Lot 508 on Deposited Plan 414835 (Aboriginal Cultural and Visitors Centre) Native Vegetation Clearing Permit Application – Supporting Information

Attachment 3

Flora and Vegetation Assessment (Focused Vision Consulting 2020b)

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FLORA AND VEGETATION ASSESSMENT – ABORIGINAL CULTURAL AND VISITORS CENTRE, BIBRA LAKE

CITY OF COCKBURN

FEBRUARY 2020

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EXECUTIVE SUMMARY

The City of Cockburn (the City) are proposing to develop an Aboriginal Cultural and Visitors Centre adjacent to Bibra Lake. The Aboriginal Cultural and Visitors Centre facility will require outdoor undercover spaces, plus access to the surrounding bushland for tours.

The proposed site is located approximately 15 km south of Perth on Progress Drive, Bibra Lake. The site occupies a section in the north-west of the Bibra Lake Reserve 46787, part of the Bush Forever site 'North Lake and Bibra Lake' (Government of Western Australia 2000). The area expected to require clearing is expected to be within the study area addressed in this report.

The City required an assessment of biological values for the proposed site. Focused Vision Consulting Pty Ltd (FVC) was commissioned by the City to undertake necessary environmental assessments of the study area, with the flora and vegetation assessment results presented in this report.

An initial field assessment, which served as a reconnaissance assessment, was conducted by Principal Ecologist, Kellie Bauer-Simpson on 8 August 2019 to determine the need for further assessments. This initial assessment determined that a detailed flora and vegetation assessment was warranted.

The detailed flora and vegetation assessment was carried out in accordance with EPA guidance for flora and vegetation assessments for environmental impact assessment (EPA 2016) and was completed by Senior Botanist, Lisa Chappell and Botanist/Ecologist, Adrian Barrett on 13 September 2019. The detailed assessment incorporated sampling of three vegetation quadrats, selective targeted survey for Threatened and Priority flora (carried out across the numerous site visits) and targeted assessment for the TECs relevant to the area.

The key findings of the flora and vegetation assessment within the study area are as follows:

- No flora of conservation significance was recorded during the field assessments, despite extensive traverses and assessment within the study area across multiple site visits during spring 2019.
- One intact vegetation unit, EmBaAfLOF, was described and mapped within the study area and defined as a Banksia Woodland, and representative of FCT SCP 28 (Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus* woodlands), which is considered to be representative of the Banksia woodlands TEC and the Tuart woodlands and forests TEC.
- Three targeted quadrats sampled within areas of intact remnant native vegetation adjacent to the study area, supporting vegetation unit EmBaAfLOF, have been confirmed to be representative of the Banksia woodlands TEC.
- One targeted quadrat (CC01) within areas of intact remnant native vegetation adjacent to the study area, supporting vegetation unit EmBaAfLOF has been confirmed to be representative of the Tuart woodlands and forests TEC.
- The Banksia woodland within and surrounding the study area is part of a medium-sized patch of 37 ha.
- The Tuart woodland and forest within and surrounding the study area is part of a medium-sized patch of 26 ha.
- The Banksia woodland and Tuart woodlands and forests TEC vegetation within the project area is in mostly 'Degraded' or 'Degraded – Good' condition and based on the condition and size of the patches mapped for each TEC, in accordance with the respective conservation advice, a large proportion of the vegetation within the study area is considered eligible as both TECs.

1. INTRODUCTION

1.1 BACKGROUND

The City of Cockburn (the City) are proposing to develop an Aboriginal Cultural and Visitors Centre adjacent to Bibra Lake. The Aboriginal Cultural and Visitors Centre facility will require outdoor undercover spaces, plus access to the surrounding bushland for tours. Inside the centre, spaces will be required for static and interactive displays, a visitor's information centre, administration areas, a café, a retail shop, a number of multifunctional spaces for a variety of cultural awareness training, educational, and other general activities.

The City required an assessment of biological values and potential environmental constraints for the proposed site. Focused Vision Consulting Pty Ltd (FVC) was commissioned by the City to undertake necessary environmental assessments of the study area, including a flora and vegetation assessment.

1.2 LOCATION

The proposed site (**Figure 1**) is located approximately 15 km south of Perth on Lot 65L Progress Drive in Bibra Lake, in the City of Cockburn. The site occupies a section in the north-west of the Bibra Lake Reserve 46787. The Bibra Lake Reserve is part of the Bush Forever site 'North Lake and Bibra Lake' (Government of Western Australia 2000).

0 15 30 45 60 m

GDA 94 / MGA Zone 50

N

Legend

Study Area

Figure 1 - Study Area

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2. EXISTING ENVIRONMENT

2.1 CLIMATE

The project area lies within the Perth Region which has a temperate Mediterranean climate characterised by hot, dry summers, mild, wet winters and moderate seasonality. Jandakot Airport (Site Number 009172) is the closest Bureau of Meteorology (BoM) recording station to the project area. The annual mean rainfall from 1972 to 2018 for Jandakot Airport was 819.2 mm. The annual mean maximum temperature ranges from 18°C in winter to 31.6°C in summer (BoM 2019). Rainfall in the month preceding the field survey (August) was similar to the long-term average (**Figure 2**).

