992	MU	12.8	Peel-Harvey Estuary	Subject to Wetland Assessment as part of the Peel-Harvey estuary group.
2994	RE	0.04	Keysbrook	Edge of wetland intersects with Survey Area. This wetland was not further assessed.
2995	CCW	15.87	Keysbrook	Located entirely within the Survey Area, this wetland was subject to a Wetlands Assessment.
3115	RE	2.85	Peel-Harvey Estuary	Subject to Wetland Assessment as part of the Peel-Harvey estuary group.
3116	CCW	5.55	Keysbrook	Located entirely within the Survey Area, this wetland was subject to a Wetlands Assessment.
3117	MU	7.88	Peel-Harvey Estuary	Represents part of the Peel-Harvey estuary group of wetlands. Condition was not observed to be significantly more degraded than adjacent RE wetland.
3118	MU	0.07	Keysbrook	Edge of wetland intersects with Carrabungup Road and the Survey Area. Forms part of UFI 2995 at this location.
3125	MU	3.74	Keysbrook	Degraded wetland located in a paddock that continues to be used as a private dwelling/pasture. Wetland was not visited due to presence of electric fence and evidence of private residency.
3367	MU	0.02	Keysbrook	Edge of wetland intersects with Survey Area. Not significant enough to warrant further investigation.
14562	RE	20.93	Peel-Harvey Estuary	Subject to Wetland Assessment as part of the Peel-Harvey estuary group.
15229	CCW	2.07	Peel-Harvey Estuary	Peel Inlet Waterbody.

2.5 Conservation estates, Bush Forever and Environmentally Sensitive Areas

The Survey Area adjoins the Austin Bay Nature Reserve on the northeast side and the west side. Austin Bay Nature Reserve is a Class A reserve that encompasses 1,658 ha. The Reserve adjoins the Survey Area along the northeast edge and the western edge. It incorporates open water, wetland vegetation and native terrestrial vegetation.

The entire Survey Area is located within an Environmentally Sensitive Area associated with the Class A nature reserve and Ramsar site. The Survey Area does not intersect with any Bush Forever Sites.

Conservation estates and ESAs are show in Figure 4.



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LEGEND

Survey Area
 Peel-Yalgorup System Ramsar

Geomorphic Wetlands

- Conservation
- Multiple Use
- Not Assessed
- Resource Enhancement

Wetlands

MAIN ROADS

NIRIMBA BIOLOGICAL ASSESSMENT

Figure 3



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0 230 460 690 920
 metres

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LEGEND

- Survey Area
- Environmentally Sensitive Areas

DPAW Managed Lands and Water

- Nature Reserve

Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Conservation Estates and ESAs

MAIN ROADS

NIRIMBA BIOLOGICAL ASSESSMENT

Figure
4

2.6 Black Cockatoos

2.6.1 Carnaby's Black Cockatoos

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DotE, 2016). This black cockatoo has a white patch on its cheek, white bands on its tail, and a strong curved bill.

Carnaby's Black Cockatoo feed on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include various proteaceous species (e.g. *Banksia*, *Grevillea* and *Hakea*), *Corymbia calophylla* (Marri), *Eucalyptus* (e.g. Jarrah [*Eucalyptus marginata*]), and seeds from the cones of Pine trees (*Pinus* sp.).

Carnaby's Black Cockatoo display strong pair bonds and nest in the hollows of live or dead mature eucalypts including Salmon Gum (*Eucalyptus salmonophloia*), York Gum (*Eucalyptus loxophleba* subsp. *loxophleba*), Flooded Gum (*Eucalyptus rudis*), Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Tuart (*Eucalyptus gomphocephala* [DSEWPaC, 2012]). Nest hollows generally range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr, 1998). There are several small resident populations on the northern Swan Coastal Plain at Boonanarring, Mooliabeenee and Yanchep National Park and on the southern Swan Coastal Plain at Lake Clifton (50–100 pairs), also near Bunbury and probably at Baldivis (DotE, 2016). The species appears to be expanding its current breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the SCP (Johnstone and Kirkby, 2006). After breeding, Carnaby's Black Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July (DotE, 2016). Breeding has been recorded from early July to mid-December.

Carnaby's Black Cockatoo has undergone a dramatic decline of approximately 50 percent in the past 45 years, with the main contributing factors the clearing of core breeding habitat in the wheatbelt, the deterioration of nesting hollows, and clearing of foraging habitat.

2.6.2 Forest Red-tailed Black Cockatoos

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (DSEWPaC, 2012). The species has a pair of black central tail feathers and a bright red, orange or yellow barring on the tail.

This species predominantly feeds in eucalypt forests, preferring Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) seeds, but also feeding in Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*Eucalyptus staeri*), Karri (*Eucalyptus diversicolor*), Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*) (Johnstone, 2016 pers. comm.). Forest Red-tailed Black Cockatoo are monogamous and pairs nest in tree hollows from 6.5–33 m above ground. Most nests are in very large and very old, mature Marri (*Corymbia calophylla*) (Johnstone, Kirkby & Sarti, 2013), though they will nest in other eucalypts such as Tuart (Johnstone, 2016 pers. comm.).

Formerly common, but now rare to uncommon and patchily distributed, the Forest Red-tailed Black Cockatoo has disappeared from about 30% of its former range. It has suffered a marked decline in numbers over the past 60 years because of the destruction and fragmentation of habitat (especially Jarrah-Marri forest), the apparent decline in Marri along the eastern side of the Darling Scarp (possibly due to climate change), logging, the impact of competitors for nest hollows, and fire (Chapman, 2008; Garnett *et al.*, 2011).

3.0 Methodology

3.1 Flora and Vegetation Assessment

The objective of the Flora and Vegetation Assessment was to broadly characterise the vegetation communities present in the Survey Area. Floristic data and vegetation community mapping was then used to inform the Black Cockatoo foraging assessment. The desktop assessment was limited to reviewing publicly available information to describe the existing environment.

The field survey followed methodology of a reconnaissance survey as described in EPA (2004) Guidance Statement 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment*, and DPaW and EPA (2015) *Technical Guide for Terrestrial Flora and Vegetation Surveys*. This included low-level sampling undertaken by two botanists Floora de Wit (Collection Permit SL011555) and Lyn van Gorp (Collection Permit SL011558) between 1 and 2 August 2016.

Twelve sample point locations (relevés) were selected to document the floristics, vegetation composition and structure. Species composition and structure was recorded at each relevé including perennial vascular plant species, their height and projected foliage cover. Additional site characteristics that were recorded included the GPS location, soil information (type and colour), vegetation condition, landform, topography, fire history, and a representative photograph was taken.

Data collected during the field survey was used to describe and characterise the vegetation communities present. Vegetation communities were described using the National Vegetation Information System framework (Australian Government, 2013). Vegetation condition mapping was not undertaken as part of this project.

3.2 Black Cockatoos

The objective of the preliminary Black Cockatoo Assessment was to define and map suitable foraging and breeding habitat for the Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo. Roosting habitat was not assessed at this time.

3.2.1 Foraging habitat

The Black Cockatoo Foraging Habitat Assessment was informed by the Flora and Vegetation Assessment and on-ground observations made during the field survey. Foraging quality was assessed at the 12 sample point locations (sites) coinciding with the flora relevés. An assessment of presence of suitable foraging species was undertaken at these sites and searches undertaken for evidence of foraging or Black Cockatoo presence. Suitable foraging species for Carnaby's was informed by the DSEWPac (2012) referral guidelines (Table 5).

Table 5 Black Cockatoo suitable foraging species informed by DSEWPac (2012) and Johnstone et al. (2013)

Carnaby's Black Cockatoo	Forest Red-tailed Black Cockatoo
Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species (e.g. <i>Banksia</i> sp., <i>Hakea</i> sp. and <i>Grevillea</i> sp.) as well as eucalypt woodland and forest that is dominated by foraging species. Also will feed on Callistemon, seeds of introduced species such as <i>Pinus</i> species and <i>Erodium</i> species, wild radish, canola, almonds and pecan nuts and occasionally apples and persimmons.	The principal foods of the FRTBC are the seeds of Marri and Jarrah. Other less important foods include Blackbutt <i>E. patens</i> , <i>E. wandoo</i> , Sheoak <i>A. fraseriana</i> , Snottygobble <i>P. longifolia</i> , <i>Hakea</i> spp., also introduced species (including Cape Lilac <i>Melia azedarach</i> , Spotted Gum <i>C. maculata</i> , Lemon-scented Gum <i>C. citriodora</i> , Silver Princess <i>E. caesia</i> , Illyarrie <i>E. erythrocorys</i> and Kaffir Plum <i>Harpephyllum caffrum</i>) and in southern forests Albany Blackbutt <i>E. staeri</i> and Karri <i>E. diversicolor</i> . Rarely observed grubbing for insect larvae on <i>Allocasuarina</i> spp.

3.2.2 Breeding habitat

A Black Cockatoo Breeding Habitat Assessment was conducted which focussed on quantifying potential breeding trees and associated habitat. Table 6 defines breeding habitat and identifies those trees that Black Cockatoos will utilise as breeding trees, according to the DSEWPaC (2012). Vegetation communities were assessed for their potential to provide breeding habitat by installing 50 x 50 m quadrats as a sample point. All trees within this quadrat were then assessed for their suitability as a potential breeding tree. Quadrats were used to provide a representative sample to determine the total amount of breeding habitat (and approximate number of potential breeding trees). Opportunistic records of trees with a DBH >500 cm were also made within the Survey Area, where time permitted. The following information was collected for all potential breeding trees with a DBH >500 cm:

- location
- fire scarring present
- tree species
- DBH
- height
- presence and number of hollows
- potential suitability of hollows.

Photographs were also taken of each potential breeding tree.

Table 6 Breeding habitat for two Western Australian Threatened Black Cockatoo species

Breeding habitat	Carnaby's	Forest Red-Tailed
Specific breeding habitat for the three Cockatoos	Nest in hollows in live or dead trees of <i>E. salmonophloia</i> , <i>E. wandoo</i> , <i>E. gomphocephala</i> , <i>E. marginata</i> , <i>E. rudis</i> , <i>E. loxophleba</i> subsp. <i>loxophleba</i> , <i>E. accedens</i> , <i>E. diversicolor</i> and <i>Corymbia calophylla</i> .	Nest in hollows in live or dead trees of <i>E. diversicolor</i> and <i>Corymbia calophylla</i> , <i>E. wandoo</i> , <i>E. megacarpa</i> , <i>E. patens</i> , <i>E. gomphocephala</i> and <i>E. marginata</i> .
Definition of potential breeding habitat	'Breeding habitat' is defined in these referral guidelines as trees of species known to support breeding within the range of the species which either have a suitable nest hollow OR are of a suitable DBH to develop a nest hollow. For most tree species, suitable DBH is 500 mm.	

Source: DSEWPaC (2012).

3.3 Wetlands

The vegetation within wetland boundaries, as mapped in the Geomorphic Wetlands dataset, was investigated to determine the extent of wetland vegetation, as well as vegetation condition. A wetland evaluation was completed for wetlands located entirely, or mostly within the Survey Areas, inclusive of vegetation, water, and fringing vegetation that grades from wetland to adjacent floodplain woodlands. Wetlands where only a small area intersects with the Survey Area, i.e. slivers and edges, were not considered.

The wetland evaluation methodology for the Swan Coastal Plain is a two-tiered approach. This approach has been adopted to avoid detailed evaluations being undertaken where it may not be necessary. The two tiers of evaluation are as follows:

- 1) Preliminary Evaluation – if any one of the preliminary evaluation criteria is met the wetland is automatically to be assigned a Conservation management category and no further evaluation is required
- 2) Secondary Evaluation – if the wetland does not meet the preliminary evaluation criteria the secondary evaluation should be conducted to determine the wetland's management category.

The Preliminary evaluation was undertaken using the information contained in the *Wetland evaluation and desktop and site assessment form*. In accordance with DPaW (2013) methodology, if a wetland met any one of the Preliminary evaluation criteria then it was assigned a Conservation management category.

3.3.1 Geomorphic Wetlands dataset of the Swan Coastal Plain

The Geomorphic Wetlands of the SCP dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the SCP. The mapping, classification and evaluation of wetlands on the SCP was initially conducted by Hill *et al.* in 1996 and then subsequently conducted in accordance with EPA Bulletin 686: *A Guide to Wetland Management in the Perth and Near Perth Swan Coastal Plain Area* (EPA, 1993). These mapping and evaluation results have been digitised into the *Geomorphic Wetlands of the SCP dataset* administered by DPaW. Geomorphic classifications are determined based on the duration of wetland inundation and associated landform.

In addition to geomorphic classifications, evaluation of wetlands is undertaken to assign the relevant management categories. EPA (2008) Guidance Statement 33 outlines the three key management categories which have been applied on the SCP, along with guidance on management objectives for each category (Table 7).

Table 7 Management Categories and Objectives for the Geomorphic Wetlands of the Swan Coastal Plain

Management Category	General Description	Management Objectives
Conservation (CC or CCW)	Wetlands which support a high level of attributes and functions.	Highest priority wetlands. Objective is to preserve and protect the existing conservation values of the wetlands through various mechanisms including: <ul style="list-style-type: none"> - reservation in national parks, crown reserves and State owned land protection under Environmental Protection Policies - wetland covenanting by landowners. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.
Resource Enhancement (RE)	Wetlands which may have been partially modified but still support substantial ecological attributes and functions	Priority wetlands. Ultimate objective is to manage, restore and protect towards improving their Conservation value. These wetlands have the potential to be restored to Conservation Category. This can be achieved by restoring wetland function, structure and biodiversity. Protection is recommended through a number of mechanisms.
Multiple Use (MU)	Wetlands with few remaining important attributes and functions	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through landcare.

3.4 Limitations

The Survey Area was subject to a preliminary flora and vegetation assessment and a targeted Black Cockatoo assessment. The limitations associated with these are presented in Table 8.

Part of the Survey Area was intersected by a fence with electric fence warning signs. This fence is located in the centre of Lot 295 heading north-south. To the east of this fence was a well-maintained shed with one sheep (recently fed) and freshly mowed lawn. The decision was made to not access this part of the property. At the time it was decided to not cross the fence and complete a site assessment from the edge. For the objective of this survey, this was not considered a significant limitation as vegetation was limited to trees in a paddock (i.e. Degraded to Good condition compared to Very Good to Excellent condition on the west side of the fence).

Table 8 Limitations associated with the biological surveys

Limitation	Constraints	
	Flora and Vegetation Assessment	Black Cockatoo Assessment
Competency/experience of consultant conducting survey	Nil. The flora and vegetation assessment was led by Floora de Wit who has 8 years' experience addressing similar scopes on the Swan Coastal Plain.	Nil. Floora has four years' experience conducting Black Cockatoo assessments.
Scope (i.e. what life forms were sampled)	Nil. All dominant vascular plant species were able to be identified in the field.	Nil. Black Cockatoo breeding and foraging habitat was assessed in accordance with the offset guidelines.
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	Nil. Sampling effort included 12 relevés and numerous opportunistic observations recorded on field maps.	Moderate. The foraging assessment was informed by the flora and vegetation data and on-ground observations. The foraging assessment was undertaken based on presence of suitable foraging species and their relative abundance. No detailed foraging quality assessment was undertaken.
Sources of information	Minor. No desktop assessment was completed. Flora and vegetation was sampled to inform the Black Cockatoo foraging quality assessment and develop preliminary vegetation maps.	Moderate. No desktop assessment was completed and no observational data was obtained from DPaW to identify known roosting and breeding trees in the local area. This limits the foraging habitat quality assessment which led to the implementation of a preliminary assessment.
Completion (is further work needed)	Nil. For the purpose of meeting the objective of this assessment, no further work is required.	Nil. The objective of the assessment was to determine whether Black Cockatoo breeding and foraging habitat was present. This assessment was completed by utilising modified methods to meet the objective within a limited timeframe.
Timing, weather, season, cycle	Nil. The level of detail for the survey was considered adequate for meeting the objective of the survey.	Nil. Timing had no impact on ability to assess Black Cockatoo foraging or breeding habitat.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	Minor. A part of the Survey Area is still being used by private resident(s).	Nil. The fauna survey was not disrupted or impacted.

Limitation	Constraints	
	Flora and Vegetation Assessment	Black Cockatoo Assessment
Intensity (was the intensity adequate)	<p>Nil.</p> <p>A total of 12 relevés were completed over two field days to assess the floristic values of the Survey Area. This is considered suitable for meeting a Level 1 Assessment requirement as stipulated by EPA (2004a).</p>	<p>Nil.</p> <p>The Survey Area was surveyed over a two day period. It enabled sufficient time to conduct the Black Cockatoo foraging, and breeding assessment.</p>
Resources (degree of expertise available in plant/animal identification)	<p>Nil.</p> <p>Flora has over eight years' experience working on the Swan Coastal Plain. She is familiar with common species and has numerous literature resources available during and after the field survey to ensure identification of species were accurate.</p>	<p>Nil.</p> <p>Flora has four years' experience conducting Black Cockatoo assessments and has been actively involved in developing Black Cockatoo assessment methodology.</p>
Remoteness and/or access problems	<p>Minor.</p> <p>The Survey Area was traversed on foot with the exception of one area that was used as a private residence and had signs of electric fences. The impact is considered minor as vegetation was viewed from the fence and was limited to trees in paddocks.</p>	
Availability of contextual information on the region	<p>Nil.</p> <p>For the purpose of this assessment, no additional contextual information was considered. This limits the ability for desktop information to inform the sample plan and survey design. However for the purposes of this assessment, this is not considered a limitation.</p>	

4.0 Field Results

4.1 Vegetation

A total of six vegetation communities were observed and mapped within the Survey Area. These include two wetland communities, three forest communities and one woodland community. The community codes, descriptions and photographs are presented in Table 9 and are spatially presented in Figure 5.