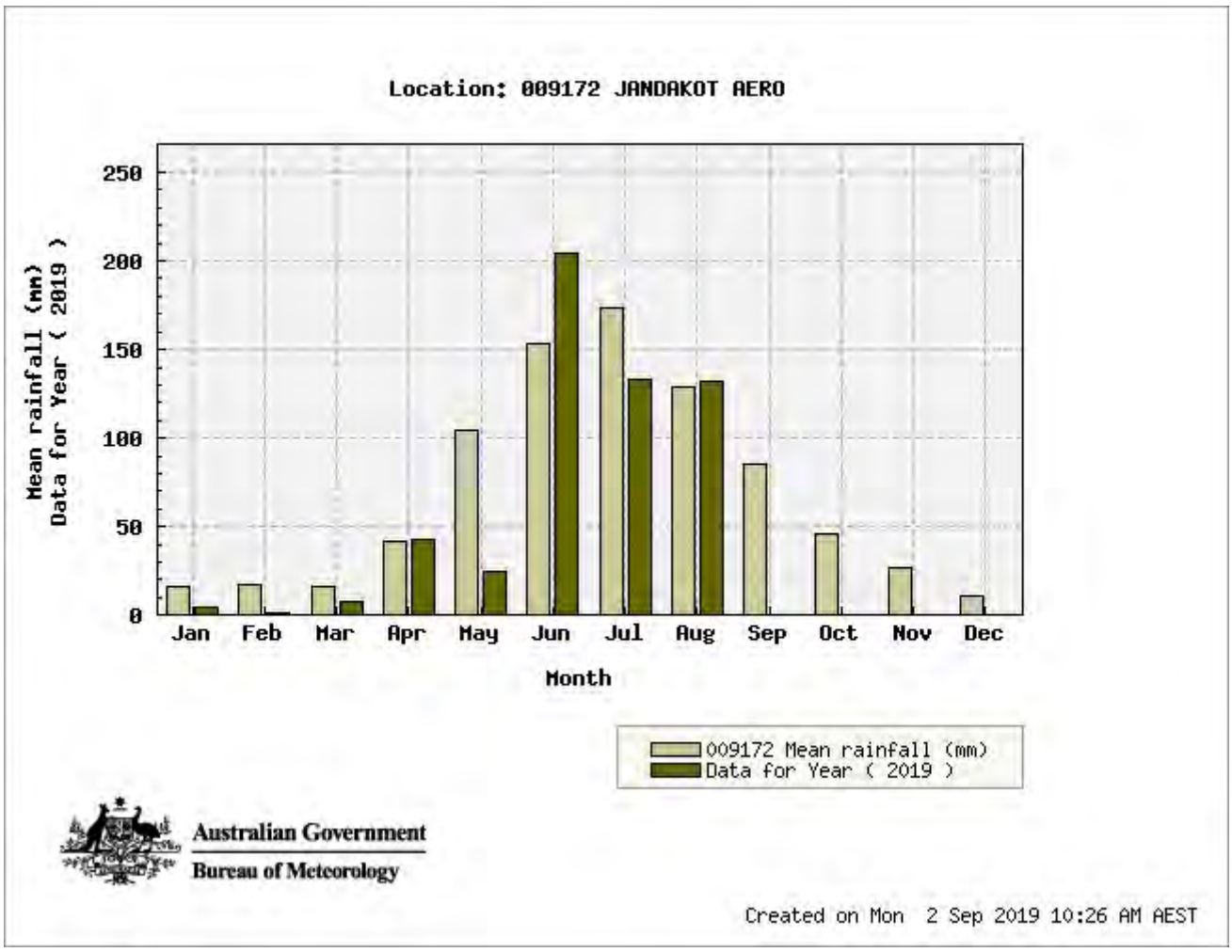

Figure 2 - Climate Data for Jandakot Airport (009172)

2.2 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 2013). The project area lies within the Swan Coastal Plain (SWA) IBRA region and, at a finer scale, within the Perth subregion (SWA2) (Mitchell *et al.* 2002).

The Swan Coastal Plain bioregion is a low lying coastal plain, mainly covered with Banksia and Tuart woodlands on sandy soils. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone, as well as heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials (Mitchell *et al.* 2002).

2.3 GEOLOGY AND SOILS

The Swan Coastal Plain supports five major geomorphological systems (landforms) that lie parallel to the coast. From west to east these are; Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward and McArthur 1980; Gibson *et al.* 1994). The study area is situated on the Pinjarra and Spearwood Systems (Government of Western Australia 2000) and are summarised **Table 1**. The spatial extent of each system is presented in **Figure 3**.

Table 1 - Summary of Soil Systems within the Study Area

System	Soil Unit	Description
Spearwood System	211Sp	Western Swan Coastal Plain from Dunsborough to Jurien. Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/brown shallow sands.
Pinjarra System	213Pj	Swan Coastal Plain from Perth to Capel. Poorly drained coastal plain with variable alluvial and aeolian soils. Variable vegetation includes Jarrah, marri, wandoo, paperbark sheoaks and rudis.

2.4 VEGETATION

Vegetation of the Perth subregion comprises heath and/or Tuart (*Eucalyptus gomphocephala*) woodlands on limestone, Jarrah (*Eucalyptus marginata*) and Banksia woodlands on Quaternary marine dunes and Marri (*Corymbia calophylla*) on colluvial and alluvial sands (Mitchell *et al.* 2002).

The study area is supported by the Swan Coastal Plain vegetation association, as broadly characterised by Beard (1990). Within the Swan Coastal Plain, the Pre-European vegetation association of the study area is the Bassendean vegetation association (Ref No. 126). The remaining extent across Western Australia, the Swan Coastal Plain and City of Cockburn are presented in **Table 2** and spatially in **Figure 4**.

Table 2 - Pre-European Vegetation of the Study Area (Beard 1990, DBCA 2018)

Vegetation Association No.	Beard Vegetation Description	Extent Context	Pre–European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent in DBCA Managed Lands
126	fl - Bare areas; freshwater lakes	Western Australia	23,503.39	9,558.32	40.67	38.59
		Swan Coastal Plain	3,420.06	787.10	23.01	38.19
		City of Cockburn	575.25	123.50	21.47	30.14

Vegetation complexes have also been defined by Heddle *et al.* (1980) and are based on vegetation in association with landforms and underlying geology. One vegetation complex, the Herdsman Complex, occurs within the study area. This complex is described as sedgelands and fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca* species. The vegetation complexes are presented in **Figure 5**, with the remaining extent of the Herdsman Complex across Western Australia and the City of Cockburn presented in **Table 3**.

Table 3 – Remaining Extent of the Herdsman Complex (Heddle *et al.* 1980)

Extent Context	Pre–European Extent (ha)	Current Extent (ha)	% Remaining
Western Australia	9,665.15	3,081.05	31.88
City of Cockburn	1,230.82	507.62	41.24

Figure 3 - Soils

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Figure 4 - Pre-European Vegetation