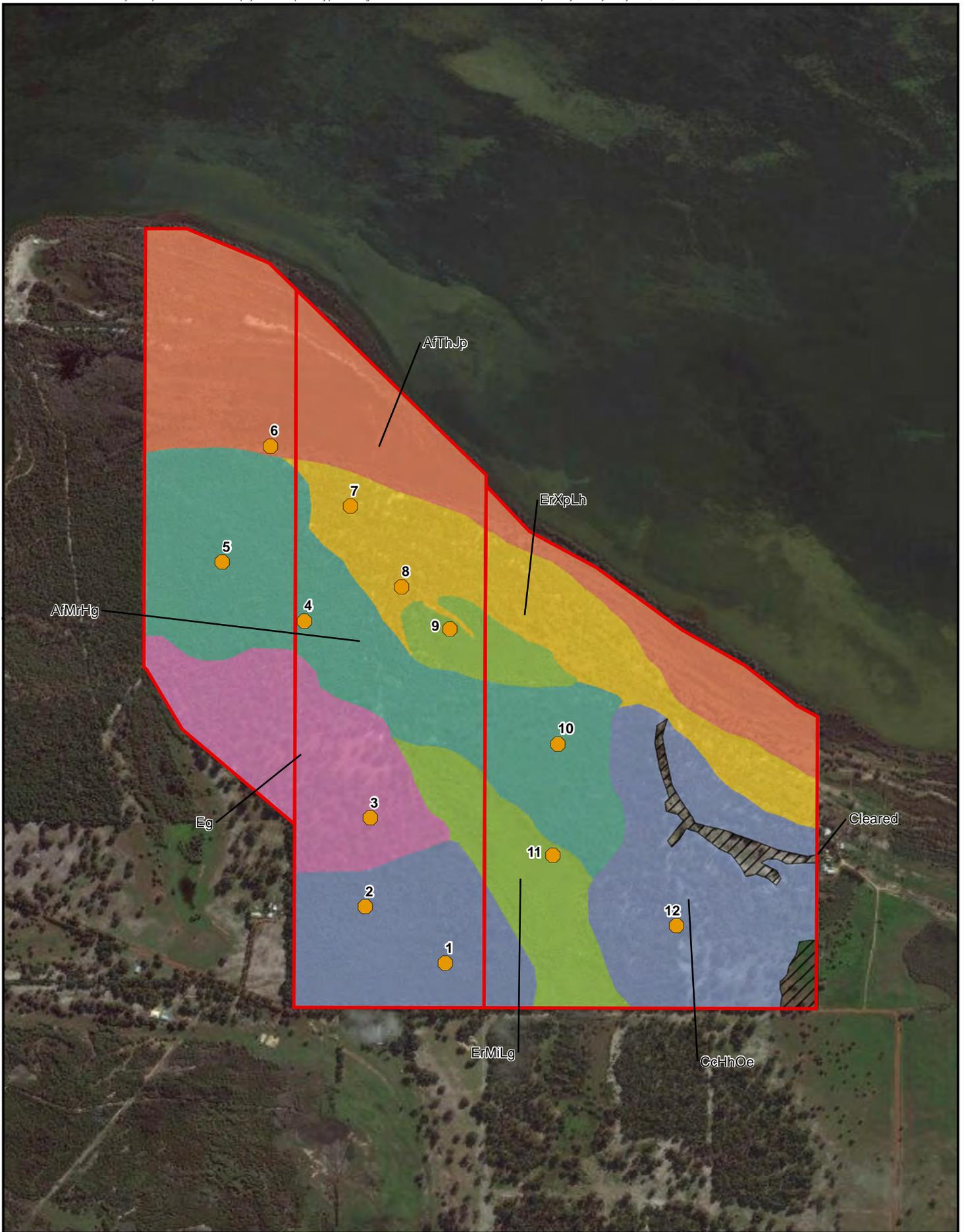
A review of inferred Floristic Community Types that represent PECs and TECs indicate that it is unlikely that TECs or PECs are present.

Table 9 Vegetation community codes, descriptions and representative photograph

Community Code	Description	Photograph
AfMrHg	<p><i>Allocasuarina fraseriana</i>, <i>Kunzea glabrescens</i> and <i>Banksia attenuata</i> low to mid open forest over <i>Macrozamia riedlei</i>, <i>Acacia pulchella</i> and <i>Xanthorrhoea preissii</i> low to mid sparse shrubland over <i>Hypochaeris glabra</i>, <i>Ursinia anthemoides</i> and <i>Pyrorchis nigricans</i> low open forbland.</p> <p>Area: 53.58 ha Lot 295: 14.85 ha Lot 842: 22.87 ha Lot 1262: 15.87 ha</p> <p>Sites: three relevés (4, 5, and 10) Species richness: 31 native species, at least five weed species</p>	
ErXpLh	<p><i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>, <i>Melaleuca raphiophylla</i> and <i>Banksia grandis</i> low to tall open forest to woodland over <i>Xanthorrhoea preissii</i>, <i>Macrozamia riedlei</i> and <i>Jacksonia sternbergiana</i> mid to tall open shrubland over <i>Lagenophora huegelii</i> and common weeds.</p> <p>Area: 31.00 ha Lot 295: 16.92 ha Lot 842: 0.05 ha Lot 1262: 14.03 ha</p> <p>Sites: two relevés (7 and 8) Species richness: 15 native species, at least ten weed species</p>	

Community Code	Description	Photograph
CcHhOe	<p><i>Corymbia calophylla</i>, <i>Banksia attenuata</i> and <i>Allocasuarina fraseriana</i> low to tall woodland over <i>Hibbertia hypericoides</i>, <i>Xanthorrhoea preissii</i> and <i>Leucopogon propinquus</i> mid open shrubland over <i>Opercularia echinocephala</i> and common weeds.</p> <p>Area: 58.72 ha Lot 295: 37.62 ha Lot 842: 0.00 ha Lot 1262: 21.10 ha</p> <p>Sites: four relevés (1, 2, 12, and 13) Species richness: 42 native species, at least six weed species</p>	
Eg	<p><i>Eucalyptus gomphocephala</i>, <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> tall open forest over common weeds.</p> <p>Area: 27.78 ha Lot 295: 0.00 ha Lot 842: 12.18 ha Lot 1262: 15.61 ha</p> <p>Sites: one relevé (3) Species richness: five native species, at least ten weed species</p>	

Community Code	Description	Photograph
ErMiLg	<p><i>Eucalyptus rudis</i>, <i>Melaleuca raphiophylla</i> mid to tall woodland over <i>Melaleuca incana</i> subsp. <i>incana</i> and <i>Calothamnus lateralis</i> mid shrubland over <i>Lepyrodia glauca</i>, <i>Chaetanthus aristatus</i> and <i>Hypolaena exsulca</i> tall rushland.</p> <p>Area: 23.74 ha Lot 295: 15.27 ha Lot 842: 0.00 ha Lot 1262: 8.47 ha</p> <p>Sites: two relevés (9 and 11) Species richness: 16 native species, at least five weed species</p>	
AfThJp	<p><i>Allocasuarina fraseriana</i> and <i>Melaleuca preissiana</i> mid isolated trees over <i>Tecticornia ?halocnemoides</i> and <i>Tecticornia lepidosperma</i> low samphire shrubland with <i>Juncus pallidus</i>, <i>Baumea rubiginosa</i> and <i>Hypolaena exsulca</i> low open rushland.</p> <p>This community represents the estuarine zone of the Peel-Harvey Inlet, part of the Peel-Yalgorup listed Ramsar wetland.</p> <p>Area: 51.35 ha Lot 295: 12.54 ha Lot 842: 23.43 ha Lot 1262: 15.38 ha</p> <p>Sites: one relevé (6) Species richness: ten native species, at least ten weed species</p>	



<p>PROJECT ID 60100953 CREATED BY DGF APPROVED BY JL LAST MODIFIED 19 AUG 2016</p>	<p>AECOM www.aecom.com</p>	<p>LEGEND</p> <p> Survey Area</p> <p> Sites</p> <p>Community</p> <ul style="list-style-type: none"> AfMrHg AfThJp CcHhOe Eg ErMiLg ErXpLh 	<p style="text-align: center;">Vegetation Community Mapping</p> <hr/> <p>MAIN ROADS</p> <p style="text-align: center;"><i>NIRIMBA BIOLOGICAL ASSESSMENT</i></p>
<p style="text-align: center;">N</p> <p>DATUM GDA 1994, PROJECTION MGA ZONE 50</p> <p style="text-align: center;">0 110 220 330 440</p> <p style="text-align: center;">metres</p> <p style="text-align: center;">1:15,000 when printed at A4</p>	<p>Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community</p>		<p>Figure</p> <p style="font-size: 2em;">5</p>

4.2 Flora

4.2.1 Threatened and Priority flora

One Priority 4 species, *Eucalyptus rudis* subsp. *cratyantha* was collected during the field survey. This species is characterised by bigger fruits compared to the common *Eucalyptus rudis*. The specimen was submitted to and confirmed by the WA Herbarium due to lack of descriptive materials publicly available to distinguish between the Priority and common species.

It was collected at one location in community ErXpLh, an open forest containing an estimated 1000 individuals. As not every tree was assessed it is uncertain of the exact size and extent of this population. During the field survey, the larger *E. rudis* fruits were observed at a number of locations. It is therefore likely to be locally common in the area.

4.2.2 Diversity

A total of 69 native flora species from 52 genera and 28 families were recorded during the field survey. Families with the highest representation includes Myrtaceae (13 native species) and Fabaceae (eight native species).

Nine weed species were recorded during the field survey. As the survey was not extensive, it is likely that more weeds are present. One Declared Pest listed under the BAM Act as a Category 3 species was recorded. This species, *Zantedeschia aethiopica* (Arum Lily) was recorded at one location in community CcHhOe. No extensive populations of the Arum Lily were observed and only one population of less than 50 individuals was recorded.

A species by community matrix is provided in Appendix A.

4.3 Black Cockatoo foraging habitat

4.3.1 Carnaby's Black Cockatoo

The Survey Area contains 171.08 ha of potentially suitable foraging habitat. These communities were dominated by *Banksia attenuata* species and included *Banksia grandis*, *Eucalyptus marginata*, *Corymbia calophylla* and *Eucalyptus gomphocephala*. A breakdown of suitable foraging area by Lot number is provided in Table 10. There were no sightings of Carnaby's Black Cockatoo during the field survey, and no foraging evidence was observed in the Survey Area.

Table 10 Carnaby's Black Cockatoo foraging habitat

	Lot 295	Lot 842	Lot 1262	Total
Foraging habitat	69.39	35.1	66.6	171.08

4.3.2 Forest Red-tailed Black Cockatoo

A total of 140.08 ha of Forest Red-tailed Black Cockatoo foraging habitat was mapped within the Survey Area. A breakdown of suitable foraging habitat present within each Lot is provided in Table 11. Evidence of recent foraging (chewed Marri nuts) was recorded twice during the field survey. Observations are shown in Table 12.

A flock of Forest Red-tail Black Cockatoos was observed one kilometre west of the Survey Area, occupying trees in adjacent paddocks (Marri trees).

Table 11 Forest Red-tailed Black Cockatoo foraging habitat

	Lot 295	Lot 842	Lot 1262	Total
Foraging habitat	52.47	35.04	52.57	140.08

Table 12 Forest Red-tail Black Cockatoo observations

Record ID	Observation	Date	Location (GDA Zone 50)		Plate
Opp_2	Call heard	1 Aug 2016	380878	6386843	NA
Opp_3	Potential foraging evidence – chewed Marri chewed nuts	1 Aug 2016	380898	6386423	Plate 1
Opp_5	Potential foraging evidence – chewed Marri nuts	2 Aug 2016	381617	6387040	Plate 2
Opp_6	Flock seen on adjacent property,	2 Aug 2016	382180	6386023	Plate 3



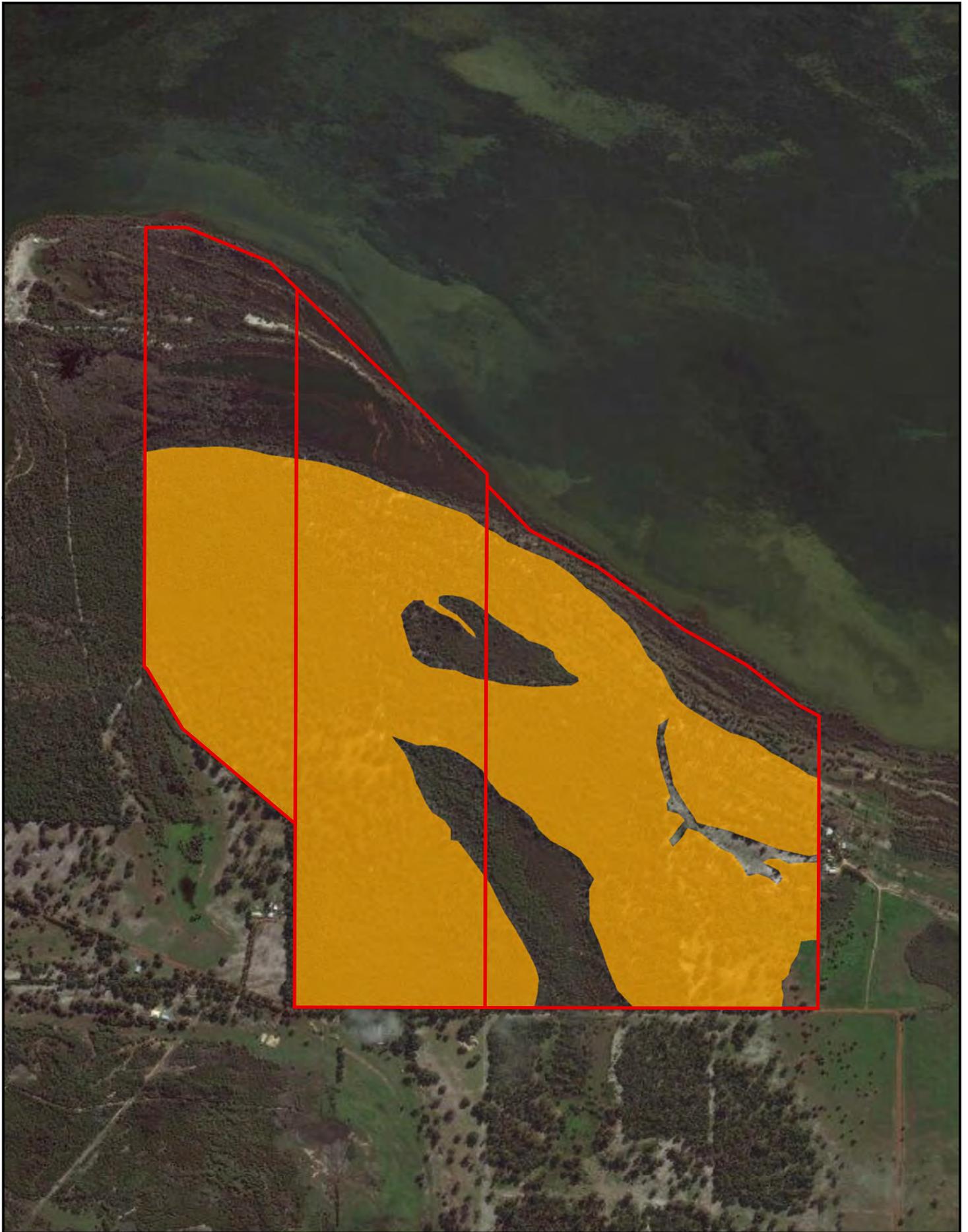
Plate 1 Forest Red-tailed Black Cockatoo foraging evidence 1



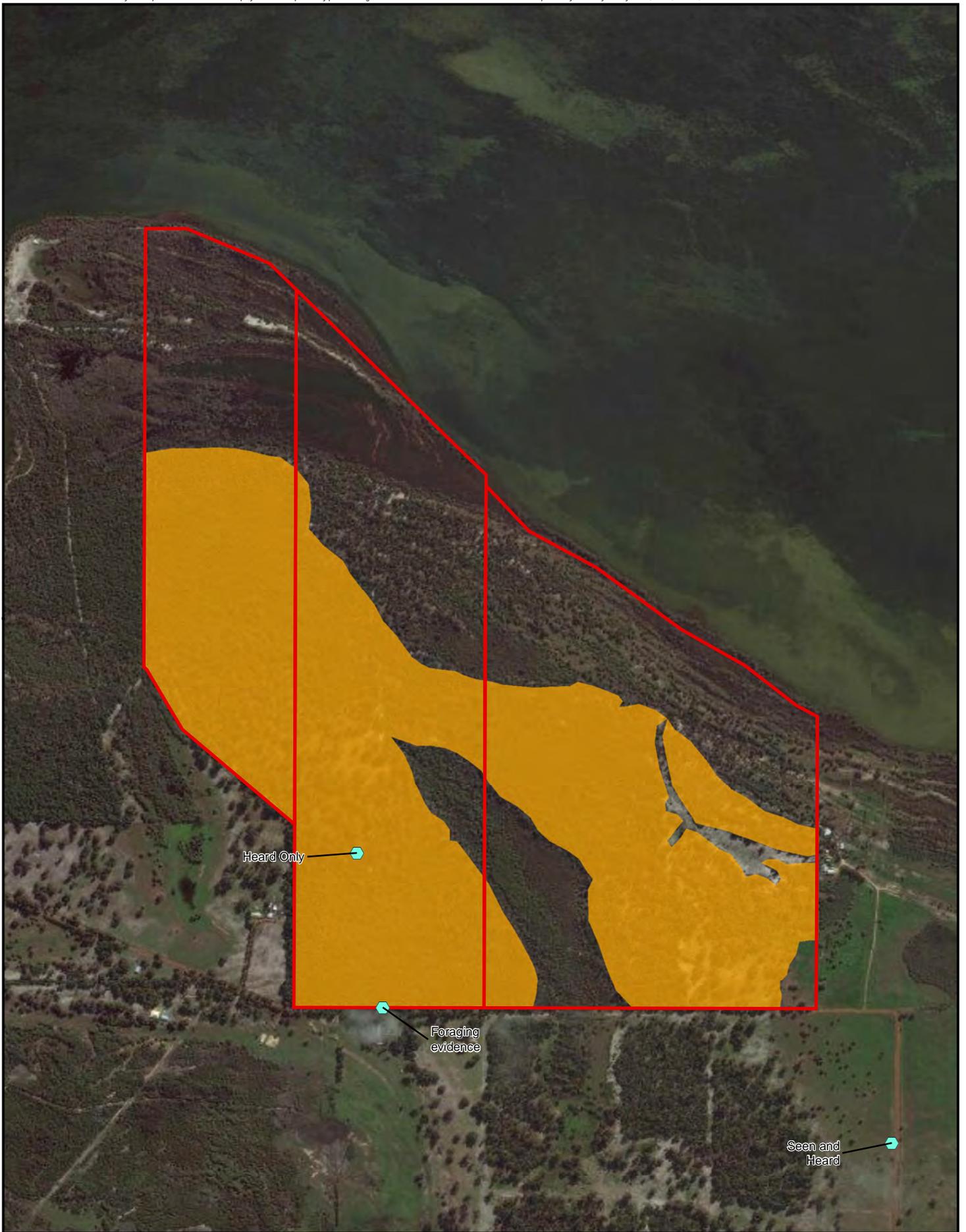
Plate 2 Forest Red-tailed Black Cockatoo foraging evidence 2



Plate 3 Flock of Forest Red-tailed Black Cockatoos on neighbouring property



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<p>DATUM GDA 1994, PROJECTION MGA ZONE 50</p>  <p>1:15,000 when printed at A4</p>		<p><small>Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community</small></p>	<p>MAIN ROADS</p> <p><i>NIRIMBA BIOLOGICAL ASSESSMENT</i></p> <p style="text-align: right;">Figure 6</p>



<p>PROJECT ID 60100953 CREATED BY DGF APPROVED BY JL LAST MODIFIED 19 AUG 2016</p>	 <p>www.aecom.com</p>	<p>LEGEND</p> <ul style="list-style-type: none"> Survey Area Opportunistic Records Forest Red-tailed Black Cockatoo Foraging Habitat 	<p>Forest Red-tailed Black Cockatoo Foraging Habitat and Opportunistic Records</p> <p>MAIN ROADS</p> <p><i>NIRIMBA BIOLOGICAL ASSESSMENT</i></p>
<p>DATUM GDA 1994, PROJECTION MGA ZONE 50</p>  <p>1:15,000 when printed at A4</p>		<p><small>Data sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community</small></p>	<p style="text-align: right;">Figure 7</p>

4.4 Black Cockatoo breeding habitat

A total of 171.09 ha was considered potential Black Cockatoo breeding habitat. That is, in these areas at least one or more potential breeding trees were observed either within quadrats or opportunistically as the Survey Area was traversed. A breeding quality assessment was undertaken based on the density of potentially suitable breeding trees within the defined vegetation communities. Vegetation with a high density of potentially suitable breeding trees was considered 'Quality' breeding habitat. Vegetation where trees were less dense was considered 'Valued', and vegetation with few potentially suitable trees was mapped as 'Low' quality breeding habitat. A breeding habitat map was produced, as shown in Figure 8.