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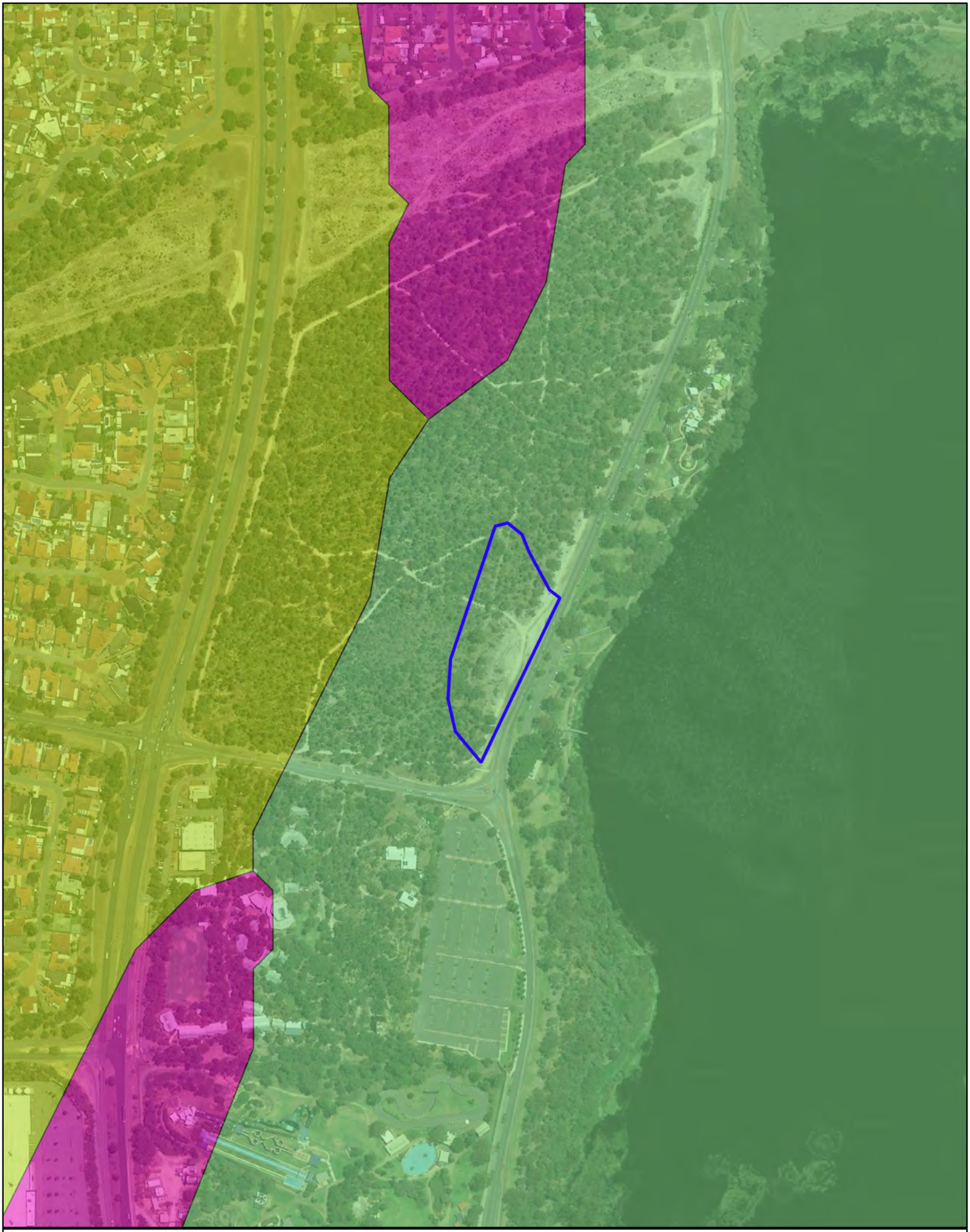


Figure 5 - Vegetation Complexes

The objective of the Environmental Protection Authority (EPA) in relation to flora and vegetation is: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained* (EPA 2016). The EPA considers it is important that vegetation associations are maintained above a threshold level of 30% of unconstrained areas and 10% for constrained areas, of the original pre-clearing extent of each association (EPA 2008). A level of 30% pre-clearing extent is considered to be the level below which species loss appears to accelerate exponentially at the ecosystem level (EPA 2008).

The following key criteria are applied to vegetation clearing from a biodiversity perspective, which justifies the retention targets (EPA 2000):

- the 'threshold level' below which species loss appears to accelerate exponentially within an ecosystem level, is regarded as being at a level of 30% (of the pre-European, i.e. pre-1750 extent of the vegetation type)
- a level of 10% of the original extent of a vegetation community is regarded as being a level representing Endangered
- clearing which would increase the threat level to a vegetation community should be avoided.

The remaining extents of the Beard vegetation association (**Table 2**) and Heddle vegetation complex (**Table 3**) of the study area, within the City of Cockburn do not fall below the 10% threshold, and therefore, the remaining extents meet the EPA objective of retention for the purpose of biodiversity conservation.

2.5 GEOMORPHIC WETLANDS OF THE SWAN COASTAL PLAIN

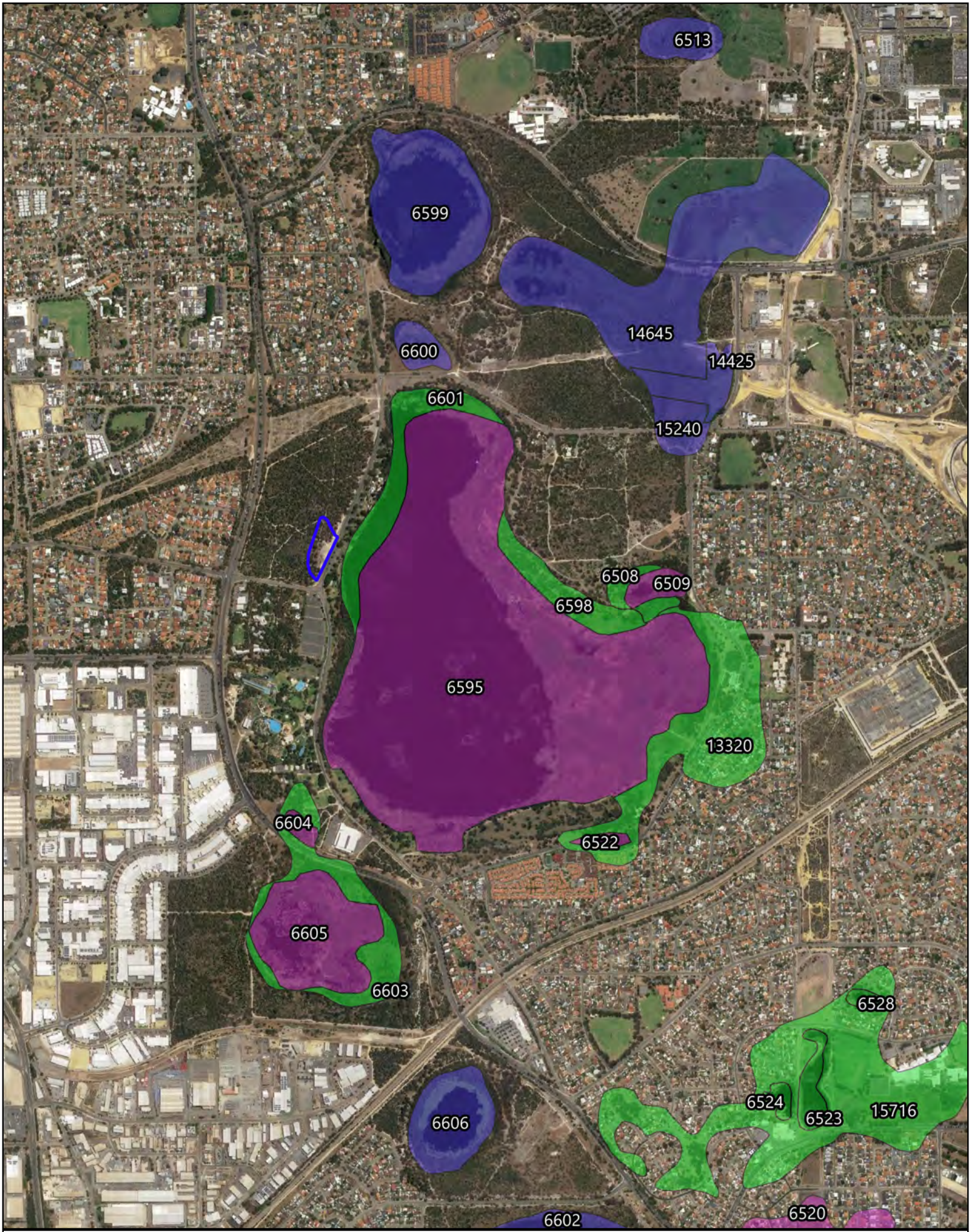
The Geomorphic Wetlands of the Swan Coastal Plain dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain. Wetland management categories are based on their ecological, hydrological and geomorphological significance, and take into account the degree of disturbance that has occurred. The three Wetland Management Categories on the Swan Coastal Plain can be summarised as follows:

- Conservation Category (CC) – wetlands that support a high level of ecological attributes and functions (generally having intact vegetation and natural hydrological processes), or that have a reasonable level of functionality and are representative of wetland types that are rare or poorly protected.
- Resource Enhancement (RE) – wetlands that have been modified (degraded) but still support substantial ecological attributes (wetland dependant vegetation covering more than 10%) and functions (hydrological properties that support wetland dependent vegetation and associated fauna), and have some potential to be restored to CC quality. Typically, such wetlands still support some elements of the original native vegetation, and hydrological function.
- Multiple Use (MU) – wetlands that are assessed as possessing few remaining ecological attributes and functions. While such wetlands can still play an important role in regional or landscape ecosystem management, including water management, they are considered to have low intrinsic ecological value. Typically, they have very little or no native vegetation remaining (less than 10%).

According to the Geomorphic Wetlands Swan Coastal Plain dataset, 16 geomorphic wetlands occur within 2 km of the study area (**Table 4** and **Figure 6**).

Table 4 – Geomorphic Wetlands within 2 km of the Study Area

Wetland Classification	Wetland Name	Management Category	Unique Identifier Number (UFI)
Lake	unknown	Conservation	6600
Lake	North Lake	Conservation	6599
Lake	Bibra Lake	Resource Enhancement	6522
Lake	Bibra Lake	Resource Enhancement	6595
Lake	Bibra Lake	Multiple Use	6601
Lake	Bibra Lake	Multiple Use	13320
Lake	Bibra Lake	Multiple Use	6598
Sumpland	unknown	Conservation	14645
Sumpland	unknown	Conservation	14425
Sumpland	unknown	Conservation	15240
Sumpland	Roe Swamp and Surrounding Sumpland	Resource Enhancement	6509
Sumpland	Roe Swamp and Surrounding Sumpland	Multiple Use	6510
Sumpland	Roe Swamp and Surrounding Sumpland	Multiple Use	6508
Sumpland	South Lake	Resource Enhancement	6604
Sumpland	South Lake	Resource Enhancement	6605
Sumpland	South Lake	Multiple Use	6603



0 250 500 750 1000 m

GDA 94 / MGA Zone 50

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- Study Area
- Conservation
- Multiple Use
- Resource Enhancement

Figure 6 - Geomorphic Wetlands of the Swan Coastal Plain

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2.6 THREATENED ECOLOGICAL COMMUNITIES

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat, which are subject to processes that threaten to destroy or significantly modify the assemblage across its range (DEC 2001). Vegetation communities in Western Australia may be considered threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (Mattiske 2015).

With regards to Commonwealth significance, some TECs or Priority Ecological Communities (PECs) of State (WA) significance are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Under the Act, a person must not take an action that has or will have significant impact on a listed TEC without approval from the Commonwealth Minister for the Environment, unless those actions are not prohibited under the Act.

2.6.1 Banksia Woodlands of the Swan Coastal Plain TEC

The *Banksia Woodlands of the Swan Coastal Plain Ecological Community* (Banksia woodlands TEC) was approved for inclusion as an Endangered TEC under the EPBC Act on 16 September 2016. This ecological community is woodland associated with some soils of the Swan Coastal Plain with a prominent tree layer of Banksia with scattered Eucalypts and other tree species among or emerging above the canopy. The understorey is comprised of a species rich mix of sclerophyllous shrubs, graminoids and forbs (Threatened Species Scientific Committee 2016).

The Banksia woodlands TEC is largely restricted to the Swan Coastal Plain IBRA bioregion, within the Perth (SWA02) and Dandaragan (SWA01) sub-regions. It extends into the adjacent Jarrah Forrest IBRA region (JA01 and JA02 sub-regions) and areas of the Whicher and Darling escarpments where pockets of Banksia woodland may occur. This TEC mainly occurs on deep Bassendean and Spearwood sands or occasionally on Quindalup sands at the eastern edge (Threatened Species Scientific Committee 2016).

Twenty-one Floristic Community Types (FCTs) described by Gibson *et al* (1994), in Bush Forever (Government of Western Australia 2000), Keighery *et al* (2008) and Urban Bushland Council (2011) best correspond to the Banksia woodlands TEC (Threatened Species Scientific Committee 2016) and these are summarised in **Table 5**.