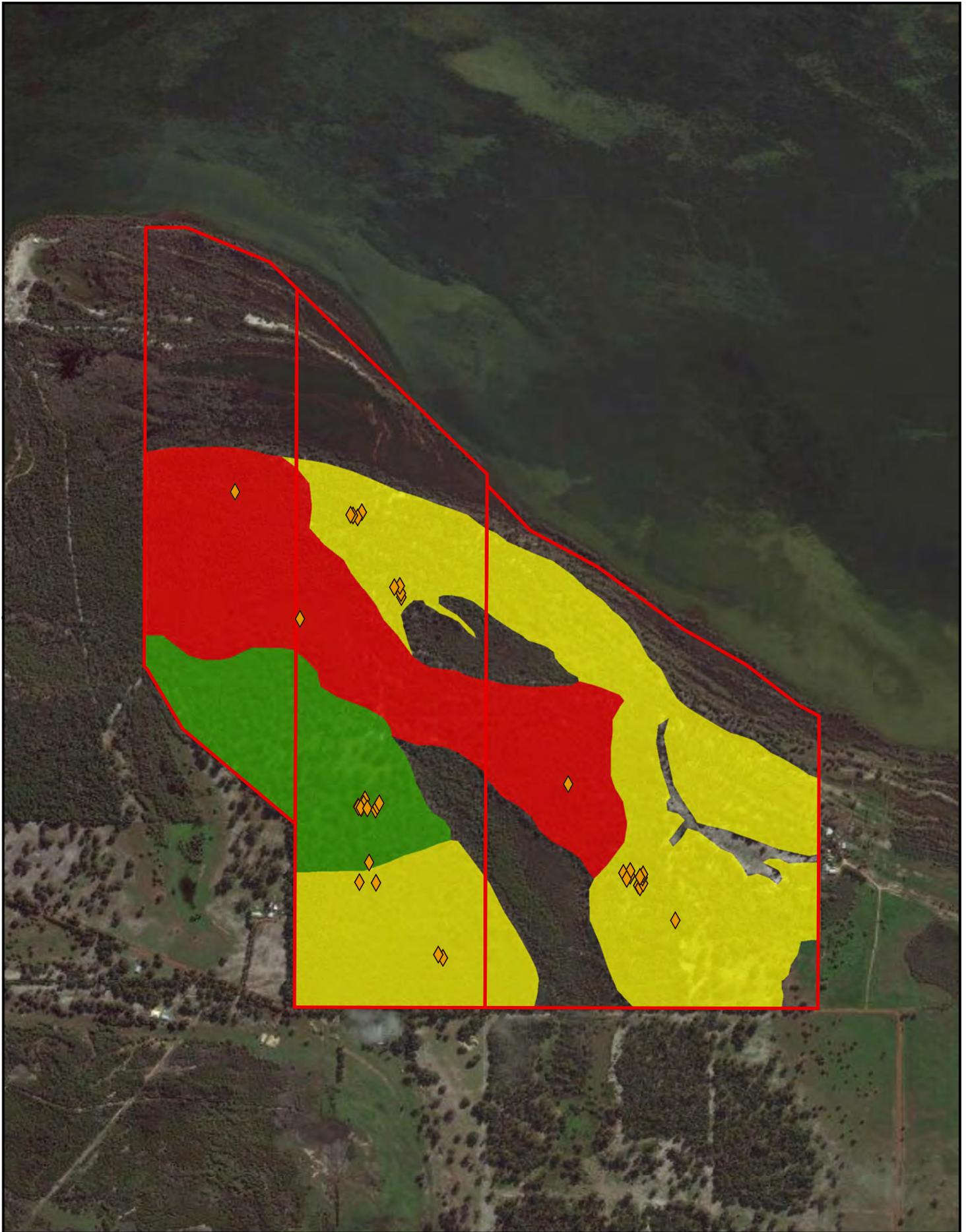
Potentially suitable breeding trees were recorded in nine of the 12 sites. The quadrats with the highest number of trees was within community Eg, characterised by Tuart trees in a paddock. This community extends for 27.78 ha, and may support an estimated 1,111 potentially suitable breeding trees. This vegetation community is considered 'Quality' breeding habitat. Communities CcHhOe and ErXpLh showed the second highest density of potential breeding trees within quadrats. A total of 20 trees were recorded within quadrats in these communities, with 562 potential breeding trees estimated to occur across the 89.72 ha that comprise these communities. This community is considered 'Valued' breeding habitat. The results of the Black Cockatoo Breeding Habitat Assessment including tree count and habitat quality is shown in Table 13. A breakdown of area for each Lot within the Survey Area is shown in Table 14.

Table 13 Black Cockatoo potential breeding trees recorded and estimated total trees potentially present in the Survey Area

Breeding Quality	Vegetation Unit	Number of Breeding Tree Quadrats	Total Trees Counted	Total Area of Vegetation Units	Approximate Number of Trees
Low	AfMrHg	3	1	53.58	24
Valued	CcHhOe and ErXpLh	5	20	89.72	562
Quality	Eg	1	10	27.78	1111
Totals				171.08	1,697

Table 14 Breeding quality results and extent for each of the three Lots in the Survey Area

Breeding Quality	Lot 295	Lot 842	Lot 1262	Total
Low	14.84	22.87	15.87	53.58
Valued	54.54	0.05	35.12	89.72
Quality	0.00	12.18	15.61	27.78
Totals	69.39	35.10	66.60	171.09



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4.5 Wetlands

4.5.1 Wetland vegetation

A number of wetlands associated with the Peel-Harvey inlet were subject to one Wetland Assessment (as a group). These included UFI 2992, 3115 and 14562. The current classification of these wetlands varies from MU to RE. Other wetlands associated with this group were not visited due to inundation. A Wetland Assessment was undertaken in accordance with DPaW (2013) Wetland Assessment methodology. This assessment grouped together the Peel-Harvey inlet (including UFI 14562, 2992 and 3115). This group of wetlands are currently listed as Resource Enhancement (RE) and Multiple Use (MU) Wetlands however the preliminary assessment evaluation triggered automatic consideration as Conservation wetlands. They are listed on the Register of National Estate, and have more than 90% of wetland vegetation considered in 'Good' or better condition. Some clearing was evident adjacent to this wetland group, with open areas dominated by weeds.

A secondary evaluation was undertaken, which confirmed the assessment results that all wetlands in this group would be considered suitable for a Conservation management category based on wetland processes and fauna habitat.

Two wetlands (UFI 2995 and 3116) are located in their entirety within the Survey Area. These include UFI 2995 and 3116. Vegetation within these wetlands is represented by community ErMiLg. Similarly, vegetation boundaries closely resemble the Geomorphic Wetlands dataset.

Implementing the DPaW (2013) Wetlands Assessment triggered one preliminary attribute for these sumplands, leading to an immediate classification as Conservation wetlands. The attribute that triggered this assessment is that both wetlands have equal to or greater than 90% of wetland vegetation in 'Good' or better condition. It is possible that more preliminary evaluation triggers are present however lacking detailed desktop information regarding Threatened species and communities, these were not identified at this time.

The secondary evaluation also resulted in both wetlands being classified as Conservation wetlands. The evaluation showed that both wetlands contain significant geomorphology, wetland processes and flora values and are therefore suitable for consideration as Conservation category. These findings are consistent with the current Geomorphic Wetlands mapping which already classifies these wetlands as CC wetlands.

One Multiple Use wetland, UFI 3125 despite being located entirely within the Survey Area, was not subject to a Wetlands Assessment. Access to this wetland was limited due to an electric fence and evidence of private use.

A summary of Wetland Assessment and foreshore assessment outcomes are provided in Table 15. Completed wetland forms are provided in Appendix B.

4.5.2 Boundary mapping

There are 14 wetlands completely or partially intersecting the Survey Area, comprising 23.49 ha of CCW, 23.82 ha of RE and 26.41 ha of MU wetlands (73.72 ha total). Despite the different categories, the Wetlands Assessment showed all wetlands (or wetland groups) support attributes representative of a CCW.

Wetland vegetation was recorded along the edge of the Peel-Harvey inlet (mapped as AfThJp). The wetland vegetation mapping closely follows the boundaries mapped in the Geomorphic Wetlands of the Swan Coastal Plain dataset. Furthermore, the two CCW in the Survey Area were mapped as ErMiLg, considered in 'Excellent' condition. A total of 75.09 ha of wetland vegetation was mapped (Figure 5) and considered to closely resemble the existing Geomorphologic Wetlands dataset boundary mapping.

Table 15 Wetlands assessment summary of results including foreshore assessment and DPaW (2013) Wetlands Assessment results

UFI	Comments	Wetlands Assessment	
		Preliminary	Secondary
2995	Entirety of wetland situated within Survey Area supporting vegetation in 'Excellent' condition. No surface water evident at the time of the survey and unlikely to express water often.	- Equal to or greater than 90% of the wetland supports vegetation in a good or better condition.	Conservation - geomorphology, wetland processes and flora values
3116	This CCW wetland is situated in its entirety within the Survey Area. No surface water was present at the time of the field survey, and it seemed unlikely to express water at any time of the year. The entire wetland was vegetated with dense shrubs, sedges and rushes (see Table 9 for photographs and community description). The wetland vegetation was considered in 'Excellent' condition.	- Equal to or greater than 90% of the wetland supports vegetation in a good or better condition.	Conservation – geomorphology and flora values
14562, 2992 and 3115	Representing the edge of the Peel-Harvey estuary. Mosquito populations were high, and weeds were observed in areas seemingly bare from native vegetation. Vegetation condition considered 'Very Good' and 'Excellent'.	- Listed on the Register of National Estate (Commonwealth of Australia 2007). - Equal to or greater than 90% of the wetland supports vegetation in a good or better condition.	Conservation – wetland processes and fauna values

5.0 References

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Appendix A

Vascular Flora Species List by Vegetation Community, Nirimba 2016

Appendix A Vascular Flora Species List by Vegetation Community, Nirimba 2016

Family	Weed	Taxon	AfMrHg	ErXpLh	CcHhOe	Eg	AfThJp	ErMiLg
Loranthaceae		<i>Cassytha</i> sp.		x				x
Myrtaceae		<i>Nuytsia floribunda</i>			x			
		<i>Astartea affinis</i>						x
		<i>Calothamnus lateralis</i>						x
		<i>Corymbia calophylla</i>			x	x		
		<i>Eucalyptus gomphocephala</i>	x			x		
		<i>Eucalyptus marginata</i>	x		x	x		
	P4	<i>Eucalyptus rudis</i>		x	x		x	x
		<i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>		x				
		<i>Kunzea ericifolia</i> subsp. <i>ericifolia</i>		x	x			x
		<i>Kunzea recurva</i>						x
		<i>Melaleuca incana</i> subsp. <i>incana</i>		x				x
		<i>Melaleuca preissiana</i>		x	x		x	
		<i>Melaleuca raphiophylla</i>		x			x	x
		<i>Melaleuca teretifolia</i>						x
		<i>Kunzea glabrescens</i>	x					
Orchidaceae		<i>Leporella fimbriata</i>	x		x			
		<i>Orchid</i> sp.	x		x			
		<i>Pheladenia deformis</i>	x	x	x			
		<i>Pterostylis</i> sp. (nana complex)	x					
		<i>Pyrorchis nigricans</i>	x		x			
Poaceae		* <i>Lagurus ovatus</i>			x			
		* Poaceae sp.	x					
Primulaceae			x					
		* <i>Lysimachia arvensis</i>	x					
Proteaceae		<i>Banksia attenuata</i>	x		x			
		<i>Banksia grandis</i>	x	x	x			
		<i>Banksia littoralis</i>			x			x
		<i>Hakea prostrata</i>			x			
		<i>Xylomelum occidentale</i>			x			
Ranunculaceae		<i>Clematis pubescens</i>				x		
Restionaceae		<i>Alexgeorgea nitens</i>			x			
		<i>Chaetanthus aristatus</i>						x
		<i>Lepyrodia glauca</i>						x
		<i>Loxocarya cinerea</i>			x			
		<i>Hypolaena exsulca</i>					x	x
Rubiaceae		<i>Opercularia echinocephala</i>			x			
Stylidiaceae			x		x			
		<i>Stylidium piliferum</i>	x		x			
Violaceae		<i>Hybanthus calycinus</i>	x		x			
Xanthorrhoeaceae		<i>Xanthorrhoea gracilis</i>			x			
		<i>Xanthorrhoea preissii</i>	x	x	x			
Zamiaceae		<i>Macrozamia riedlei</i>	x	x	x	x		

Appendix B

Wetland Assessment Forms

Appendix B Wetland Assessment Forms

1.0 UFI 3116

1.1 General Information

Assessor details	
Name	Floora de Wit and Lyn van Gorp
Date of site visit	2 August 2016
Company	AECOM Australia Pty Ltd
Weather during visit	Cloudy
Landowner	Main Roads Western Australia
Property details	Vegetated, mostly in Very Good to Excellent condition.
Location (lot/street)	Lot 1262 and 295 Carrabungup Road
Latitude and longitude or Easting northing	
Wetland details	
Name	
UFI	3116
Hill et al. (1996) map sheet number and wetland ID number	
Consanguineous suite	Keysbrook
Area (ha) of wetland	~6 ha
Area (ha) subject to this evaluation	~6 ha
Is wetland assessed as portion of wetland with varying degrees of value?	No
Mapped management category	Conservation
Wetland type (see table below)	Sumpland

Water permanence	Host landform				
	Basin	Flat	Slope	Highland	Channel
Permanent inundation	Lake	-	-	-	River*
Seasonal inundation	Sumpland	Floodplain*	-	-	Creek*
Intermittent inundation	Playa*	Barlkarra*	-	-	Wadi*
Seasonal waterlogging	Dampland	Palusplain	Paluslope	Palusmont*	Trough*

*Wetland types not applicable to this evaluation methodology.

1.2 Wetland desktop evaluation

Land uses	
Current ownership of wetland	Main Roads Western Australia
Current land use	Vegetated
Past land use	Unknown
Surrounding land use	RAMSAR wetland, agriculture
Existing management	No known management
Fire history/regime	Unknown, no evidence of recent fire

International, national or regional significance	
Indicate whether the wetland is identified (permanent or interim) on one of the following international, national or state registers or listings.	
Conservation Significance	Y/N
Ramsar Convention on Wetlands (Ramsar 1971)	N
Directory of Important Wetlands in Australia (Environment Australia 2001)	N
Register of National Estate (Commonwealth of Australia 2007)	N
Conservation Reserves for Western Australia Systems 1, 2, 3, 5 (Department of Conservation and Environment, 1976)	n/a
Conservation Reserves for Western Australia, The Darling System – System 6 (Department of Conservation and Environment, 1983)	N
A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region (Pen 1997)	N
The Environmental Significance of Wetlands in the Perth to Bunbury Region (Le Provost et al. 1987)	N
Bush Forever (Government of Western Australia 2000)	N
Swan Bioplan (Environmental Protection Authority 2010)	N
Environmental Protection (Swan Coastal Plain Lakes) Policy 1992	N
Environmental Protection (Western Swamp Tortoise Habitat) Policy Approval Order 2002	N
Conservation Estate (e.g. National Park, Nature Reserve, A Class Reserve)	N
Other (list):	Y ESA
Does the wetland retain the values for which it was originally registered or listed, describe:	

Fauna			
Note the presence (recorded or observed) or evidence of fauna in or surrounding the wetland which is listed by the Commonwealth (e.g. Environment Protection and Biodiversity Conservation Act 1999, CAMBA, RoKAMBA, JAMBA) or State (e.g. Threatened or Specially Protected Fauna under the Wildlife Conservation Act 1950) or Priority Fauna or Priority or Threatened Ecological Communities related to fauna which are listed by DPaW.			
Species / name of ecological community	Significance (e.g. EPBC Act, CAMBA)	Observations (e.g. population size, age, evidence, activities, habitat requirements)	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Scientific value		
List any scientific values including geoheritage or geoconservation values (e.g. important sediments or geological features, fossils, pollen records, stromatolites, thrombolites, evidence of evolutionary processes, evidence of a change in climate, unique flora or fauna adaptations) that the wetland may contain.		
Scientific, geoheritage or geoconservation values	Significance and observations	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Flora				
Use aerial photography and a site visit to determine and confirm the condition of the vegetation within and 50 metres surrounding the wetland. Using the scale outlined in Appendix B, display the locations of the vegetation conditions in the attached map and calculate their total area:				
Vegetation condition	Total area (%) within the wetland	Area (%) 50 metres surrounding the wetland		
Pristine				
Excellent	100%	100%		
Very Good				
Good				
Degraded				
Completely Degraded				
Using this information, is the wetland dominated by vegetation in a good or better condition:		Yes		
What vegetation complex (Hedde et al. 1980) does the wetland belong to:		Vasse complex		
Using the information sources outlined in Appendix B, what extent of the vegetation complex is remaining on the Swan Coastal Plain		35.9 %		
List any occurrences of Priority and Threatened Ecological Communities related to flora and wetland systems which are known to occur within and 5 kilometres surrounding the wetland. If they are located within or adjacent to the wetland display their boundary in the attached map:				
Name of ecological community	Significance (e.g. priority, threatened)	Observations (e.g. condition, area, habitat type)	Source of information (e.g. observatory, literature, DPaW)	
No detailed desktop undertaken				
List any occurrences of Declared Rare flora or Priority flora known to occur within and 1 kilometre surrounding the wetland and display their location in the attached map:				
Species	Significance (e.g. Declared Rare, Priority 1)	Population measure (number, single record, abundance comment)	Observations (e.g. habitat type, flowering season)	Source of information (e.g., literature, DPaW, surveyed population, Herbarium record)
No detailed desktop undertaken				

Representativeness	
Using the wetlands data outlined in section 4.3, Appendix D and available on DPaW's website record the corresponding area:	
	% area
What is the % area of wetlands with the same classification assigned a Conservation management category on the Swan Coastal Plain	37.0

Representativeness	
What is the % area of wetlands in the same consanguineous suite assigned a Conservation management category	1.5
What is the % area of wetlands with the same classification in the same consanguineous suite assigned a conservation management category	8.1
Is the wetland rare? (e.g. only wetland in its consanguineous suite, best wetland example in its consanguineous suite or region, only Conservation management category wetland in the consanguineous suite or region, primary saline wetland within a consanguineous suite predominated by freshwater):	N

No.	Criteria	Y/N
1	The wetland is currently recognised as internationally or nationally significant for its natural values. Lists/registers include: <ul style="list-style-type: none"> - The Ramsar Convention on Wetlands - State government endorsed candidate sites for the Ramsar Convention on Wetlands - Directory of Important Wetlands in Australia - National Heritage List - Or equivalent. 	N N N N N
2	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is identified as significant for its natural values under one or more of the following: <ul style="list-style-type: none"> - <i>Conservation Reserves for Western Australia Systems 1, 2, 3, 5</i> - <i>Conservation Reserves for Western Australia, The Darling System – System 6</i> - <i>A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region</i> - <i>The Environmental Significance of Wetlands in the Perth to Bunbury Region</i> - <i>Bush Forever, Swan Bioplan or equivalent.</i> 	N N N N N
3	The wetland supports a breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, <i>Environment Protection and Biodiversity Conservation Act 1999</i> , migratory bird agreements such as JAMBA, CAMBA and RoKAMBA) or the State (for example, Threatened and Specially Protected Fauna listed under the Wildlife Conservation Act 1950).	N
4	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and supports one or more of the following: <ul style="list-style-type: none"> - An occurrence of a Threatened Ecological Community - A confirmed occurrence of a Priority 1 or Priority 2 Ecological Community - A confirmed occurrence of a Declared Rare (Threatened) flora species. 	N N N
5	Equal to or greater than 90% of the wetland supports vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B.	Y
6	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is known to support internationally, nationally or state-wide scientific values including geoheritage and geoconservation.	N
7	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and meets one of the following: <ul style="list-style-type: none"> - ≤10% of wetlands of the same type are assigned Conservation management category within the Swan Coastal Plain (by area) - ≤10% of all wetlands in the same consanguineous suite are assigned Conservation management category (by area) - ≤10% of wetlands of the same type in its consanguineous suite are assigned Conservation management category (by area) - best representative of its type within its consanguineous suite domain. 	N N N N

1.3 Secondary Assessment Form

No.	General criteria	Criteria	Score
Geomorphology			
1	<i>Representativeness</i>	≤20% of wetlands of the same type are assigned Conservation on the Swan Coastal Plain by area.	H
2		≤20% of wetlands in the same consanguineous suite are assigned Conservation by area.	H
3		≤20% of wetlands of the same type in the same consanguineous suite are assigned Conservation by area.	H
4		The wetland is outstanding in some geomorphic aspect, for example size, origin, height relative to sea level, depth, age.	H
5	<i>Naturalness</i>	Alteration to the wetland's geomorphology by % area: < 25% altered 25-75% altered > 75% altered.	H I L
6	<i>Scarcity</i>	The wetland exhibits unusual geomorphology or unusual internal geomorphic features compared to other wetlands of the same type in the consanguineous suite.	H
7		The wetland is the best example of its type in its consanguineous suite.	H
Wetland processes			
8	<i>Representativeness</i>	The wetland is an important component of the natural hydrological cycle providing natural functions (e.g. flood protection and recharge/discharge). The wetland's vegetation, geomorphology, hydrology or sediments are modified; however, the wetland is still a component of the hydrological cycle providing natural and artificial functions (e.g. flood remediation, recharge/discharge and hydrological storage). The wetland's vegetation, geomorphology, hydrology or sediments are modified to the extent that the wetlands hydrological functions are artificial such as storage, or the wetland has been disconnected from the natural hydrological cycle and no longer provides natural attributes and functions.	H I L
9		The wetland supports a representative process (e.g. wetland process typical of the wetland's hydrological setting, sediment accretionary process typical of the wetland's geomorphic setting or hydrochemical process typical of the wetland's geological setting).	H
10	<i>Naturalness</i>	The wetland is not subject to altered wetland processes or, is subject to altered wetland processes and the wetland's natural attributes and functions are maintained. The wetland is subject to altered wetland processes and the wetland's natural attributes and functions have been changed; however, they have the potential to be rehabilitated. The wetland is subject to altered wetland processes to the extent that the wetland no longer supports natural attributes and functions.	H I L
11	<i>Scarcity</i>	The wetland exhibits unusual processes (e.g. hydrological, sedimentological, chemical, biological) compared to other wetlands of the same type in the consanguineous suite.	H
Linkages			
12	<i>Representativeness</i>	The wetland is a hydrological link in a larger or more complex and intact system.	H
13	<i>Naturalness</i>	The wetland is part of a continuous ecological linkage or wildlife corridor, or a regionally significant ecological linkage or wildlife corridor connecting bushland or	H

No.	General criteria	Criteria	Score
		wetland areas. The wetland is part of a fragmented ecological linkage or wildlife corridor. The wetland is disturbed and isolated, surrounded by either a built or highly disturbed environment with no nearby native vegetation or waterways to support an intact or fragmented ecological linkage or wildlife corridor.	I L
14	<i>Scarcity</i>	The wetland has unusual hydrological, hydrochemical or ecological linkages with adjacent wetland or bushland.	I
Habitats			
15	<i>Representativeness</i>	The wetland is isolated from other undisturbed wetlands or bushland and as a result, maintains important ecological or genetic fauna or flora diversity within its consanguineous suite domain.	H
16		The wetland contains evidence of surface water that is vital to maintaining regionally significant populations of native aquatic or terrestrial flora or fauna.	H
17		The wetland provides a nursery for native fauna populations, or maintains fauna populations at a vulnerable stage of their life cycle.	H
18	<i>Naturalness</i>	The wetland supports habitats that are unaltered or the wetland has been altered and its natural habitats are maintained. The wetland supports habitats that are altered; however, the habitats are still identifiable and have the potential to be rehabilitated. The wetland is altered and as a result is no longer supporting natural habitats which can be rehabilitated.	H I L
19	<i>Scarcity</i>	The wetland supports habitats that are unusual compared to other wetlands of the same type on the Swan Coastal Plain.	H
Flora			
20	<i>Representativeness</i>	The wetland's current diversity of native flora is similar to what would be expected in an unaltered state. The wetland supports a reduced diversity of native flora due to human induced disturbances. The wetland supports a significantly reduced diversity of native flora species due to human induced disturbances.	H I L
21		The wetland is identified in a vegetation complex (Hedde et al. 1980) which is represented by: ≤30% of the pre-European extent 30-50% of the pre-European extent.	H I
22	<i>Naturalness</i>	Using the vegetation condition scale outlined in Appendix B, the wetland's vegetation condition by area is: ≥ 75% Good, Very Good, Excellent or Pristine 25-75% Good, Very Good, Excellent or Pristine < 25% Good, Very Good, Excellent or Pristine.	H I L
23		The wetland or ≥ 50% of the wetland boundary is surrounded by land dominated by remnant native vegetation. The wetland or 10-50% of the wetland boundary is surrounded by land	H I

No.	General criteria	Criteria	Score
		dominated by remnant native vegetation. The wetland or < 10% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	L
24	<i>Scarcity</i>	The wetland supports an occurrence of Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora, or an occurrence of 3 or more significant flora taxa.	H
25		The wetland is likely to support Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora; however, the occurrence cannot be located or its habitat has been altered and is no longer in a natural state.	I
26		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
27		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community.	I
Fauna			
28	<i>Representativeness</i>	The wetland is an ecological refuge for regionally significant fauna species or fauna assemblages. The wetland has the potential to be an ecological refuge but is disturbed and its attributes and functions require rehabilitation.	H I
29		The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regionally significant native fauna. The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regional or local fauna but only in association with other surrounding natural areas.	H I
30	<i>Naturalness</i>	The wetland's current diversity of native fauna is similar to what would be expected in an unaltered state, or the wetland supports diverse fauna compared to other wetlands of the same type. The wetland supports a reduced diversity of fauna compared to other wetlands of the same type.	H I
31		The wetland supports limited attributes and functions for fauna populations due to human induced disturbances.	L
32	<i>Scarcity</i>	The wetland is likely to support a breeding, roosting, refuge or feeding site for populations of fauna listed by the Commonwealth (e.g. <i>EPBC Act 1999</i> , JAMBA, CAMBA, RoKAMBA Agreements) or the State (e.g. Threatened or Specially Protected Fauna listed under the <i>Wildlife Conservation Act 1950</i>).	H
33		The wetland supports a breeding, roosting, refuge or feeding site for Priority 1, Priority 2, Priority 3 or Priority 4 fauna.	H
34		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
35		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community or a breeding, roosting, refuge or feeding site for significant fauna.	I
Cultural			
36	<i>Representativeness</i>	The wetland or its immediate surrounds is identified for its natural values on a national or State heritage list or the wetland supports other known regional heritage values.	H
37		The wetland or its immediate surrounds is identified for its natural values on a municipal heritage list or the wetland supports other known local heritage values.	I
38		The wetland or its immediate surrounds is identified on a national, State or local list or register for its Aboriginal cultural value (e.g. Department of Aboriginal Affairs register).	H
39		The wetland is important to the local community either nationally or state wide for its natural values.	H

No.	General criteria	Criteria	Score
40		The wetland is or has the potential to be a site for public or private based recreation.	I
41		The wetland is likely to support heritage, cultural or social values; however, the value cannot be confirmed or the value has been disturbed and are no longer as important or significant. The wetland did support heritage, cultural or social values; however, these have been significantly disturbed and are no longer important or the values have been removed.	I L
Scientific and educational			
42	<i>Representativeness</i>	The wetland supports known important teaching or research characteristics and for this reason is an existing or potential education or research site. Note, the wetland must still support the relevant teaching or research characteristics. The wetland has the potential to be used as a study or research site.	H I
43		The wetland supports known scientific, geoheritage or geoconservation values.	H
44		The wetland did support scientific or educational values; however, these have been significantly disturbed and are no longer as important or the values have been removed.	L

1.4 Results

Attributes/functions /values	Scores		
	High	Intermediate	Low
Geomorphology	3	0	0
Wetland processes	2	0	0
Linkages	0	1	0
Habitats	1	0	0
Flora	3	0	0
Fauna	1	0	0
Cultural	0	0	0
Scientific and educational	0	0	0
Total Score	10	1	0
Defining attributes/ functions/values	Geomorphology and flora values		
Applicable management category	Conservation		

2.0 UFI 14562, 2992, 3115

2.1 General Information

Assessor details	
Name	Floora de Wit and Lyn van Gorp
Date of site visit	2 August 2016
Company	AECOM Australia Pty Ltd
Weather during visit	Cloudy
Landowner	Main Roads Western Australia
Property details	Vegetated, mostly in Very Good to Excellent condition.
Location (lot/street)	Lot 1262, 295 and 842 Carrabungup Road
Latitude and longitude or Easting northing	
Wetland details	
Name	
UFI	14562, 2992 and 3115
Hill et al. (1996) map sheet number and wetland ID number	
Consanguineous suite	
Area (ha) of wetland	~53 ha
Area (ha) subject to this evaluation	~41 ha
Is wetland assessed as portion of wetland with varying degrees of value?	Yes, grouped with other wetlands considered MU and RE
Mapped management category	Conservation Category
Wetland type (see table below)	Estuary – Peripheral

Water permanence	Host landform				
	Basin	Flat	Slope	Highland	Channel
Permanent inundation	Lake	-	-	-	River*
Seasonal inundation	Sumpland	Floodplain*	-	-	Creek*
Intermittent inundation	Playa*	Barlkarra*	-	-	Wadi*
Seasonal waterlogging	Dampland	Palusplain	Paluslope	Palusmont*	Trough*

*Wetland types not applicable to this evaluation methodology.

2.2 Wetland desktop evaluation

Land uses	
Current ownership of wetland	Main Roads Western Australia
Current land use	Vegetated
Past land use	Unknown
Surrounding land use	RAMSAR wetland, agriculture
Existing management	No known management
Fire history/regime	Unknown, no evidence of recent fire

International, national or regional significance	
Indicate whether the wetland is identified (permanent or interim) on one of the following international, national or state registers or listings.	
Conservation Significance	Y/N
Ramsar Convention on Wetlands (Ramsar 1971)	N
Directory of Important Wetlands in Australia (Environment Australia 2001)	N
Register of National Estate (Commonwealth of Australia 2007)	N
Conservation Reserves for Western Australia Systems 1, 2, 3, 5 (Department of Conservation and Environment, 1976)	n/a
Conservation Reserves for Western Australia, The Darling System – System 6 (Department of Conservation and Environment, 1983)	N
A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region (Pen 1997)	N
The Environmental Significance of Wetlands in the Perth to Bunbury Region (Le Provost et al. 1987)	N
Bush Forever (Government of Western Australia 2000)	N
Swan Bioplan (Environmental Protection Authority 2010)	N
Environmental Protection (Swan Coastal Plain Lakes) Policy 1992	N
Environmental Protection (Western Swamp Tortoise Habitat) Policy Approval Order 2002	N
Conservation Estate (e.g. National Park, Nature Reserve, A Class Reserve)	N
Other (list):	Y ESA
Does the wetland retain the values for which it was originally registered or listed, describe:	

Fauna			
Note the presence (recorded or observed) or evidence of fauna in or surrounding the wetland which is listed by the Commonwealth (e.g. Environment Protection and Biodiversity Conservation Act 1999, CAMBA, RoKAMBA, JAMBA) or State (e.g. Threatened or Specially Protected Fauna under the Wildlife Conservation Act 1950) or Priority Fauna or Priority or Threatened Ecological Communities related to fauna which are listed by DPaW.			
Species / name of ecological community	Significance (e.g. EPBC Act, CAMBA)	Observations (e.g. population size, age, evidence, activities, habitat requirements)	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Scientific value		
List any scientific values including geoheritage or geoconservation values (e.g. important sediments or geological features, fossils, pollen records, stromatolites, thrombolites, evidence of evolutionary processes, evidence of a change in climate, unique flora or fauna adaptations) that the wetland may contain.		
Scientific, geoheritage or geoconservation values	Significance and observations	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Flora				
Use aerial photography and a site visit to determine and confirm the condition of the vegetation within and 50 metres surrounding the wetland. Using the scale outlined in Appendix B, display the locations of the vegetation conditions in the attached map and calculate their total area:				
Vegetation condition	Total area (%) within the wetland	Area (%) 50 metres surrounding the wetland		
Pristine				
Excellent	80%	100%		
Very Good				
Good	20%			
Degraded				
Completely Degraded				
Using this information, is the wetland dominated by vegetation in a good or better condition:		Yes		
What vegetation complex (Heddlé et al. 1980) does the wetland belong to:		Vasse complex		
Using the information sources outlined in Appendix B, what extent of the vegetation complex is remaining on the Swan Coastal Plain		35.9 %		
List any occurrences of Priority and Threatened Ecological Communities related to flora and wetland systems which are known to occur within and 5 kilometres surrounding the wetland. If they are located within or adjacent to the wetland display their boundary in the attached map:				
Name of ecological community	Significance (e.g. priority, threatened)	Observations (e.g. condition, area, habitat type)	Source of information (e.g. observatory, literature, DPaW)	
No detailed desktop undertaken				
List any occurrences of Declared Rare flora or Priority flora known to occur within and 1 kilometre surrounding the wetland and display their location in the attached map:				
Species	Significance (e.g. Declared Rare, Priority 1)	Population measure (number, single record, abundance comment)	Observations (e.g. habitat type, flowering season)	Source of information (e.g., literature, DPaW, surveyed population, Herbarium record)
No detailed desktop undertaken				

Representativeness	
Using the wetlands data outlined in section 4.3, Appendix D and available on DPaW's website record the corresponding area:	
	% area
What is the % area of wetlands with the same classification assigned a Conservation management category on the Swan Coastal Plain	55.3

Representativeness	
What is the % area of wetlands in the same consanguineous suite assigned a Conservation management category	0.8
What is the % area of wetlands with the same classification in the same consanguineous suite assigned a conservation management category	69.2
Is the wetland rare? (e.g. only wetland in its consanguineous suite, best wetland example in its consanguineous suite or region, only Conservation management category wetland in the consanguineous suite or region, primary saline wetland within a consanguineous suite predominated by freshwater):	N

No.	Criteria	Y/N
1	The wetland is currently recognised as internationally or nationally significant for its natural values. Lists/registers include: <ul style="list-style-type: none"> - The Ramsar Convention on Wetlands - State government endorsed candidate sites for the Ramsar Convention on Wetlands - Directory of Important Wetlands in Australia - National Heritage List - Or equivalent. 	N N N Y N
2	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is identified as significant for its natural values under one or more of the following: <ul style="list-style-type: none"> - <i>Conservation Reserves for Western Australia Systems 1, 2, 3, 5</i> - <i>Conservation Reserves for Western Australia, The Darling System – System 6</i> - <i>A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region</i> - <i>The Environmental Significance of Wetlands in the Perth to Bunbury Region</i> - <i>Bush Forever, Swan Bioplan or equivalent.</i> 	N N N N N
3	The wetland supports a breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, <i>Environment Protection and Biodiversity Conservation Act 1999</i> , migratory bird agreements such as JAMBA, CAMBA and RoKAMBA) or the State (for example, Threatened and Specially Protected Fauna listed under the Wildlife Conservation Act 1950).	N
4	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and supports one or more of the following: <ul style="list-style-type: none"> - An occurrence of a Threatened Ecological Community - A confirmed occurrence of a Priority 1 or Priority 2 Ecological Community - A confirmed occurrence of a Declared Rare (Threatened) flora species. 	N N N
5	Equal to or greater than 90% of the wetland supports vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B.	Y
6	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is known to support internationally, nationally or state-wide scientific values including geoheritage and geoconservation.	N
7	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and meets one of the following: <ul style="list-style-type: none"> - ≤10% of wetlands of the same type are assigned Conservation management category within the Swan Coastal Plain (by area) - ≤10% of all wetlands in the same consanguineous suite are assigned Conservation management category (by area) - ≤10% of wetlands of the same type in its consanguineous suite are assigned Conservation management category (by area) - best representative of its type within its consanguineous suite domain. 	N N N N

2.3 Secondary Assessment Form

No.	General criteria	Criteria	Score
Geomorphology			
1	<i>Representativeness</i>	≤20% of wetlands of the same type are assigned Conservation on the Swan Coastal Plain by area.	H
2		≤20% of wetlands in the same consanguineous suite are assigned Conservation by area.	H
3		≤20% of wetlands of the same type in the same consanguineous suite are assigned Conservation by area.	H
4		The wetland is outstanding in some geomorphic aspect, for example size, origin, height relative to sea level, depth, age.	H
5	<i>Naturalness</i>	Alteration to the wetland's geomorphology by % area: < 25% altered 25-75% altered > 75% altered.	H I L
6	<i>Scarcity</i>	The wetland exhibits unusual geomorphology or unusual internal geomorphic features compared to other wetlands of the same type in the consanguineous suite.	H
7		The wetland is the best example of its type in its consanguineous suite.	H
Wetland processes			
8	<i>Representativeness</i>	The wetland is an important component of the natural hydrological cycle providing natural functions (e.g. flood protection and recharge/discharge). The wetland's vegetation, geomorphology, hydrology or sediments are modified; however, the wetland is still a component of the hydrological cycle providing natural and artificial functions (e.g. flood remediation, recharge/discharge and hydrological storage). The wetland's vegetation, geomorphology, hydrology or sediments are modified to the extent that the wetlands hydrological functions are artificial such as storage, or the wetland has been disconnected from the natural hydrological cycle and no longer provides natural attributes and functions.	H I L
9		The wetland supports a representative process (e.g. wetland process typical of the wetland's hydrological setting, sediment accretionary process typical of the wetland's geomorphic setting or hydrochemical process typical of the wetland's geological setting).	H
10	<i>Naturalness</i>	The wetland is not subject to altered wetland processes or, is subject to altered wetland processes and the wetland's natural attributes and functions are maintained. The wetland is subject to altered wetland processes and the wetland's natural attributes and functions have been changed; however, they have the potential to be rehabilitated. The wetland is subject to altered wetland processes to the extent that the wetland no longer supports natural attributes and functions.	H I L
11	<i>Scarcity</i>	The wetland exhibits unusual processes (e.g. hydrological, sedimentological, chemical, biological) compared to other wetlands of the same type in the consanguineous suite.	H
Linkages			
12	<i>Representativeness</i>	The wetland is a hydrological link in a larger or more complex and intact system.	H
13	<i>Naturalness</i>	The wetland is part of a continuous ecological linkage or wildlife corridor, or a regionally significant ecological linkage or wildlife corridor connecting bushland or	H