Table 5 - Floristic Community Types corresponding to the Banksia Woodlands TEC

FCT	FCT Name	WA TEC/PEC	EPBC TEC
Supergroup 3 – Uplands centred on Bassendean Dunes and Dandaragan Plateau			
20a	*Banksia attenuata* woodlands over species rich dense shrublands	Endangered	
20b	Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands	Endangered	
20c	Eastern shrublands and woodlands	Critically Endangered	Endangered
21a	Central *Banksia attenuata - Eucalyptus marginata* woodlands		
21b	Southern *Banksia attenuata* woodlands	P3	
21c	Low lying *Banksia attenuata* woodlands or shrublands	P3	
22	*Banksia ilicifolia* woodlands	P2	
23a	Central *Banksia attenuata - Banksia menziesii* woodlands		
23b	Northern *Banksia attenuata - Banksia menziesii* woodlands	P3	
23c	North-eastern *Banksia attenuata - Banksia menziesii* woodlands		
S09	*Banksia attenuata* woodlands over dense low shrublands		
Supergroup 4 – Uplands centred on Spearwood and Quindalup Dunes			
24	Northern Spearwood shrublands and woodlands	P3	
25	Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands	P3	
28	Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands		
Whicher Scarp FCTs (Keighery *et al.* 2008)			
A1	Central Whicher Scarp Mountain Marri Woodland WHSFCT_A1	P1	
A2	North Whicher Scarp Jarrah and Woody Pear woodland WHSFCT_A2		
A3	North Whicher Scarp *Banksia* and Woody Pear woodland WHSFCT_A3		
A4	Whicher Scarp *Banksia grandis*, Jarrah and Marri woodland WHSFCT_A4		
B1	Swan Coastal Plain /North Whicher Scarp *Banksia attenuata* woodland WHSFCT_B1		
B2	West Whicher Scarp *Banksia attenuata* woodland WHSFCT_B2		
C2	Whicher Scarp Jarrah woodland on deep coloured sands WHSFCT_C2		

2.6.2 Tuart Woodlands and Forests of the Swan Coastal Plain TEC

The *Tuart* (Eucalyptus gomphocephala) *Woodlands and Forests of the Swan Coastal Plain Ecological Community* (Tuart woodland and forests TEC) was approved for inclusion as an Endangered TEC under the EPBC Act on 4 July 2019. This ecological community occurs as woodland, forest or other structural forms associated with soils of the Swan Coastal Plain with a prominent tree layer of *Eucalyptus gomphocephala* (Tuart) as the defining feature (DEE 2019b).

The Tuart woodland and forests TEC occurs within the Swan Coastal Plain IBRA region within the Perth subregion, from Jurien, 200 km north of Perth, to Sabina River near Busselton, 225 km south of Perth (DEE 2019b). The distribution of the ecological community is limited by the distribution of Tuart, although Tuart trees do also occur as a component of other vegetation communities, including the nationally-listed Banksia woodlands of the Swan Coastal Plain threatened ecological community (DEE 2016).

Twelve FCTs described by Gibson *et al* (1994) contain Tuarts as a component of the FCT and these are summarised in **Table 6.**

Table 6 - Floristic Community Types corresponding to the Tuart Woodlands and Forests TEC

FCT	FCT Name	WA TEC/PEC	EPBC TEC
Supergroup 2 – Seasonal Wetlands			
16	Highly saline seasonal wetlands		
17	*Melaleuca rhaphiophylla* - *Gahnia trifida* seasonal wetlands		
19b	Woodlands over sedgelands in Holocene dune swales		
Supergroup 3– Uplands centred on Bassendean Dunes			
21a	Central *Banksia attenuata* - *Eucalyptus marginata* woodlands		
Supergroup 4 - Uplands centred on Spearwood and Quindalup Dunes			
24	Northern Spearwood shrublands and woodlands	P3	
25	Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands	P3	
26b	Woodlands and mallees on Limestone		
28	Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus* woodlands		
29a	Coastal shrublands on shallow sands	P3	
30b	Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands	P3	
30c2	Woodlands and shrublands on Holocene dunes (re-allocated from 30c and 30a as per Gibson *et al.* 1994)		
S11	Northern *Acacia rostellifera* - *Melaleuca systena* shrublands		

3. METHODOLOGY

3.1 DESKTOP REVIEW

The desktop assessment incorporated a review of NatureMap (DBCA 2019a) (**Appendix A**), FloraBase (DBCA 2019b), DBCA databases (DBCA 2019c; 2019e), online lists for TECs and PECs (DBCA 2019d), and the Commonwealth Department of the Environment and Energy's (DEE's) Matters of National Environmental Significance (MNES) Protected Matters Search Tool (PMST) (DEE 2019a) for the presence of Threatened or Priority flora or Ecological Communities (**Appendix B**). The NatureMap and MNES database searches were based on a central point within the study area; -32.09 latitude and 115.82 longitude, surrounded by a 5 km buffer. The DBCA data was provided by the City and applies to the entire of the City of Cockburn.

A review of available literature and reports for previous studies within and near the project area was also carried out.

The review of the above information provided guidance for field preparations and assisted in the preparation of this report.

3.2 FIELD ASSESSMENT

An initial field assessment was conducted by Principal Ecologist, Kellie Bauer-Simpson on 8 August 2019 to determine the need for further assessments. This initial inspection served as a reconnaissance assessment, providing broad description and maps for the vegetation units and condition of vegetation within the study area. This initial assessment determined that a detailed flora and vegetation assessment was warranted.

The detailed flora and vegetation assessment was carried out in accordance with EPA guidance for flora and vegetation assessments for environmental impact assessment (EPA 2016) and was completed by Senior Botanist, Lisa Chappell and Botanist/Ecologist, Adrian Barrett on 13 September 2019.

Field data was collected using an electronic tablet with customised data forms and mobile spatial mapping capability, within the software program, Mappt™.

EPA guidance for flora and vegetation assessments (EPA 2016) requires that intact native vegetation units represented within a study area are defined based on data collected from at least three quadrats per vegetation unit, sampled from within 'Good' or better condition vegetation. The study area supports vegetation in mostly 'Degraded' and 'Degraded to Good' condition, with a small area in 'Good' condition. Therefore, the three quadrats sampled to define the vegetation unit present were established within 'Good' or better condition vegetation, outside the study area.