No.	General criteria	Criteria	Score
		wetland areas. The wetland is part of a fragmented ecological linkage or wildlife corridor. The wetland is disturbed and isolated, surrounded by either a built or highly disturbed environment with no nearby native vegetation or waterways to support an intact or fragmented ecological linkage or wildlife corridor.	I L
14	<i>Scarcity</i>	The wetland has unusual hydrological, hydrochemical or ecological linkages with adjacent wetland or bushland.	I
Habitats			
15	<i>Representativeness</i>	The wetland is isolated from other undisturbed wetlands or bushland and as a result, maintains important ecological or genetic fauna or flora diversity within its consanguineous suite domain.	H
16		The wetland contains evidence of surface water that is vital to maintaining regionally significant populations of native aquatic or terrestrial flora or fauna.	H
17		The wetland provides a nursery for native fauna populations, or maintains fauna populations at a vulnerable stage of their life cycle.	H
18	<i>Naturalness</i>	The wetland supports habitats that are unaltered or the wetland has been altered and its natural habitats are maintained. The wetland supports habitats that are altered; however, the habitats are still identifiable and have the potential to be rehabilitated. The wetland is altered and as a result is no longer supporting natural habitats which can be rehabilitated.	H I L
19	<i>Scarcity</i>	The wetland supports habitats that are unusual compared to other wetlands of the same type on the Swan Coastal Plain.	H
Flora			
20	<i>Representativeness</i>	The wetland's current diversity of native flora is similar to what would be expected in an unaltered state. The wetland supports a reduced diversity of native flora due to human induced disturbances. The wetland supports a significantly reduced diversity of native flora species due to human induced disturbances.	H I L
21		The wetland is identified in a vegetation complex (Hedde et al. 1980) which is represented by: ≤30% of the pre-European extent 30-50% of the pre-European extent.	H I
22	<i>Naturalness</i>	Using the vegetation condition scale outlined in Appendix B, the wetland's vegetation condition by area is: ≥ 75% Good, Very Good, Excellent or Pristine 25-75% Good, Very Good, Excellent or Pristine < 25% Good, Very Good, Excellent or Pristine.	H I L
23		The wetland or ≥ 50% of the wetland boundary is surrounded by land dominated by remnant native vegetation. The wetland or 10-50% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	H I

No.	General criteria	Criteria	Score
		The wetland or < 10% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	L
24	<i>Scarcity</i>	The wetland supports an occurrence of Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora, or an occurrence of 3 or more significant flora taxa.	H
25		The wetland is likely to support Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora; however, the occurrence cannot be located or its habitat has been altered and is no longer in a natural state.	I
26		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
27		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community.	I
Fauna			
28	<i>Representativeness</i>	The wetland is an ecological refuge for regionally significant fauna species or fauna assemblages.	H
		The wetland has the potential to be an ecological refuge but is disturbed and its attributes and functions require rehabilitation.	I
29		The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regionally significant native fauna.	H
		The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regional or local fauna but only in association with other surrounding natural areas.	I
30	<i>Naturalness</i>	The wetland's current diversity of native fauna is similar to what would be expected in an unaltered state, or the wetland supports diverse fauna compared to other wetlands of the same type.	H
		The wetland supports a reduced diversity of fauna compared to other wetlands of the same type.	I
31		The wetland supports limited attributes and functions for fauna populations due to human induced disturbances.	L
32	<i>Scarcity</i>	The wetland is likely to support a breeding, roosting, refuge or feeding site for populations of fauna listed by the Commonwealth (e.g. <i>EPBC Act 1999</i> , JAMBA, CAMBA, RoKAMBA Agreements) or the State (e.g. Threatened or Specially Protected Fauna listed under the <i>Wildlife Conservation Act 1950</i>).	H
33		The wetland supports a breeding, roosting, refuge or feeding site for Priority 1, Priority 2, Priority 3 or Priority 4 fauna.	H
34		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
35		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community or a breeding, roosting, refuge or feeding site for significant fauna.	I
Cultural			
36	<i>Representativeness</i>	The wetland or its immediate surrounds is identified for its natural values on a national or State heritage list or the wetland supports other known regional heritage values.	H
37		The wetland or its immediate surrounds is identified for its natural values on a municipal heritage list or the wetland supports other known local heritage values.	I
38		The wetland or its immediate surrounds is identified on a national, State or local list or register for its Aboriginal cultural value (e.g. Department of Aboriginal Affairs register).	H
39		The wetland is important to the local community either nationally or state wide for its natural values.	H
40		The wetland is or has the potential to be a site for public or private based recreation.	I

No.	General criteria	Criteria	Score
41		The wetland is likely to support heritage, cultural or social values; however, the value cannot be confirmed or the value has been disturbed and are no longer as important or significant.	I
		The wetland did support heritage, cultural or social values; however, these have been significantly disturbed and are no longer important or the values have been removed.	L
Scientific and educational			
42	<i>Representativeness</i>	The wetland supports known important teaching or research characteristics and for this reason is an existing or potential education or research site. Note, the wetland must still support the relevant teaching or research characteristics.	H
		The wetland has the potential to be used as a study or research site.	I
43		The wetland supports known scientific, geoheritage or geoconservation values.	H
44		The wetland did support scientific or educational values; however, these have been significantly disturbed and are no longer as important or the values have been removed.	L

2.4 Results

Attributes/functions /values	Scores		
	High	Intermediate	Low
Geomorphology	2	0	0
Wetland processes	3	0	0
Linkages	2	1	0
Habitats	1	1	0
Flora	2	2	0
Fauna	3	2	0
Cultural	1	0	0
Scientific and educational	0	1	0
Total Score	14	6	0
Defining attributes/ functions/values	Wetland processes and fauna		
Applicable management category	Conservation		

3.0 UFI 2995

3.1 General Information

Assessor details	
Name	Floora de Wit and Lyn van Gorp
Date of site visit	2 August 2016
Company	AECOM Australia Pty Ltd
Weather during visit	Cloudy, rain patches
Landowner	Main Roads Western Australia
Property details	Vegetated, mostly in Excellent condition.
Location (lot/street)	Lot 252 Carrabungup Road
Latitude and longitude or Easting northing	
Wetland details	
Name	
UFI	2995
Hill et al. (1996) map sheet number and wetland ID number	
Consanguineous suite	Keysbrook
Area (ha) of wetland	~17 ha
Area (ha) subject to this evaluation	~17 ha
Is wetland assessed as portion of wetland with varying degrees of value?	No
Mapped management category	Conservation
Wetland type (see table below)	Sumpland

Water permanence	Host landform				
	Basin	Flat	Slope	Highland	Channel
Permanent inundation	Lake	-	-	-	River*
Seasonal inundation	Sumpland	Floodplain*	-	-	Creek*
Intermittent inundation	Playa*	Barlkarra*	-	-	Wadi*
Seasonal waterlogging	Dampland	Palusplain	Paluslope	Palusmont*	Trough*

*Wetland types not applicable to this evaluation methodology.

3.2 Wetland desktop evaluation

Land uses	
Current ownership of wetland	Main Roads Western Australia
Current land use	Vegetated
Past land use	Unknown
Surrounding land use	RAMSAR wetland, agriculture
Existing management	No known management
Fire history/regime	Unknown, no evidence of recent fire

International, national or regional significance	
Indicate whether the wetland is identified (permanent or interim) on one of the following international, national or state registers or listings.	
Conservation Significance	Y/N
Ramsar Convention on Wetlands (Ramsar 1971)	N
Directory of Important Wetlands in Australia (Environment Australia 2001)	N
Register of National Estate (Commonwealth of Australia 2007)	N
Conservation Reserves for Western Australia Systems 1, 2, 3, 5 (Department of Conservation and Environment, 1976)	n/a
Conservation Reserves for Western Australia, The Darling System – System 6 (Department of Conservation and Environment, 1983)	N
A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region (Pen 1997)	N
The Environmental Significance of Wetlands in the Perth to Bunbury Region (Le Provost et al. 1987)	N
Bush Forever (Government of Western Australia 2000)	N
Swan Bioplan (Environmental Protection Authority 2010)	N
Environmental Protection (Swan Coastal Plain Lakes) Policy 1992	N
Environmental Protection (Western Swamp Tortoise Habitat) Policy Approval Order 2002	N
Conservation Estate (e.g. National Park, Nature Reserve, A Class Reserve)	N
Other (list):	Y ESA
Does the wetland retain the values for which it was originally registered or listed, describe:	

Fauna			
Note the presence (recorded or observed) or evidence of fauna in or surrounding the wetland which is listed by the Commonwealth (e.g. Environment Protection and Biodiversity Conservation Act 1999, CAMBA, RoKAMBA, JAMBA) or State (e.g. Threatened or Specially Protected Fauna under the Wildlife Conservation Act 1950) or Priority Fauna or Priority or Threatened Ecological Communities related to fauna which are listed by DPaW.			
Species / name of ecological community	Significance (e.g. EPBC Act, CAMBA)	Observations (e.g. population size, age, evidence, activities, habitat requirements)	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Scientific value		
List any scientific values including geoheritage or geoconservation values (e.g. important sediments or geological features, fossils, pollen records, stromatolites, thrombolites, evidence of evolutionary processes, evidence of a change in climate, unique flora or fauna adaptations) that the wetland may contain.		
Scientific, geoheritage or geoconservation values	Significance and observations	Source of information (e.g. observatory, literature, DPaW, WA Museum)

Flora				
Use aerial photography and a site visit to determine and confirm the condition of the vegetation within and 50 metres surrounding the wetland. Using the scale outlined in Appendix B, display the locations of the vegetation conditions in the attached map and calculate their total area:				
Vegetation condition	Total area (%) within the wetland	Area (%) 50 metres surrounding the wetland		
Pristine				
Excellent	100%	100%		
Very Good				
Good				
Degraded				
Completely Degraded				
Using this information, is the wetland dominated by vegetation in a good or better condition:		Yes		
What vegetation complex (Hedde et al. 1980) does the wetland belong to:		Vasse complex		
Using the information sources outlined in Appendix B, what extent of the vegetation complex is remaining on the Swan Coastal Plain		35.9 %		
List any occurrences of Priority and Threatened Ecological Communities related to flora and wetland systems which are known to occur within and 5 kilometres surrounding the wetland. If they are located within or adjacent to the wetland display their boundary in the attached map:				
Name of ecological community	Significance (e.g. priority, threatened)	Observations (e.g. condition, area, habitat type)	Source of information (e.g. observatory, literature, DPaW)	
No detailed desktop undertaken				
List any occurrences of Declared Rare flora or Priority flora known to occur within and 1 kilometre surrounding the wetland and display their location in the attached map:				
Species	Significance (e.g. Declared Rare, Priority 1)	Population measure (number, single record, abundance comment)	Observations (e.g. habitat type, flowering season)	Source of information (e.g., literature, DPaW, surveyed population, Herbarium record)
No detailed desktop undertaken				

Representativeness	
Using the wetlands data outlined in section 4.3, Appendix D and available on DPaW's website record the corresponding area:	
	% area
What is the % area of wetlands with the same classification assigned a Conservation management category on the Swan Coastal Plain	37.0

Representativeness	
What is the % area of wetlands in the same consanguineous suite assigned a Conservation management category	1.5
What is the % area of wetlands with the same classification in the same consanguineous suite assigned a conservation management category	8.1
Is the wetland rare? (e.g. only wetland in its consanguineous suite, best wetland example in its consanguineous suite or region, only Conservation management category wetland in the consanguineous suite or region, primary saline wetland within a consanguineous suite predominated by freshwater):	N

No.	Criteria	Y/N
1	The wetland is currently recognised as internationally or nationally significant for its natural values. Lists/registers include: <ul style="list-style-type: none"> - The Ramsar Convention on Wetlands - State government endorsed candidate sites for the Ramsar Convention on Wetlands - Directory of Important Wetlands in Australia - National Heritage List - Or equivalent. 	N N N N N
2	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is identified as significant for its natural values under one or more of the following: <ul style="list-style-type: none"> - <i>Conservation Reserves for Western Australia Systems 1, 2, 3, 5</i> - <i>Conservation Reserves for Western Australia, The Darling System – System 6</i> - <i>A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region</i> - <i>The Environmental Significance of Wetlands in the Perth to Bunbury Region</i> - <i>Bush Forever, Swan Bioplan or equivalent.</i> 	N N N N N
3	The wetland supports a breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, <i>Environment Protection and Biodiversity Conservation Act 1999</i> , migratory bird agreements such as JAMBA, CAMBA and RoKAMBA) or the State (for example, Threatened and Specially Protected Fauna listed under the Wildlife Conservation Act 1950).	N
4	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and supports one or more of the following: <ul style="list-style-type: none"> - An occurrence of a Threatened Ecological Community - A confirmed occurrence of a Priority 1 or Priority 2 Ecological Community - A confirmed occurrence of a Declared Rare (Threatened) flora species. 	N N N
5	Equal to or greater than 90% of the wetland supports vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B.	Y
6	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is known to support internationally, nationally or state-wide scientific values including geoheritage and geoconservation.	N
7	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and meets one of the following: <ul style="list-style-type: none"> - ≤10% of wetlands of the same type are assigned Conservation management category within the Swan Coastal Plain (by area) - ≤10% of all wetlands in the same consanguineous suite are assigned Conservation management category (by area) - ≤10% of wetlands of the same type in its consanguineous suite are assigned Conservation management category (by area) - best representative of its type within its consanguineous suite domain. 	N N N N

3.3 Secondary Assessment Form

No.	General criteria	Criteria	Score
Geomorphology			
1	<i>Representativeness</i>	≤20% of wetlands of the same type are assigned Conservation on the Swan Coastal Plain by area.	H
2		≤20% of wetlands in the same consanguineous suite are assigned Conservation by area.	H
3		≤20% of wetlands of the same type in the same consanguineous suite are assigned Conservation by area.	H
4		The wetland is outstanding in some geomorphic aspect, for example size, origin, height relative to sea level, depth, age.	H
5	<i>Naturalness</i>	Alteration to the wetland's geomorphology by % area: < 25% altered 25-75% altered > 75% altered.	H I L
6	<i>Scarcity</i>	The wetland exhibits unusual geomorphology or unusual internal geomorphic features compared to other wetlands of the same type in the consanguineous suite.	H
7		The wetland is the best example of its type in its consanguineous suite.	H
Wetland processes			
8	<i>Representativeness</i>	The wetland is an important component of the natural hydrological cycle providing natural functions (e.g. flood protection and recharge/discharge). The wetland's vegetation, geomorphology, hydrology or sediments are modified; however, the wetland is still a component of the hydrological cycle providing natural and artificial functions (e.g. flood remediation, recharge/discharge and hydrological storage). The wetland's vegetation, geomorphology, hydrology or sediments are modified to the extent that the wetlands hydrological functions are artificial such as storage, or the wetland has been disconnected from the natural hydrological cycle and no longer provides natural attributes and functions.	H I L
9		The wetland supports a representative process (e.g. wetland process typical of the wetland's hydrological setting, sediment accretionary process typical of the wetland's geomorphic setting or hydrochemical process typical of the wetland's geological setting).	H
10	<i>Naturalness</i>	The wetland is not subject to altered wetland processes or, is subject to altered wetland processes and the wetland's natural attributes and functions are maintained. The wetland is subject to altered wetland processes and the wetland's natural attributes and functions have been changed; however, they have the potential to be rehabilitated. The wetland is subject to altered wetland processes to the extent that the wetland no longer supports natural attributes and functions.	H I L
11	<i>Scarcity</i>	The wetland exhibits unusual processes (e.g. hydrological, sedimentological, chemical, biological) compared to other wetlands of the same type in the consanguineous suite.	H
Linkages			
12	<i>Representativeness</i>	The wetland is a hydrological link in a larger or more complex and intact system.	H
13	<i>Naturalness</i>	The wetland is part of a continuous ecological linkage or wildlife corridor, or a regionally significant ecological linkage or wildlife corridor connecting bushland or	H