Quadrat data was recorded within a 10 m x 10 m area which was marked out with measuring tapes and a single peg (galvanised fence-dropper) installed in the north-west corner, in accordance with EPA guidance (EPA 2016). The following information was collected within each quadrat:

- observer
- date
- location/site
- GPS location (GDA94)
- representative photograph
- soil type and colour
- topography
- vegetation condition/degradation/disturbances (e.g. weed invasion, fire)
- flora species observed, including height and projected foliage cover of dominant species within each stratum

- vegetation unit, described in accordance with Level 5 of the National Vegetation Information System (NVIS)
- vegetation condition, assessed against the currently accepted scale; an adaptation of the Keighery (1994) and Trudgen (1991) condition scales.

Observations and opportunistic records were also logged continuously within and throughout the study area.

Vegetation condition was assessed and documented at each quadrat and at appropriate locations throughout the study area using the current bushland condition scale, which is an adaptation of Keighery (1994) and Trudgen (1991), as described in EPA (2016). The spatial extent of the varying vegetation condition was prepared in the field using Mappt™ and transferred to GIS for presentation in the report.

Banksia woodlands were expected to constitute a portion of the intact native vegetation within the study area. The field assessment specifically focused on vegetation units containing Banksia species, in order to collect sufficient data for a targeted Banksia woodlands TEC assessment, in accordance with the Commonwealth Conservation Advice (Threatened Species Scientific Committee 2016). The targeted assessment was carried out to diagnose/characterise, map and quantify the extent of Banksia woodlands TEC within and connected to the study area. For the purposes of "patch" mapping, the vegetation condition of Banksia woodland within the study area and in adjacent areas was confirmed or determined and mapped in accordance with the adaptation of the Keighery (1994) and Trudgen (1991) condition scales (as per EPA 2016).

The Banksia woodland assessment methodology requires sampling of quadrats, and analysis of this data to determine FCTs based on analysis against the Gibson *et al.* (1994) dataset that defined the main floristic communities of the Swan Coastal Plain. Areas of Banksia woodland within or adjacent the study area were sampled from three 10 m x 10 m quadrats.

FVC's tailored diagnostic tool has been developed in direct reference to the criteria listed in the Conservation Advice (Threatened Species Scientific Committee 2016), which incorporates assessment of the following:

- IBRA region
- soil and landform systems
- overstorey layer (Banksia species)
- emergent or other tree layer (associated non-Banksia tree species)
- understorey/mid-ground sclerophyllous shrub layer species
- herbaceous ground layer species
- FCT
- continuity/connectedness
- condition.

Following the recent Commonwealth listing of the Tuart woodlands and forests TEC under the EPBC Act on 4 July 2019 and upon discovery of the existence of Tuarts within the study area, the presence of the TEC was assessed in reference to the Conservation Advice for the TEC (DEE 2019b). The diagnosis of the TEC incorporates assessment of the following:

- IBRA region
- soil and landform systems
- presence, location and canopy extent of Tuart trees and the distance between canopy (30 m) buffers
- community structural formation
- overstorey/tree layer species composition
- understorey species composition
- FCT
- continuity/connectedness.

Targeted assessments of the Tuart woodlands and forests TEC requires assessment of the extent and size of the patch (continuity/connectedness), which FVC undertook using a combination of confirmed extent from within the study area, with spatial extent from the DBCA database search results.

A small proportion of the study area supports good quality vegetation, more likely to support Threatened and Priority flora species than adjacent cleared or highly degraded areas. A dedicated targeted survey for Threatened and Priority flora was not carried out, however, numerous studies were conducted by FVC, with six several site visits undertaken throughout spring 2019. These numerous site assessments comprised six separate visits by experienced ecological assessors for the flora and vegetation assessment, the initial site review, a targeted Black-cockatoo habitat assessment and a bushfire risk assessment. All such assessments included opportunistic observations for significant, uncommon or unidentifiable flora (in reference to the potentially occurring conservation-significant flora resulting from the desktop assessment) and collectively, would have contributed to a thorough inspection of the full study area extent for Threatened and Priority flora.

4. RESULTS

4.1 DESKTOP REVIEW

4.1.1 Literature Review

In 2018, Eco Logical Australia (ELA) undertook a flora and vegetation survey of 16 reserves in the City of Cockburn, one of which was Bibra Lake Reserve. ELA (2018) identified three vegetation communities within Bibra Lake Reserve based on one quadrat per community. A brief summary of each is presented in **Table 5**. ELA also inferred the occurrence of one TEC, the 'Banksia Woodlands of the Swan Coastal Plain ecological community' (Banksia woodlands TEC).

Within the project area, ELA (2018) described the vegetation as the unit, EmBaAfLOF. It was inferred that this unit is representative of the Banksia woodlands TEC.

The condition of vegetation within the study area was considered by ELA (2019) to range from Very Good on the western edge to Good and Degraded in areas adjacent to Progress Drive.

Table 7 – Vegetation Communities Identified in Bibra Lake Reserve (Eco Logical Australia 2018)

Geographic Location	Vegetation Community Code	Vegetation Community Description	Within Study Area
Upland	EmBaAfLOF	*Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Allocasuarina fraseriana* low open forest over *Xanthorrhoea preissii* tall open shrubland over *Brachyloma preissii* shrubland over *Mesomelaena pseudostygia* and *Lepidosperma squamatum* very open sedgeland.	Yes
Wetland	MrErOF	*Melaleuca rhaphiophylla* and *Eucalyptus rudis* open forest over *Pericalymma ellipticum* tall open shrubland over *Baumea articulata* very open sedgeland over **Pennisetum clandestinum* grassland.	No
Wetland	MpLOW	*Melaleuca preissii* low open woodland over *Melaleuca teretifolia* tall shrubland over **Cynodon dactylon* very open grassland over *Typha orientalis* closed herbland.	No

The project area occupies a section of the Bush Forever site 'North Lake and Bibra Lake'. The vegetation of the Bibra Lake part of this site is segregated into uplands and wetlands (**Table 6**). The project area is primarily situated on upland areas, but may intersect the edge of wetland areas on its most eastern edge.

Table 8 – Vegetation Communities Identified in Bibra Lake Bush Forever Site 244 (Government of Western Australia 2000)

Geographic Location	Vegetation Community Description
Upland	*Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* low open forest, with *Eucalyptus marginata*.
Wetland	*Eucalyptus rudis, Melaleuca preissiana* and *M. rhaphiophylla* open forests, over *M. teretifolia* low closed forest or closed tall scrub, over closed sedgeland.

4.1.2 Threatened and Priority Flora

The DBCA database search results, NatureMap Species Report and the MNES Report returned results for 26 species of Threatened and Priority flora, previously recorded within close proximity to the study area (**Table 7**, **Figure 5**).

Previously recorded significant flora includes 11 Commonwealth and State listed Threatened flora, one Priority 1, one Priority 2, seven Priority 3 and six Priority 4 species.

Interrogation of the databases indicates that no species of conservation significance have been previously recorded within the study area. Of the conservation significant flora species identified from the desktop assessment, it is considered that one could occur, six may occur and 19 are considered unlikely to occur (**Table 7**).

Table 9 – Likelihood of Occurrence of Threatened and Priority Flora within the Project Area (DEE 2019a, DBCA 2019a, 2019c)

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence	Source
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Critically Endangered	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Flowers yellow, October	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a)
Andersonia gracilis	Endangered	Vulnerable	Slender erect or open straggly shrub, 0.1-0.5(1) m high. Flowers white & pink & purple, September to November	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a), DBCA (2019c)
Caladenia huegelii	Endangered	Critically Endangered	Tuberous, perennial, herb, 0.25-0.6 m high. Flowers green & cream & red, September to October	Grey or brown sand, clay loam	Could occur - species habitat likely to occur within study area	DEE (2019a), DBCA (2019a, 2019c)
Diuris purdiei	Endangered	Endangered	Tuberous, perennial, herb, 0.15-0.35 m high. Flowers yellow, September to October	Grey-black sand, moist. Winter-wet swamps	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a)
Drakaea elastica	Endangered	Critically Endangered	Tuberous, perennial, herb, 0.12-0.3 m high. Flowers red & green & yellow, October to November	White or grey sand. Low-lying situations adjoining winter-wet swamps	May occur - species habitat likely to occur within study area	DEE (2019a), DBCA (2019c)
Lepidosperma rostratum	Endangered	Endangered	Rhizomatous, tufted perennial, grass-like or herb (sedge), 0.5 m high. Flowers Brown	Peaty sand, clay	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a), DBCA (2019c)
Thelymitra dedmaniarum	Endangered	Critically Endangered	Tuberous, perennial, herb, to 0.8 m high. Flowers yellow, November to December or January	Associated with granite	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a)
Diuris drummondii	Vulnerable	Vulnerable	Tuberous, perennial, herb, 0.5-1 m high. Flowers yellow, November to January	Low-lying depressions, swamps	May occur - species habitat likely to occur within study area	DBCA (2019a, 2019c)
Diuris micrantha	Vulnerable	Vulnerable	Tuberous, perennial, herb, 0.3-0.6 m high. Flowers yellow & brown, September to October	Brown loamy clay. Winter-wet swamps, in shallow water	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a)
Drakaea micrantha	Vulnerable	Endangered	Tuberous, perennial, herb, 0.15-0.3 m high. Flowers red & yellow, September to October	White-grey sand	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a), DBCA (2019c)
Eleocharis keigheryi	Vulnerable	Vulnerable	Clumping grass like sedge, green with yellow hairs. 0.2-03 m high	Claypan with brown clay. Found in open water ponds	Unlikely to occur - suitable habitat unlikely to occur within study area	DEE (2019a), DBCA (2019c)

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence	Source
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026)	-	Priority 1	Shrub, 0.4-1.5 m high. Flowers yellow, May or August	Grey or black sand over clay in swampy areas, winter wet lowlands	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Thelymitra variegata	-	Priority 2	Tuberous, perennial, herb, 0.1-0.35 m high. Flowers orange & red & purple & pink, June to September	Sandy clay or sand, associated with laterite	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Cyathochaeta teretifolia	-	Priority 3	Rhizomatous, clumped, perennial sedge, to 2 m high, to 1.0 m wide. Flowers brown.	Grey sand, sandy clay. Swamps, creek edges	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Dampiera triloba	-	Priority 3	Erect perennial, herb or shrub, to 0.5 m high. Flowers blue, August to December	Dark brown/black peaty soils	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Jacksonia gracillima	-	Priority 3	Erect to spreading shrub, to 2 m high. Flowers yellow-orange & red	Sand and loam soils, winter wet flats, slopes	May occur - species habitat likely to occur within study area	DBCA (2019a, 2019c)
Phlebocarya pilosissima subsp. *pilosissima*	-	Priority 3	Rhizomatous, compactly tufted perennial, grass-like or herb, 0.15-0.4 m high. Flowers cream-white, August to October	White or grey sand, associated with lateritic gravel	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Pimelea calcicola	-	Priority 3	Erect to spreading shrub, 0.2 to 1 m high. Flowers pink, September to November.	Coastal limestone ridges	Unlikely to occur - suitable habitat not present within study area	DBCA (2019c)
Stylidium paludicola	-	Priority 3	Perennial, herb, 0.35-1 m high, Flowers pink, October to December	Peaty sand over clay. Winter wet habitats. Marri and *Melaleuca* woodland, *Melaleuca* shrubland	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Styphelia filifolia	-	Priority 3	Spreading shrub, 0.4 to 0.9 m high. Flowers white, March to June	Sandy soils, flats and slopes	May occur - species habitat likely to occur within study area	DBCA (2019a, 2019c)
Dodonaea hackettiana	-	Priority 4	Erect shrub or tree, 1-5 m high. Flowers yellow & green-red, mainly July to October	Sandy soils, associated with limestone outcropping	Unlikely to occur- suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Jacksonia sericea	-	Priority 4	Low spreading shrub, to 0.6 m high. Flowers orange, usually Dec or Jan to Feb.	Calcareous & sandy soils.	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a)

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence	Source
Microtis quadrata	-	Priority 4	Erect herb, to 0.4 m high. Flowers green, October	Sand, clay, loam, near wetlands, slopes	May occur - species habitat likely to occur within study area	DBCA (2019a, 2019c)
Stylidium longitubum	-	Priority 4	Erect annual (ephemeral), herb, 0.05-0.12 m high. Flowers pink, October to December	Sandy clay, clay. Seasonal wetlands	Unlikely to occur - suitable habitat unlikely to occur within study area	DBCA (2019a, 2019c)
Tripterococcus sp. Brachylobus (A.S. George 14234)	-	Priority 4	Slender erect multi-stemmed shrub to 40 cm. Flowers orange-yellow.	Grey/white sand, peaty sand over clay. Winter damp flats, dry flats and slopes.	May occur - species habitat likely to occur within study area	DBCA (2019a)
Verticordia lindleyi subsp. *lindleyi*	-	Priority 4	Erect shrub, 0.2 to 0.75 m high. Flowers pink, May or November to December or January.	Sand, sandy clay. Winter-wet depressions.	Unlikely to occur - suitable habitat not present within study area	DBCA (2019a)