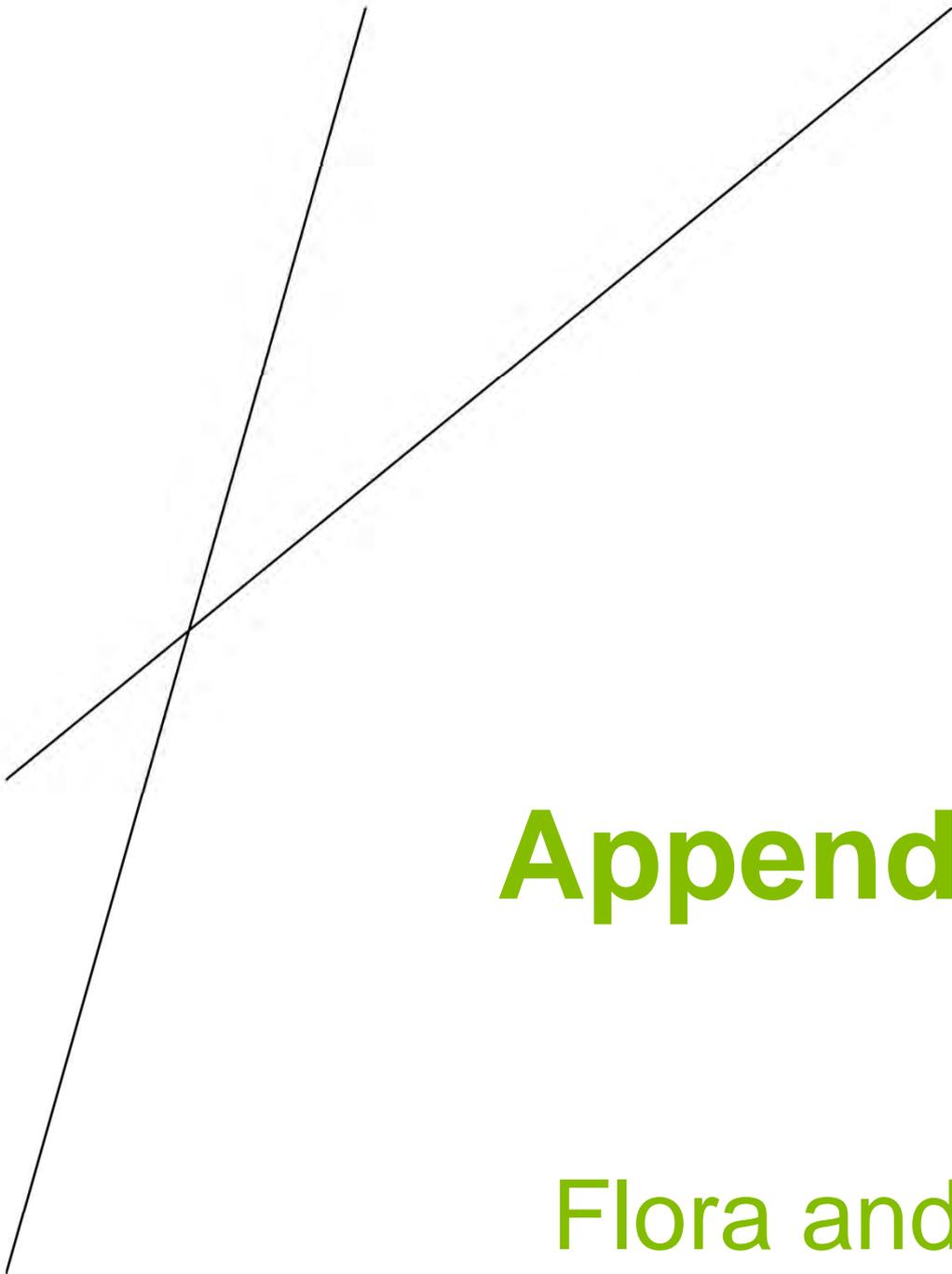
No.	General criteria	Criteria	Score
		wetland areas. The wetland is part of a fragmented ecological linkage or wildlife corridor. The wetland is disturbed and isolated, surrounded by either a built or highly disturbed environment with no nearby native vegetation or waterways to support an intact or fragmented ecological linkage or wildlife corridor.	I L
14	<i>Scarcity</i>	The wetland has unusual hydrological, hydrochemical or ecological linkages with adjacent wetland or bushland.	I
Habitats			
15	<i>Representativeness</i>	The wetland is isolated from other undisturbed wetlands or bushland and as a result, maintains important ecological or genetic fauna or flora diversity within its consanguineous suite domain.	H
16		The wetland contains evidence of surface water that is vital to maintaining regionally significant populations of native aquatic or terrestrial flora or fauna.	H
17		The wetland provides a nursery for native fauna populations, or maintains fauna populations at a vulnerable stage of their life cycle.	H
18	<i>Naturalness</i>	The wetland supports habitats that are unaltered or the wetland has been altered and its natural habitats are maintained. The wetland supports habitats that are altered; however, the habitats are still identifiable and have the potential to be rehabilitated. The wetland is altered and as a result is no longer supporting natural habitats which can be rehabilitated.	H I L
19	<i>Scarcity</i>	The wetland supports habitats that are unusual compared to other wetlands of the same type on the Swan Coastal Plain.	H
Flora			
20	<i>Representativeness</i>	The wetland's current diversity of native flora is similar to what would be expected in an unaltered state. The wetland supports a reduced diversity of native flora due to human induced disturbances. The wetland supports a significantly reduced diversity of native flora species due to human induced disturbances.	H I L
21		The wetland is identified in a vegetation complex (Hedde et al. 1980) which is represented by: ≤30% of the pre-European extent 30-50% of the pre-European extent.	H I
22	<i>Naturalness</i>	Using the vegetation condition scale outlined in Appendix B, the wetland's vegetation condition by area is: ≥ 75% Good, Very Good, Excellent or Pristine 25-75% Good, Very Good, Excellent or Pristine < 25% Good, Very Good, Excellent or Pristine.	H I L
23		The wetland or ≥ 50% of the wetland boundary is surrounded by land dominated by remnant native vegetation. The wetland or 10-50% of the wetland boundary is surrounded by land	H I

No.	General criteria	Criteria	Score
		dominated by remnant native vegetation. The wetland or < 10% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	L
24	<i>Scarcity</i>	The wetland supports an occurrence of Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora, or an occurrence of 3 or more significant flora taxa.	H
25		The wetland is likely to support Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora; however, the occurrence cannot be located or its habitat has been altered and is no longer in a natural state.	I
26		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
27		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community.	I
Fauna			
28	<i>Representativeness</i>	The wetland is an ecological refuge for regionally significant fauna species or fauna assemblages. The wetland has the potential to be an ecological refuge but is disturbed and its attributes and functions require rehabilitation.	H I
29		The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regionally significant native fauna. The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regional or local fauna but only in association with other surrounding natural areas.	H I
30	<i>Naturalness</i>	The wetland's current diversity of native fauna is similar to what would be expected in an unaltered state, or the wetland supports diverse fauna compared to other wetlands of the same type. The wetland supports a reduced diversity of fauna compared to other wetlands of the same type.	H I
31		The wetland supports limited attributes and functions for fauna populations due to human induced disturbances.	L
32	<i>Scarcity</i>	The wetland is likely to support a breeding, roosting, refuge or feeding site for populations of fauna listed by the Commonwealth (e.g. <i>EPBC Act 1999</i> , JAMBA, CAMBA, RoKAMBA Agreements) or the State (e.g. Threatened or Specially Protected Fauna listed under the <i>Wildlife Conservation Act 1950</i>).	H
33		The wetland supports a breeding, roosting, refuge or feeding site for Priority 1, Priority 2, Priority 3 or Priority 4 fauna.	H
34		The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	H
35		The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community or a breeding, roosting, refuge or feeding site for significant fauna.	I
Cultural			
36	<i>Representativeness</i>	The wetland or its immediate surrounds is identified for its natural values on a national or State heritage list or the wetland supports other known regional heritage values.	H
37		The wetland or its immediate surrounds is identified for its natural values on a municipal heritage list or the wetland supports other known local heritage values.	I
38		The wetland or its immediate surrounds is identified on a national, State or local list or register for its Aboriginal cultural value (e.g. Department of Aboriginal Affairs register).	H
39		The wetland is important to the local community either nationally or state wide for its natural values.	H

No.	General criteria	Criteria	Score
40		The wetland is or has the potential to be a site for public or private based recreation.	I
41		The wetland is likely to support heritage, cultural or social values; however, the value cannot be confirmed or the value has been disturbed and are no longer as important or significant. The wetland did support heritage, cultural or social values; however, these have been significantly disturbed and are no longer important or the values have been removed.	I L
Scientific and educational			
42	<i>Representativeness</i>	The wetland supports known important teaching or research characteristics and for this reason is an existing or potential education or research site. Note, the wetland must still support the relevant teaching or research characteristics. The wetland has the potential to be used as a study or research site.	H I
43		The wetland supports known scientific, geoheritage or geoconservation values.	H
44		The wetland did support scientific or educational values; however, these have been significantly disturbed and are no longer as important or the values have been removed.	L

3.4 Results

Attributes/functions /values	Scores		
	High	Intermediate	Low
Geomorphology	3	0	0
Wetland processes	3	0	0
Linkages	0	1	0
Habitats	1	0	0
Flora	3	1	0
Fauna	1	0	0
Cultural	0	0	0
Scientific and educational	0	0	0
Total Score	11	2	0
Defining attributes/ functions/values	Geomorphology, wetland processes and flora		
Applicable management category	Conservation		



Appendix B

Flora and Fauna Species Comparison

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
Flora				
<i>Acacia alata</i>	1			
<i>Acacia cochlearis</i>	1	1	1	
<i>Acacia cyclops</i>	1	1	1	
<i>Acacia huegelii</i>	1			
<i>Acacia iteaphylla</i>	1			
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	1			
<i>Acacia littorea</i>		1		
<i>Acacia longifolia</i>	1			
<i>Acacia pulchella</i>	1	1	1	
<i>Acacia pycnantha</i>	1			
<i>Acacia rostellifera</i>	1	1	1	1
<i>Acacia saligna</i>	1	1	1	
<i>Acacia saligna</i> subsp. <i>saligna</i>	1			
<i>Acacia stenoptera</i>	1			
<i>Acacia truncata</i>		1		
<i>Acacia willdenowiana</i>	1			
<i>Acanthocarpus preissii</i>	1	1	1	1
<i>Acrotriche cordata</i>		1		
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	1			
<i>Agonis flexuosa</i>	1	1	1	1
<i>Agrostocrinum hirsutum</i>	1			
<i>Allocasuarina fraseriana</i>	1	1	1	1
<i>Allocasuarina humilis</i>	1			
<i>Alyxia buxifolia</i>		1		
<i>Amhipogon turbinatus</i>	1			
<i>Anigozanthos humilis</i> subsp. <i>humilis</i>	1			
<i>Anigozanthos manglesii</i>	1			
<i>Anthocercis littorea</i>		1		
<i>Aotus cordifolia</i>	1			
<i>Astartea scoparia</i>	1			
<i>Asteridea pulverulenta</i>		1		
<i>Astroloma pallidum</i>	1	1	1	
<i>Austrostipa compressa</i>	1			
<i>Austrostipa elegantissima</i>	1			
<i>Austrostipa flavescens</i>		1		
<i>Austrostipa nitida</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Babingtonia camphorosmae</i>	1			
<i>Banksia attenuata</i>	1	1	1	1
<i>Banksia dallaneyi</i>	1	1	1	
<i>Banksia grandis</i>	1	1	1	1
<i>Banksia ilicifolia</i>	1			
<i>Banksia littoralis</i>	1	1	1	1
<i>Banksia menziesii</i>	1			
<i>Banksia sessilis</i>	1	1	1	1
<i>Baumea articulata</i>	1	1	1	
<i>Baumea juncea</i>		1		
<i>Baumea preissii</i> subsp. <i>laxa</i> (Nees) K.L.Wilson ms	1			
<i>Baumea vaginalis</i>	1	1	1	
<i>Beaufortia elegans</i>	1			
<i>Boronia crenulata</i>	1			
<i>Borya sphaerocephala</i>	1			
<i>Bossiaea eriocarpa</i>	1			
<i>Bossiaea ornata</i>	1			
<i>Bromus arenarius</i>	1	1	1	
<i>Brunonia australis</i>	1			
<i>Burchardia congesta</i>	1			
<i>Caesia micrantha</i> sens lat.	1			
<i>Caladenia arenicola</i>	1			
<i>Caladenia discoidea</i>	1			
<i>Caladenia flava</i> subsp. <i>flava</i>	1			
<i>Caladenia georgei</i>	1			
<i>Caladenia latifolia</i>	1			
<i>Caladenia longicauda</i>	1			
<i>Caladenia longicauda</i> subsp. <i>calcigena</i>	1			
<i>Caladenia longicauda</i> subsp. <i>longicauda</i>	1			
<i>Calandrinia ?brevipedata</i>		1		
<i>Calandrinia corrigioloides</i>	1			
<i>Calandrinia granulifera</i>	1			
<i>Calectasia narragara</i>	1			
<i>Callistemon phoeniceus</i>	1			
<i>Callitris preissii</i>		1		
<i>Calothamnus quadrifidus</i>	1			
<i>Calothamnus rupestris</i> (P4)	1			
<i>Calytrix flavescens</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project	Site - Lake		
	Area	Clifton		
<i>Calytrix fraseri</i>	1			
<i>Carpobrotus virescens</i>		1		
<i>Cassytha racemosa</i>	1	1	1	
<i>Centaurium erythraea</i>	1			
<i>Centella asiatica</i>	1			
<i>Centrolepis drummondiana</i>	1			
<i>Chamaecytisus palmensis</i>	1			
<i>Chamaescilla corymbosa</i>	1			
<i>Chamelaucium uncinatum</i>	1			
<i>Chordifex sinuosus</i>	1			
Clematis linearifolia		1		
<i>Clematis pubescens</i>		1		
<i>Comesperma ?flavum</i>		1		
<i>Comesperma calymega</i>	1			
<i>Conospermum canaliculatum</i>	1			
<i>Conostephium minus</i>	1			
<i>Conostephium pendulum</i>	1	1	1	
<i>Conostephium preissii</i>	1			
<i>Conostylis aculeata</i>	1			
<i>Conostylis aculeata</i> subsp. <i>aculeata</i>	1			
<i>Conostylis candicans</i> subsp. <i>candicans</i>	1			
<i>Conostylis candicans</i> subsp. <i>calcicola</i>		1		
<i>Conostylis juncea</i>	1			
<i>Conostylis setigera</i> subsp. <i>setigera</i>	1			
<i>Conostylis setosa</i>	1			
<i>Corymbia calophylla</i>	1			
<i>Corymbia citriodora</i>	1			
<i>Corymbia ficifolia</i>	1			
<i>Corymbia maculata</i>	1			
<i>Corynotheca micrantha</i>	1			
<i>Crassula colorata</i>	1	1	1	
<i>Crassula colorata</i> var. <i>acuminata</i>		1		
<i>Crassula colorata</i> var. <i>colorata</i>	1			
<i>Cryptandra mutila</i>		1		
<i>Cyathochaeta teretifolia</i> (P3)	1			
<i>Dampiera lindleyi</i>	1			
<i>Dampiera linearis</i>	1			
<i>Dampiera triloba</i> (P1)	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Dasypogon bromeliifolius</i>	1			
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>	1			
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>	1			
<i>Daviesia physodes</i>	1			
<i>Daviesia triflora</i>	1			
<i>Desmocladius fasciculatus</i>	1			
<i>Desmocladius flexuosus</i>	1	1	1	
<i>Dianella revoluta</i> var. <i>divaricata</i>	1			
<i>Dimorphotheca ecklonis</i>	1			
<i>Diplolaena dampieri</i>		1		
<i>Diplolaena drummondii</i>		1		
<i>Diuris longifolia</i>	1			
<i>Diuris magnifica</i>	1			
<i>Dodonaea hackettiana</i> (P4)	1			
<i>Drosera erythrorhiza</i>	1	1	1	
<i>Drosera helodes</i>	1			
<i>Drosera macrantha</i>	1	1	1	
<i>Drosera menziesii</i>	1			
<i>Drosera menziesii</i> subsp. <i>?penicillaris</i>	1			
<i>Drosera menziesii</i> subsp. <i>penicillaris</i>	1			
<i>Drosera pallida</i>	1			
<i>Drosera stolonifera</i>	1			
<i>Ecdeiocollea monostachya</i>	1			
<i>Eremaea asterocarpa</i> subsp. <i>asterocarpa</i>	1			
<i>Eremaea beaufortioides</i>	1			
<i>Eremaea pauciflora</i>	1			
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	1			
<i>Eriobotrya japonica</i>	1			
<i>Eriochilus dilatatus</i>	1			
<i>Erodium botrys</i>	1			
<i>Erodium cicutarium</i>	1			
<i>Erodium cygnorum</i>	1			
<i>Eryngium pinnatifidum</i>	1			
<i>Eryngium pinnatifidum</i> subsp. <i>palustre</i> ms (P3)	1			
<i>Eucalyptus argutifolia</i> (T)		1		
<i>Eucalyptus caesia</i> (P4)	1			
<i>Eucalyptus camaldulensis</i>	1			
<i>Eucalyptus conferruminata</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Eucalyptus decipiens</i>		1		
<i>Eucalyptus decipiens</i> subsp. <i>decipiens</i>		1		
<i>Eucalyptus erythrocorys</i>	1			
<i>Eucalyptus foecunda</i>		1		
<i>Eucalyptus gomphocephala</i>	1	1	1	1
<i>Eucalyptus grandis</i>	1			
<i>Eucalyptus lehmannii</i>		1		
<i>Eucalyptus leucoxydon</i>	1			
<i>Eucalyptus macrocarpa</i> subsp. <i>macrocarpa</i>	1			
<i>Eucalyptus marginata</i>	1	1	1	1
<i>Eucalyptus petrensis</i>		1		
<i>Eucalyptus platypus</i>	1	1	1	
<i>Eucalyptus rudis</i>	1			
<i>Eucalyptus sideroxylon</i>	1			
<i>Eucalyptus todtiana</i>	1			
<i>Eucalyptus torquata</i>	1			
<i>Ficinia nodosa</i>	1	1	1	
<i>Foeniculum vulgare</i>	1			
<i>Gahnia trifida</i>		1		
<i>Gastrolobium capitatum</i>	1			
<i>Gastrolobium ebracteolatum</i>	1			
<i>Gazania linearis</i>	1			
<i>Geranium retrorsum</i>		1		
<i>Gompholobium tomentosum</i>	1			
<i>Gonocarpus pithyoides</i>	1			
<i>Grevillea bipinnatifida</i>	1			
<i>Grevillea crithmifolia</i>	1			
<i>Grevillea preissii</i> subsp. <i>preissii</i>		1		
<i>Haemodorum laxum</i>	1			
<i>Hakea costata</i>		1		
<i>Hakea lissocarpha</i>		1		
<i>Hakea prostrata</i>	1	1	1	
<i>Hakea ruscifolia</i>		1		
<i>Hakea trifurcata</i>	1	1	1	
<i>Hardenbergia comptoniana</i>	1	1	1	
<i>Hedypnois rhagadioloides</i> subsp. <i>cretica</i>	1			
<i>Helminthotheca echioides</i>	1			
<i>Hemiandra pungens</i>	1	1	1	
<i>Hibbertia cuneiformis</i>	1	1	1	1

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project	Site - Lake		
	Area	Clifton		
<i>Hibbertia huegelii</i>	1	1	1	
<i>Hibbertia hypericoides</i>	1	1	1	1
<i>Hibbertia racemosa</i>		1		
<i>Hibbertia scandens</i>	1			
<i>Hibbertia subvaginata</i>	1			
<i>Hibbertia vaginata</i>	1			
<i>Hovea pungens</i>	1			
<i>Hovea trisperma</i>	1			
<i>Hyalosperma cotula</i>	1			
<i>Hybanthus calycinus</i>	1			
<i>Hybanthus floribundus</i> subsp. <i>floribundus</i>	1			
<i>Hydrocotyle tetragonocarpa</i>		1		
<i>Hypocalymma angustifolium</i>	1			
<i>Hypocalymma robustum</i>	1			
<i>Hypolaena exsulca</i>	1			
<i>Isotoma hypocrateriformis</i>		1		
<i>Isotropis cuneifolia</i>	1			
<i>Ixiolaena viscosa</i>	1			
<i>Jacksonia furcellata</i>	1	1	1	
<i>Jacksonia gracillima</i> (P3)	1			
<i>Jacksonia sternbergiana</i>	1			
<i>Juncus kraussii</i> subsp. <i>australiensis</i>		1		
<i>Juncus pallidus</i>	1	1	1	
<i>Kennedia coccinea</i>		1		
<i>Kennedia prostrata</i>	1			
<i>Kunzea glabrescens</i>	1			
<i>Lachnagrostis filiformis</i>	1			
<i>Lagenophora huegelii</i>	1	1	1	
<i>Lavandula dentata</i>	1			
<i>Laxmannia squarrosa</i>	1			
<i>Lechenaultia floribunda</i>	1			
<i>Lechenaultia linarioides</i>	1			
<i>Lepidosperma gladiatum</i>		1		
<i>Lepidosperma longitudinale</i>	1			
<i>Lepidosperma pubisquameum</i>	1	1	1	
<i>Lepidosperma pubisquameum</i> sens. lat.	1			
<i>Lepidosperma</i> sp. Coastal Dunes (R.J.Cranfield 9963)	1			
<i>Lepidosperma squamatum</i>	1	1	1	

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project	Site - Lake Clifton		
<i>Lepidosperma squamatum</i> (complex variant)	1			
<i>Lepidosperma squamatum</i> (narrow form)	1			
<i>Lepidosperma squamatum</i> sens. lat.	1			
<i>Lepidosperma tenue</i>	1			
<i>Leporella fimbriata</i>	1			
<i>Leptomeria cunninghamii</i>	1			
<i>Leptomeria pauciflora</i>	1			
<i>Leptorhynchus scaber</i>		1		
<i>Leptospermum laevigatum</i>	1			
<i>Leptospermum spinescens</i>	1			
Lepyrodia drummondiana		1		
<i>Leucopogon ?oxycedrus</i>	1			
<i>Leucopogon capitellatus</i>	1			
<i>Leucopogon conostephioides</i>	1			
<i>Leucopogon nutans</i>	1	1	1	
<i>Leucopogon parviflorus</i>		1		
<i>Leucopogon polymorphus</i>	1			
<i>Leucopogon propinquus</i>	1	1	1	
<i>Leucopogon</i> sp. Murdoch (M. Hislop 1037)	1			
<i>Leucopogon verticillatus</i>	1			
<i>Levenhookia pusilla</i>	1			
<i>Lobelia anceps</i>	1			
<i>Lobelia tenuior</i>	1	1	1	
<i>Lomandra caespitosa</i>	1			
<i>Lomandra hermaphrodita</i>	1			
<i>Lomandra maritima</i>		1		
<i>Lomandra micrantha</i>	1	1	1	
<i>Lomandra nigricans</i>	1			
<i>Lomandra odora</i>	1			
<i>Lomandra sonderi</i>	1			
<i>Lomandra suaveolens</i>	1	1	1	
<i>Loxocarya cinerea</i>	1	1	1	
<i>Lupinus angustifolius</i>	1			
<i>Lupinus cosentinii</i>	1			
<i>Lupinus luteus</i>	1			
<i>Luzula meridionalis</i>	1			
<i>Lyginia barbata</i>	1			
<i>Lyginia imberbis</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Lysinema ciliatum</i>	1			
<i>Macarthuria australis</i>	1			
<i>Macrozamia riedlei</i>	1	1	1	1
<i>Malva parviflora</i>	1			
<i>Meeboldina scariosa</i>	1			
<i>Melaleuca ?seriata</i> (sterile material)	1			
<i>Melaleuca cuticularis</i>		1		
<i>Melaleuca huegelii</i>		1		
<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>		1		
<i>Melaleuca lanceolata</i>	1	1	1	1
<i>Melaleuca leucadendra</i>	1			
<i>Melaleuca nesophila</i>	1			
<i>Melaleuca preissiana</i>	1			
<i>Melaleuca rhapsiophylla</i>	1	1	1	1
<i>Melaleuca seriata</i>	1			
<i>Melaleuca</i> sp. (<i>huegelii</i> x <i>rhapsiophylla</i>)		1		
<i>Melaleuca systema</i>	1	1	1	1
<i>Melaleuca teretifolia</i>	1	1	1	1
<i>Melaleuca thymoides</i>	1			
<i>Melaleuca viminea</i> subsp. <i>viminea</i>		1		
<i>Melaleuca viminea</i>	1			
<i>Mesomelaena pseudostygia</i>	1			
<i>Mesomelaena stygia</i> subsp. <i>stygia</i>	1			
<i>Mirbelia dilatata</i>	1			
<i>Muehlenbeckia adpressa</i>	1			
<i>Neurachne alopecuroidea</i>	1			
<i>Nuytsia floribunda</i>	1	1	1	1
<i>Oenothera drummondii</i>	1			
<i>Olearia axillaris</i>	1	1	1	
<i>Opercularia echinocephala</i>	1			
<i>Opercularia hispidula</i>		1		
<i>Opercularia vaginata</i>	1	1	1	
<i>Opuntia stricta</i>	1			
<i>Oxalis purpurea</i>	1			
<i>Ozothamnus cordatus</i>	1			
<i>Parietaria debilis</i>		1		
<i>Passiflora filamentosa</i>	1			
<i>Patersonia occidentalis</i>	1	1	1	

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Pelargonium capitatum</i>	1			
<i>Pentapeltis peltigera</i>		1		
<i>Persoonia comata</i>	1			
<i>Petrophile linearis</i>	1			
<i>Petrophile macrostachya</i>	1			
<i>Pheladenia deformis</i>	1			
<i>Philothea spicata</i>	1			
<i>Phlebocarya ciliata</i>	1			
<i>Phyllanthus calycinus</i>	1	1	1	
<i>Phytolacca octandra</i>	1			
<i>Pimelea calcicola</i> (P3)		1		
<i>Pimelea ciliata</i>	1	1	1	
<i>Pimelea ferruginea</i>		1		
<i>Pimelea rosea</i> subsp. <i>rosea</i>	1			
<i>Pimelea sulphurea</i>	1			
<i>Pithocarpa pulchella</i>	1			
<i>Plantago lanceolata</i>	1			
<i>Platysace compressa</i>	1			
<i>Platysace tenuissima</i>	1			
<i>Poa drummondiana</i>	1	1	1	
<i>Podalyria sericea</i>	1			
<i>Podolepis gracilis</i>	1	1	1	
<i>Podotheca gnaphalioides</i>	1			
<i>Poranthera microphylla</i>		1		
<i>Pteridium esculentum</i>	1			
<i>Pterostylis recurva</i>	1			
<i>Pterostylis sanguinea</i>		1		
<i>Pterostylis vittata</i>	1			
<i>Ptilotus polystachyus</i>	1			
<i>Pultenaea reticulata</i>	1			
<i>Pyrorchis nigricans</i>	1	1	1	
<i>Quinetia urvillei</i>	1			
<i>Raphanus raphanistrum</i>	1			
<i>Regelia ciliata</i>	1			
<i>Regelia inops</i>	1			
<i>Rhagodia baccata</i>	1	1	1	
<i>Rhagodia baccata</i> subsp. <i>baccata</i>		1		
<i>Rhodanthe citrina</i>		1		

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Ricinus communis</i>	1			
<i>Rosmarinus officinalis</i>	1			
<i>Rytidosperma caespitosum</i>		1		
<i>Rytidosperma occidentale</i>	1			
<i>Samolus junceus</i>		1		
Santalum acuminatum		1		
Sarcocornia blackiana		1		
<i>Scabiosa atropurpurea</i>	1			
<i>Scaevola canescens</i>	1			
<i>Scaevola crassifolia</i>	1	1	1	
<i>Scaevola nitida</i>		1		
<i>Scaevola repens</i>	1			
<i>Scaevola repens</i> var. <i>repens</i>	1			
<i>Schinus terebinthifolius</i>	1			
<i>Schoenus curvifolius</i>	1			
<i>Schoenus subfascicularis</i>	1			
<i>Scholtzia involucrata</i>	1			
<i>Senecio condylus</i>	1			
<i>Senecio diaschides</i>		1		
<i>Senecio hispidulus</i>	1			
<i>Senecio pinnatifolius</i>	1	1	1	
<i>Silene gallica</i> var. <i>gallica</i>	1			
<i>Siloxerus humifusus</i>	1			
<i>Solanum symonii</i>		1		
<i>Sowerbaea laxiflora</i>	1			
<i>Sphaerolobium medium</i>	1			
<i>Sphaerolobium vimineum</i>	1			
<i>Spinifex hirsutus</i>		1		
Spyridium globulosum	1	1	1	1
<i>Stackhousia monogyna</i>	1			
<i>Stirlingia latifolia</i>	1			
<i>Stylidium amoenum</i>	1			
<i>Stylidium brunonianum</i>	1			
<i>Stylidium bulbiferum</i>		1		
<i>Stylidium maritimum</i> (P3)		1		
<i>Stylidium piliferum</i>	1			
<i>Stylidium repens</i>	1			
<i>Stylidium schoenoides</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>	1			
<i>Taxandria linearifolia</i>	1			
Templetonia retusa		1		
<i>Tetraria capillaris</i>	1			
<i>Tetraria octandra</i>	1	1	1	
<i>Tetraria</i> sp. Chandala (G.J.Keighery 17055) (P2)	1			
<i>Thelymitra benthamiana</i>	1			
<i>Thelymitra crinita</i>	1			
<i>Thelymitra vulgaris</i>	1			
<i>Threlkeldia diffusa</i>		1		
<i>Thysanotus arbuscula</i>	1			
<i>Thysanotus dichotomus</i>	1			
<i>Thysanotus manglesianus</i>	1	1	1	
<i>Thysanotus patersonii</i>	1			
<i>Thysanotus sparteus</i>	1			
<i>Trachymene pilosa</i>	1	1	1	
<i>Tribulus terrestris</i>	1			
<i>Tricoryne elatior</i>	1			
<i>Trifolium dubium</i>	1			
<i>Tropaeolum majus</i>	1			
<i>Trymalium ledifolium</i> var. <i>ledifolium</i>		1		
<i>Trymalium odoratissimum</i> subsp. <i>odoratissimum</i>	1			
<i>Veronica distans</i>		1		
<i>Vicia sativa</i>	1			
<i>Viminaria juncea</i>	1			
<i>Vinca major</i>	1			
<i>Xanthorrhoea preissii</i>	1	1	1	1
<i>Xylomelum occidentale</i>	1			
<i>Zygophyllum ?angustifolium</i>		1		
<i>Zygophyllum fruticosum</i>		1		
<i>Agrostocrinum</i> sp.	1			
<i>Aristida</i> sp.	1			
<i>Banksia</i> sp.	1			
<i>Caladenia</i> sp.	1			
<i>Calandrinia</i> sp.	1			
<i>Calytrix</i> sp.	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
<i>Cassyltha</i> sp.		1		
<i>Chenopodiaceae</i> sp.	1			
<i>Crassula</i> sp.		1		
<i>Dichopogon</i> sp.		1		
<i>Eucalyptus</i> sp.	1			
<i>Geranium</i> sp.	1			
<i>Grevillea</i> sp.		1		
<i>Haemodorum</i> sp.	1			
<i>Haemodorum</i> sp.		1		
<i>Lepidosperma</i> sp.	1			
<i>Lomandra</i> sp.	1			
<i>Lupinus</i> sp.		1		
? <i>Monotaxis</i> sp.		1		
Myrtaceae sp.		1		
Orchid sp.		1		
<i>Pimelea</i> sp.	1			
<i>Pimelea</i> sp.		1		
Poaceae sp.		1		
<i>Podotheca</i> sp.	1			
<i>Pterostylis</i> sp.	1			
<i>Ranunculus</i> sp.		1		
<i>Rytidosperma</i> sp.		1		
<i>Stackhousia</i> sp.		1		
<i>Thysanotus</i> sp.	1			
<i>Trifolium</i> sp.	1			
? <i>Thelymitra</i> sp.		1		
	355	153	67	20
Weeds				
* <i>Acetosella vulgaris</i>	1			
* <i>Agave americana</i>	1			
* <i>Aira caryophyllea</i>	1	1		
* <i>Aira praecox</i>		1		
* <i>Aira</i> sp.		1		
* <i>Araucaria heterophylla</i>	1			
* <i>Arctotheca calendula</i>	1	1		
* <i>Arundo donax</i>	1			
* <i>Asparagus asparagoides</i>	1			
* <i>Asparagus officinalis</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project	Site - Lake		
	Area	Clifton		
* <i>Asphodelus fistulosus</i>	1	1		
* <i>Avena barbata</i>	1	1		
* <i>Avena fatua</i>	1			
* <i>Babiana angustifolia</i>	1			
* <i>Bartsia trixago</i>		1		
* <i>Brassica tournefortii</i>	1	1		
* <i>Briza maxima</i>	1			
* <i>Briza minor</i>	1	1		
* <i>Bromus diandrus</i>	1	1		
* <i>Bromus hordeaceus</i>		1		
* <i>Cakile maritima</i>		1		
* <i>Callitris</i> sp.	1			
* <i>Carpobrotus edulis</i>	1	1		
* <i>Catapodium rigidum</i>		1		
* <i>Cerastium glomeratum</i>		1		
* <i>Chasmanthe floribunda</i>	1			
* <i>Cirsium vulgare</i>	1	1		
* <i>Conyza bonariensis</i>	1			
* <i>Conyza sumatrensis</i>	1			
* <i>Conyza</i> sp.		1		
* <i>Cortaderia selloana</i>	1			
* <i>Crassula glomerata</i>	1	1		
* <i>Cynodon dactylon</i>	1	1		
* <i>Cyperus polystachyos</i>	1			
* <i>Daucus glochidiatus</i>		1		
* <i>Disa bracteata</i>	1			
* <i>Dischisma arenarium</i>		1		
* <i>Dittrichia graveolens</i>	1	1		
* <i>Ehrharta calycina</i>	1			
* <i>Ehrharta longiflora</i>	1			
* <i>Eragrostis curvula</i>	1			
* <i>Euphorbia paralias</i>		1		
* <i>Euphorbia peplus</i>	1	1		
* <i>Euphorbia terracina</i>	1	1		
* <i>Ferraria crispa</i>	1			
* <i>Ficus carica</i>	1			
* <i>Freesia alba x leichtlinii</i>	1			
* <i>Fumaria capreolata</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
* <i>Fumaria</i> sp.		1		
* <i>Galium murale</i>	1	1		
* <i>Geranium molle</i>	1	1		
* <i>Gladiolus caryophyllaceus</i>	1			
* <i>Gladiolus</i> sp.	1			
* <i>Gomphocarpus fruticosus</i>		1		
* <i>Goodenia pulchella</i>		1		
* <i>Heliophila pusilla</i>	1	1		
* <i>Holcus lanatus</i>	1			
* <i>Holcus setiger</i>		1		
* <i>Hordeum hystrix</i>		1		
* <i>Hordeum leporinum</i>		1		
* <i>Hypochaeris glabra</i>	1	1		
* <i>Isolepis marginata</i>	1	1		
* <i>Ixia maculata</i>	1			
* <i>Lagurus ovatus</i>	1			
* <i>Melilotus albus</i>		1		
* <i>Melilotus indicus</i>		1		
* <i>Lolium rigidum</i>	1	1		
* <i>Lolium</i> sp.	1			
* <i>Lotus angustissimus</i>		1		
* <i>Lotus subbiflorus</i>	1	1		
* <i>Lysimachia arvensis</i>	1	1		
* <i>Microtis media</i>	1	1		
* <i>Moraea flaccida</i>	1			
* <i>Olea europaea</i>		1		
* <i>Orobanche minor</i>	1	1		
* <i>Oxalis pes-caprae</i>	1	1		
* <i>Oxalis</i> sp.		1		
* <i>Paspalum dilatatum</i>	1			
* <i>Pennisetum clandestinum</i>	1			
* <i>Pentaschistis airoides</i>	1			
* <i>Petrorhagia dubia</i>	1	1		
* <i>Pinus pinaster</i>	1			
* <i>Pinus radiata</i>	1			
* <i>Poa annua</i>	1			
* <i>Polycarpon tetraphyllum</i>		1		
* <i>Romulea rosea</i>	1			

Species	Roe Highway	Proposed Offset	In common	Key species
	Extension Project Area	Site - Lake Clifton		
* <i>Rumex crispus</i>	1			
* <i>Sherardia arvensis</i>		1		
* <i>Solanum linnaeanum</i>		1		
* <i>Solanum nigrum</i>	1	1		
* <i>Sonchus asper</i>	1	1		
* <i>Sonchus oleraceus</i>	1	1		
* <i>Sorghum ?xdrummondii</i>	1			
* <i>Stenotaphrum secundatum</i>	1			
* <i>Tetragonia decumbens</i>		1		
* <i>Trachyandra divaricata</i>	1	1		
* <i>Trifolium campestre</i>		1		
* <i>Trifolium campestre</i> var. <i>campestre</i>		1		
* <i>Trifolium fragiferum</i> var. <i>fragiferum</i>		1		
* <i>Trifolium</i> sp.		1		
* <i>Typha orientalis</i>	1	1		
* <i>Typha</i> sp.		1		
* <i>Ursinia anthemoides</i>	1	1		
* <i>Vulpia muralis</i>		1		
* <i>Vulpia myuros</i>		1		
* <i>Wahlenbergia capensis</i>	1	1		
* <i>Watsonia meriana</i>	1			
* <i>Zantedeschia aethiopica</i>	1	1		
Planted				
# <i>Adenanthos cuneatus</i>	1			
# <i>Callistemon</i> sp. (planted)		1		
# <i>Eucalyptus</i> sp. (planted)		1		
# <i>Grevillea banksii</i> x <i>bipinnatifida</i>	1			
# <i>Hakea petiolaris</i>	1			

Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	Recorded in common
Native					
Southern Brown Bandicoot (<i>Isodon obesulus fusciventer</i>)	1	1	1	1	1
Honey Possum (<i>Tarsipes rostratus</i>)		1		1	
Pseudocheirus occidentalis (T:VU)			1		
Cercartetus concinnus				1	
Tachyglossus aculeatus			1		
Dasyurus geoffroii (T:VU)				1	
Antechinus flavipes leucogaster				1	
Phascogale tapoatafa ssp. (WAM M434) (T)				1	
Sminthopsis gilberti				1	
Sminthopsis griseoventer griseoventer				1	
Common Brushtail Possum (<i>Trichosurus vulpecula</i>)	1	1	1	1	1
Western Grey Kangaroo (<i>Macropus fuliginosus</i>)	1	1	1	1	1
Western Brush Wallaby (<i>Macropus irma</i>) (P4)		1		1	
<i>Rattus fuscipes</i>				1	
Mormopterus sp. 4 (South-western Free-tailed Bat)	1	1			
Mormopterus planiceps (Southern Freetail-bat)				1	
White-striped Free-tailed Bat (<i>Tadarida australis</i>)	1	1		1	
Gould's Wattled Bat (<i>Chalinolobus gouldii</i>)	1	1	1	1	1
Chocolate Wattled Bat (<i>Chalinolobus morio</i>)		1			
Lesser Long-eared Bat (<i>Nyctophilus geoffroyi</i>)	1	1	1	1	1
Gould's Long-eared Bat (<i>Nyctophilus gouldii</i>)		1		1	
Western Long-eared Bat (<i>Nyctophilus</i> sp.)		1			
<i>Nyctophilus major</i> (Western Long-eared Bat)				1	
Southern Forest Bat (<i>Vespadelus regulus</i>)	1	1	1	1	1
<i>Hydromys chrysogaster</i> (Water Rat) (P2)		1		1	
<i>Dromaius novaehollandiae</i>			1	1	
Stubble Quail (<i>Coturnix pectoralis</i>)		1			
Brown Quail (<i>Coturnix ypsilophora</i>)		1		1	
Musk Duck (<i>Biziura lobata</i>)	1	1	1	1	1
Freckled Duck (<i>Stictonetta naevosa</i>)		1		1	
Black Swan (<i>Cygnus atratus</i>)	1	1	1		1
Australian Shelduck (<i>Tadorna tadornoides</i>)	1	1	1	1	1
<i>Falsistrellus mackenziei</i> (P4)				1	
Australian Wood Duck (<i>Chenonetta jubata</i>)		1			
Pink-eared Duck (<i>Malacorhynchus membranaceus</i>)	1	1			

Species	Roe Highway Extension	Previously recorded in study area/region	Proposed Offset Site - Lake Clifton		Recorded in common
	Recorded in Project Area		Recorded in Project Area^	Previously recorded in study area/region	
Australasian Shoveler (<i>Anas rhynchos</i>)	1	1			
Grey Teal (<i>Anas gracilis</i>)	1	1	1		1
Chestnut Teal (<i>Anas castanea</i>)	1	1			
Northern Mallard (<i>Anas platyrhynchos</i>)		1			
Pacific Black Duck (<i>Anas superciliosa</i>)	1	1	1	1	1
Hardhead (<i>Aythya australis</i>)		1			
Blue-billed Duck (<i>Oxyura australis</i>)	1	1			
Radjah Shelduck (<i>Tadorna radjah</i>)	1				
Australasian Grebe (<i>Tachybaptus novaehollandiae</i>)		1			
Hoary-headed Grebe (<i>Poliiocephalus poliocephalus</i>)	1	1		1	
Great Crested Grebe (<i>Podiceps cristatus</i>)		1	1	1	
Common Bronzewing (<i>Phaps chalcoptera</i>)		1	1	1	
Brush Bronzewing (<i>Phaps elegans</i>)		1		1	
Crested Pigeon (<i>Ocyphaps lophotes</i>)	1	1			
Tawny Frogmouth (<i>Podargus strigoides</i>)		1		1	
<i>Aegotheles cristatus</i>	1	1	1	1	1
<i>Apus pacificus</i>		1		1	
<i>Anhinga novaehollandiae</i>	1	1	1	1	1
<i>Microcarbo melanoleucos</i>	1	1			
<i>Phalacrocorax carbo</i>	1	1		1	
<i>Phalacrocorax melanoleucos melanoleucos</i>				1	
<i>Phalacrocorax sulcirostris</i>		1		1	
<i>Phalacrocorax varius</i>		1	1	1	
<i>Pelecanus conspicillatus</i>	1	1		1	
<i>Botaurus poiciloptilus</i>		1			
<i>Ixobrychus dubius</i> P3		1			
<i>Ardea pacifica</i>		1			
<i>Ardea modesta</i>	1	1			
<i>Ardea ibis</i>		1			
<i>Egretta novaehollandiae</i>	1	1	1		1
<i>Egretta garzetta</i>		1			
<i>Egretta sacra</i>		1			
<i>Nycticorax caledonicus</i>	1	1			
<i>Plegadis falcinellus</i>	1	1			
<i>Threskiornis molucca</i>	1	1			
<i>Threskiornis spinicollis</i>	1	1			
<i>Platalea flavipes</i>	1	1			

Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	Recorded in common
Pandion cristatus	1	1			
Elanus axillaris	1	1			
Haliastur sphenurus	1	1	1	1	1
Hamirostra isura				1	
Milvus migrans		1			
Accipiter fasciatus	1	1		1	
Accipiter cirrocephalus		1	1	1	
Circus assimilis		1			
Circus approximans	1	1	1		1
Aquila audax	1	1	1	1	1
Hieraaetus morphnoides		1	1	1	
Falco cenchroides	1	1	1	1	1
Falco berigora		1	1	1	
Falco longipennis	1	1		1	
Falco peregrinus		1		1	
Porphyrio porphyrio	1	1			
Gallirallus philippensis		1			
Porzana pusilla		1			
Porzana fluminea	1				
Porzana tabuensis		1			
Tribonyx ventralis	1	1			
Gallinula tenebrosa	1	1	1		1
Fulica atra	1	1	1		1
Haematopus longirostris		1			
Himantopus himantopus	1	1		1	
Recurvirostra novaehollandiae	1	1		1	
Cladorhynchus leucocephalus		1		1	
Pluvialis fulva		1			
Pluvialis squatarola		1			
Charadrius rubricollis rubricollis (P4)			1	1	
Charadrius ruficapillus		1	1	1	
Charadrius leschenaultii		1		1	
Elsayornis melanops	1	1		1	
Thinornis rubricollis		1			
Erythrogonys cinctus		1			
Vanellus tricolor		1			
Limosa limosa		1			

Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	Recorded in common
Xenus cinereus		1			
Actitis hypoleucos		1			
Tringa brevipes		1			
Tringa nebularia		1		1	
Tringa stagnatilis		1			
Tringa glareola		1			
Arenaria interpres		1			
Calidris tenuirostris		1			
Calidris canutus		1			
Calidris alba		1			
Calidris ruficollis		1		1	
Calidris subminuta		1			
Calidris melanotos		1			
Calidris acuminata		1			
Calidris ferruginea		1			
Philomachus pugnax		1			
Turnix varius		1		1	
Onychoprion anaethetus		1			
Sternula nereis		1			
Gelochelidon nilotica		1			
Hydroprogne caspia		1	1		
Larus novaehollandiae novaehollandiae				1	
Chlidonias hybrida		1			
Sterna bergii			1	1	
Sterna hirundo		1			
Sterna leucoptera				1	
Sterna nereis nereis				1	
Thalasseus bergii		1			
Chroicocephalus novaehollandiae	1	1			
Calyptorhynchus latirostris	1	1	1	1	1
Calyptorhynchus baudinii		1	outside survey area)		
Calyptorhynchus banksii naso	1	1		1	
Eolophus roseicapillus	1	1	1	1	1
Cacatua tenuirostris		1			
Cacatua pastinator		1			
Cacatua sanguinea	1	1			
Cacatua sp. (Corella sp.)	1				

Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	Recorded in common
Nymphicus hollandicus		1			
Polytelis anthopeplus		1			
Platycercus icterotis		1		1	
Platycercus spurius			1	1	
Polytelis anthopeplus anthopeplus			1	1	
Barnardius zonarius	1	1	1	1	1
Glossopsitta porphyrocephala			1		
Purpureicephalus spurius	1	1			
Neophema elegans	1	1	1	1	1
Chalcites basalis		1			
Chalcites lucidus	1	1			
Cacomantis pallidus		1			
Cacomantis flabelliformis		1	1	1	
Chrysococcyx basalis			1	1	
Chrysococcyx lucidus			1	1	
Cuculus pallidus			1	1	
Ninox novaeseelandiae	1	1	1	1	1
Tyto alba				1	
Tyto javanica		1			
Tyto novaehollandiae novaehollandiae (P3)				1	
Todiramphus sanctus	1	1	1		1
Merops ornatus	1	1	1	1	1
Climacteris rufa				1	
Malurus elgans				1	
Malurus splendens	1	1	1	1	1
Stipiturus malachurus				1	
Sericornis frontalis	1	1	1	1	1
Smicromis brevirostris	1	1	1	1	1
Gerygone fusca	1	1	1	1	1
Acanthiza chrysorrhoa	1	1	1	1	1
Acanthiza inornata	1	1		1	
Acanthiza apicalis	1	1	1	1	1
Pardalotus punctatus	1	1		1	
Pardalotus striatus	1	1	1	1	1
Acanthorhynchus superciliosus	1	1		1	
Lichenostomus ornatus				1	
Lichenostomus virescens	1	1	1	1	1

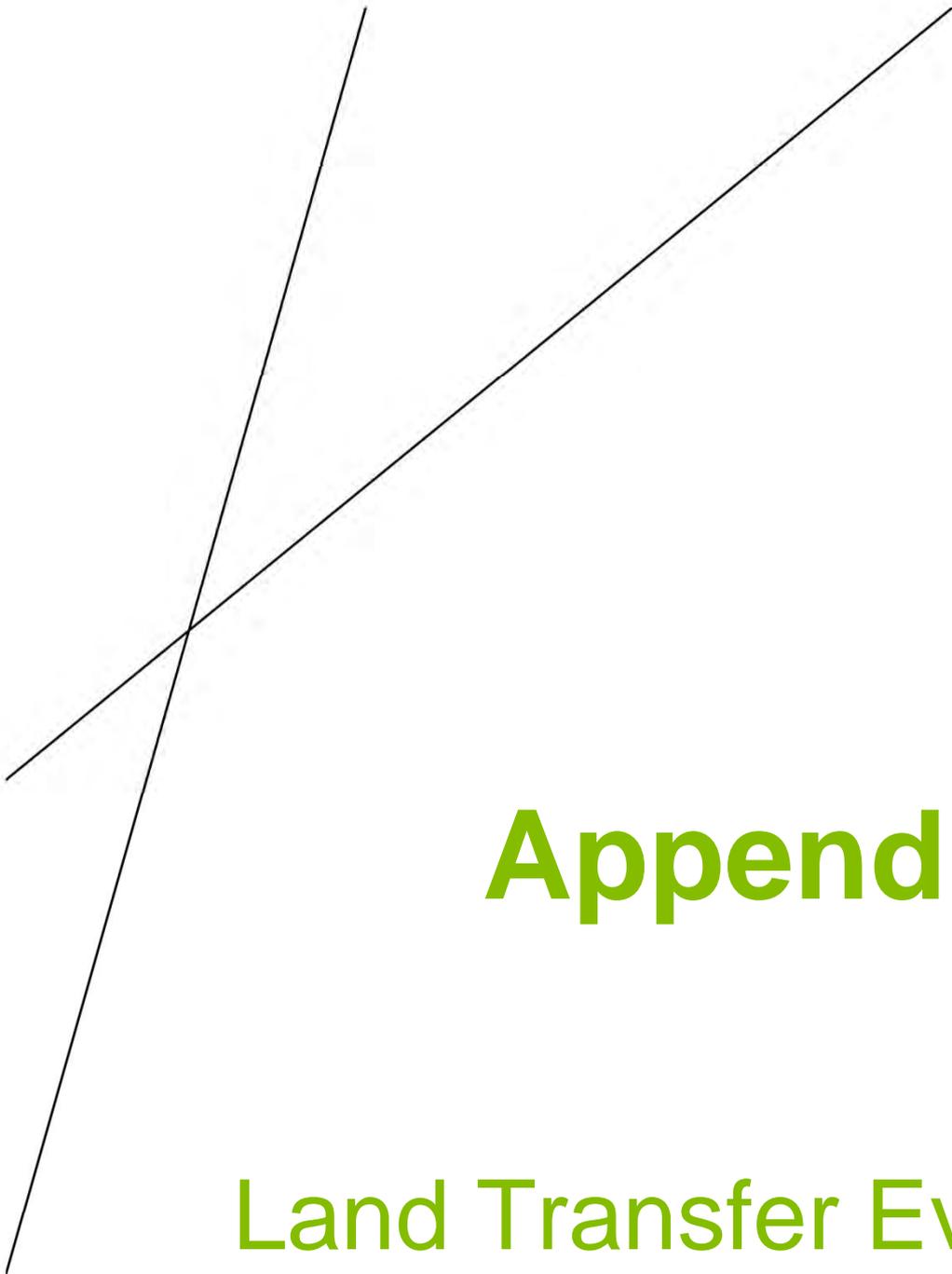
Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	Recorded in common
<i>Anthochaera lunulata</i>	1	1		1	
<i>Anthochaera carunculata</i>	1	1	1	1	1
<i>Epthianura albifrons</i>		1	1	1	
<i>Glyciphila melanops</i>	1	1			
<i>Lichmera indistincta</i>	1	1	1	1	1
<i>Phylidonyris novaehollandiae</i>	1	1	1	1	1
<i>Phylidonyris niger</i>	1	1		1	
<i>Phylidonyris melanops</i>				1	
<i>Melithreptus brevirostris leucogenys</i>				1	
<i>Melithreptus chloropsis</i>				1	
<i>Melithreptus lunatus</i>		1			
<i>Daphoenositta chrysoptera</i>	1	1		1	
<i>Coracina novaehollandiae</i>	1	1	1	1	
<i>Lalage sueurii</i>		1			
<i>Lalage tricolor</i>			1	1	
<i>Pachycephala pectoralis</i>		1	1	1	
<i>Pachycephala rufiventris</i>	1	1	1	1	1
<i>Colluricincla harmonica</i>	1	1	1	1	1
<i>Artamus cinereus</i>		1	1	1	
<i>Artamus cyanopterus</i>	1	1		1	
<i>Cracticus torquatus</i>	1	1	1	1	1
<i>Cracticus nigrogularis</i>		1			
<i>Strepera versicolor</i>				1	
<i>Myiagra inquieta</i>				1	
<i>Cracticus tibicen</i>	1	1	1	1	1
<i>Rhipidura albiscapa</i>	1	1	1		1
<i>Rhipidura fuliginosa preissi</i>			1	1	
<i>Rhipidura leucophrys</i>	1	1	1	1	1
<i>Corvus coronoides</i>	1	1	1	1	1
<i>Eopsaltria australis griseogularis</i>			1	1	
<i>Eopsaltria georgiana</i>				1	
<i>Grallina cyanoleuca</i>	1	1	1		1
<i>Petroica boodang</i>		1			
<i>Petroica multicolor campbelli</i>			1	1	
<i>Petroica goodenovii</i>		1			
<i>Melanodryas cucullata</i>		1			
<i>Acrocephalus australis</i>	1	1			

Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			Recorded in common area/region
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	
Cincloramphus cruralis			1		
Megalurus gramineus		1		1	
Zosterops lateralis	1	1	1	1	1
Cheramoeca leucosterna		1			
Hirundo neoxena	1	1	1	1	1
Hirundo nigricans nigricans			1	1	
Petrochelidon ariel		1			
Petrochelidon nigricans	1	1	1		1
Dicaeum hirundinaceum		1	1	1	
Anthus novaeseelandiae		1	1		
Chelodina oblonga	1	1	1	1	1
Christinus marmoratus	1	1	1	1	1
Strophurus spinigerus		1	1	1	
Diplodactylus polyophthalmus				1	
Underwoodisaurus milii				1	
Aprasia repens	1	1		1	
Delma fraseri		1	1	1	
Delma grayii		1	1	1	
Lialis burtonis	1	1	1	1	1
Pletholax gracilis	1	1			
Pygopus lepidopodus	1	1	1	1	1
Acritoscincus trilineatum	1	1	1	1	1
Cryptoblepharus buchananii	1	1			
Cryptoblepharus plagiocephalus			1	1	
Ctenotus australis	1	1	1	1	1
Ctenotus fallens	1	1			
Ctenotus impar				1	
Ctenotus labillardieri				1	
Egernia kingii				1	
Egernia luctuosa		1		1	
Egernia napoleonis	1	1	1	1	1
Egernia pulchra pulchra				1	
Glaphyromorphus gracilipes				1	
Hemiergus initialis initialis				1	
Hemiergus peronii tridactyla				1	
Hemiergus quadrilineata	1	1	1	1	1
Lerista distinguenda				1	

Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	Recorded in common
Lerista elegans	1	1	1	1	1
Lerista lineata (P3)	1	1	1	1	1
Lerista lineopunctulata		1		1	
Menetia greyii	1	1	1	1	1
Morethia lineocellata	1	1	1	1	1
Morethia obscura	1	1	1	1	1
Tiliqua occipitalis		1			
Tiliqua rugosa	1	1	1	1	1
Pogona minor	1	1	1	1	1
Rankinia adelaidensis		1	1		
Varanus gouldii		1		1	
Varanus rosenbergi		1	1	1	
Ramphotyphlops australis		1	1	1	
Ramphotyphlops pinguis				1	
Brachyurophis fasciolata		1			
Brachyurophis semifasciata		1			
Morelia spilota imbricata (P4)			1	1	
Demansia psammophis		1	1	1	
Echiopsis curta				1	
Elapognathus coronatus		1		1	
Neelaps bimaculatus		1	1		
Neelaps calonotus (P3)		1		1	
Notechis scutatus	1	1		1	
Parasuta gouldii		1	1	1	
Parasuta nigriceps				1	
Pseudonaja affinis	1	1	1	1	1
Pseudonaja nuchalis				1	
Simoselaps bertholdi		1	1	1	
Litoria moorei	1	1	1	1	1
Litoria adelaidensis	1	1	1	1	1
Heleioporus eyrei	1	1	1	1	1
Heleioporus inornatus				1	
Limnodynastes dorsalis	1	1	1	1	1
Neobatrachus pelobatoides		1			
Crinia georgiana	1	1		1	
Crinia glauerti	1	1		1	
Crinia insignifera	1	1	1	1	1

Species	Roe Highway Extension	Proposed Offset Site - Lake Clifton			Recorded in common area/region
	Recorded in Project Area	Previously recorded in study area/region	Recorded in Project Area^	Previously recorded in study area/region	
Geocrinea leai		1		1	
Myobatrachus gouldii		1			
Pseudophryne guentheri	1	1	1	1	1
	122	233	115	184	71
Introduced					
House Mouse (*Mus musculus)	1	1	1	1	
Black Rat (*Rattus rattus)		1		1	
Rat (*Rattus sp.)	1				
Dog (*Canis familiaris)		1	1		
European Red Fox (*Vulpes vulpes)	1	1	1	1	
Cat (*Felis catus)		1		1	
European Rabbit (*Oryctolagus cuniculus)	1	1	1	1	
*Mustela putorius				1	
Rock Dove (*Columba livia)	1	1			
Laughing Dove (*Streptopelia senegalensis)	1	1	1		
Spotted Turtle-Dove (*Streptopelia chinensis)	1	1			
*Trichoglossus haematodus	1	1			
*Dacelo novaeguineae	1	1	1	1	
Pig (Sus scrofa)			1		

^recorded by either AECOM (2016) and/or ENV Australia Pty Ltd (2007) Fauna Report prepared as an Appendix to Cape Bouvard Investment's Public Environmental Review (2009)



Appendix C

Land Transfer Evidence

WESTERN



AUSTRALIA

REGISTER NUMBER N/A	
DUPLICATE EDITION N/A	DATE DUPLICATE ISSUED N/A

RECORD OF CERTIFICATE OF TITLE
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2058** FOLIO **415**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.



REGISTRAR OF TITLES

THIS IS A MULTI-LOT TITLE

LAND DESCRIPTION:

LOT 2657 ON DEPOSITED PLAN 135701
LOT 3045 ON DEPOSITED PLAN 89915

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

STATE OF WESTERN AUSTRALIA

(T N339385) REGISTERED 27 MAY 2016

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2058-415 (3045/DP89915) , 2058-415 (2657/DP135701).
PREVIOUS TITLE: 1963-206, 1963-205, 1215-108.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: CITY OF MANDURAH.
RESPONSIBLE AGENCY: DEPARTMENT OF PARKS AND WILDLIFE.

NOTE 1: L386914 LAND PARCEL IDENTIFIER OF WELLINGTON LOCATIONS 2657 AND 3045 CHANGED TO LOT 2657 ON DEPOSITED PLAN 135701 AND LOT 3045 ON DEPOSITED PLAN 89915 ON 29.07.2010 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.



REGISTER NUMBER	
842/DP254075	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	8/2/2016

RECORD OF CERTIFICATE OF TITLE
 UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 1019 FOLIO 647

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.


 REGISTRAR OF TITLES 

LAND DESCRIPTION:

LOT 842 ON DEPOSITED PLAN 254075

REGISTERED PROPRIETOR:
 (FIRST SCHEDULE)

STATE OF WESTERN AUSTRALIA

(T N229045) REGISTERED 18 JANUARY 2016

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
 (SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
 * Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
 Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 1019-647 (842/DP254075).
 PREVIOUS TITLE: This Title.
 PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
 LOCAL GOVERNMENT AREA: SHIRE OF MURRAY.

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF MURRAY LOCATION 842 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 842 ON DEPOSITED PLAN 254075 ON 25-MAY-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.