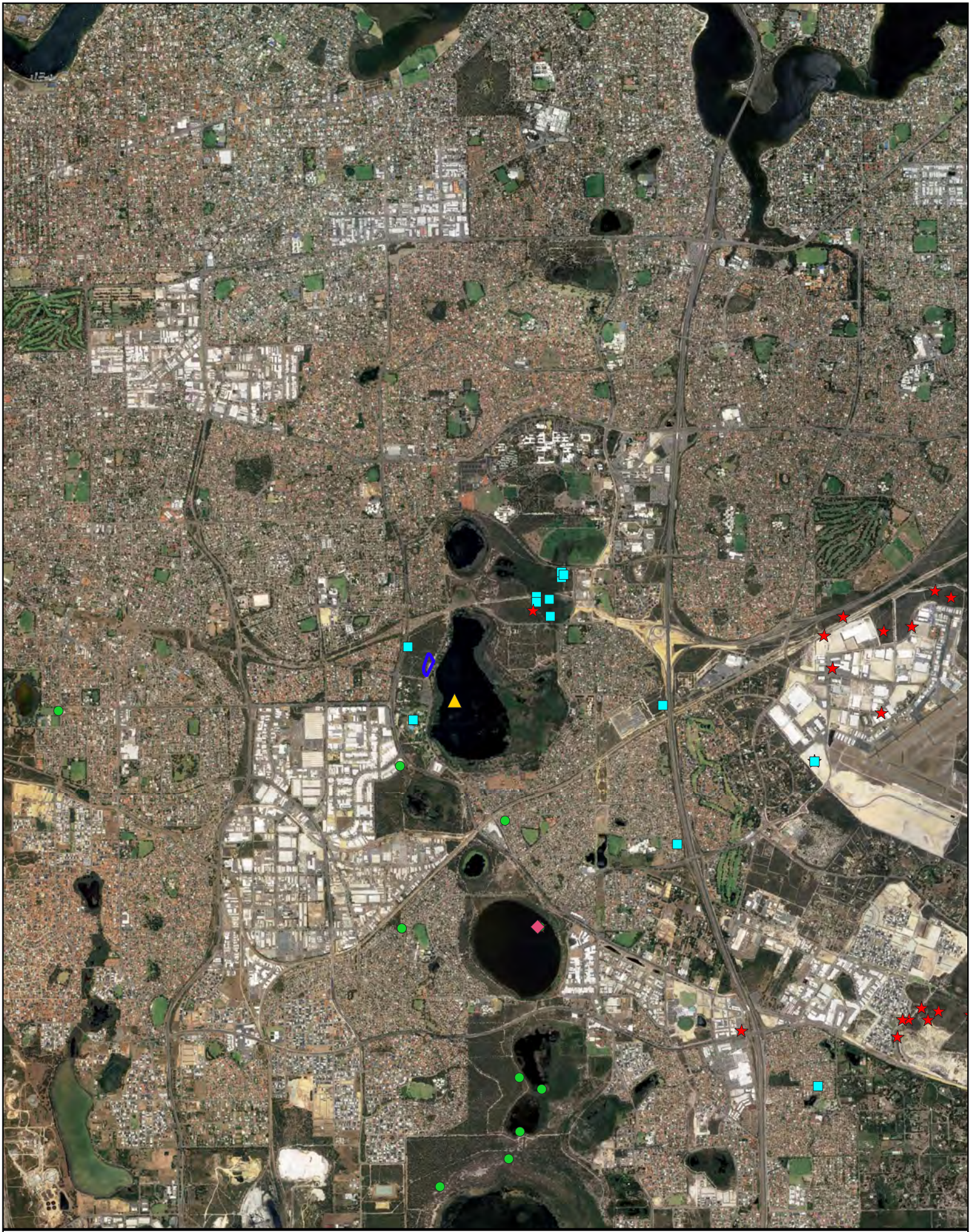

Figure 7 - Threatened and Priority Flora

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4.1.3 Threatened and Priority Ecological Communities

A review of DBCA Threatened and Priority Ecological Communities (TEC and PEC) database (DBCA 2019d, 2019e) and the EPBC Protected Matters Search Tool (DEE 2019) identified the presence of two Commonwealth listed TECs as occurring within or within close proximity to the study area (**Figure 8**). These are described as:

- *Banksia Woodlands of the Swan Coastal Plain IBRA Region ecological community* (Banksia woodlands TEC) (Endangered)
- *Tuart* (Eucalyptus gomphocephala) *woodlands and forests of the Swan Coastal Plain* ecological community' (Tuart woodlands and forests TEC) (Critically Endangered).

The Banksia Woodlands TEC consists of a dominant tree layer of *Banksia* sometimes with scattered eucalypts and other tree species present. The Banksia woodlands vary in structure and species composition but are united in having a dominant Banksia component, which includes at least one of four key species – *Banksia attenuata, B. menziesii, B. prionotes* and/or *B. ilicifolia*. The ecological community is associated with the Swan Coastal Plain, typically occurring on well drained, low nutrient soils in sands, particularly on Bassendean and Spearwood sands (DEE 2016).

The Tuart woodlands and forests TEC was approved for inclusion as an Endangered TEC under the EPBC Act on 4 July 2019. This ecological community occurs as woodland, forest or other structural forms associated with soils of the Swan Coastal Plain, with a prominent tree layer of *Eucalyptus gomphocephala* (Tuart) (DEE 2019b). The distribution of the ecological community is limited by the distribution of Tuart (DEE 2019b). The ecological community intergrades and/or interacts with other ecological communities of the Swan Coastal Plain, including the Banksia Woodlands of the Swan Coastal Plain TEC, where tuart occurs as an occasional emergent above a stratum dominated or co-dominated by Banksia species *including Banksia attenuata, B. menziesii*, *B. prionotes* or *B. ilicifolia* (DEE 2019b).

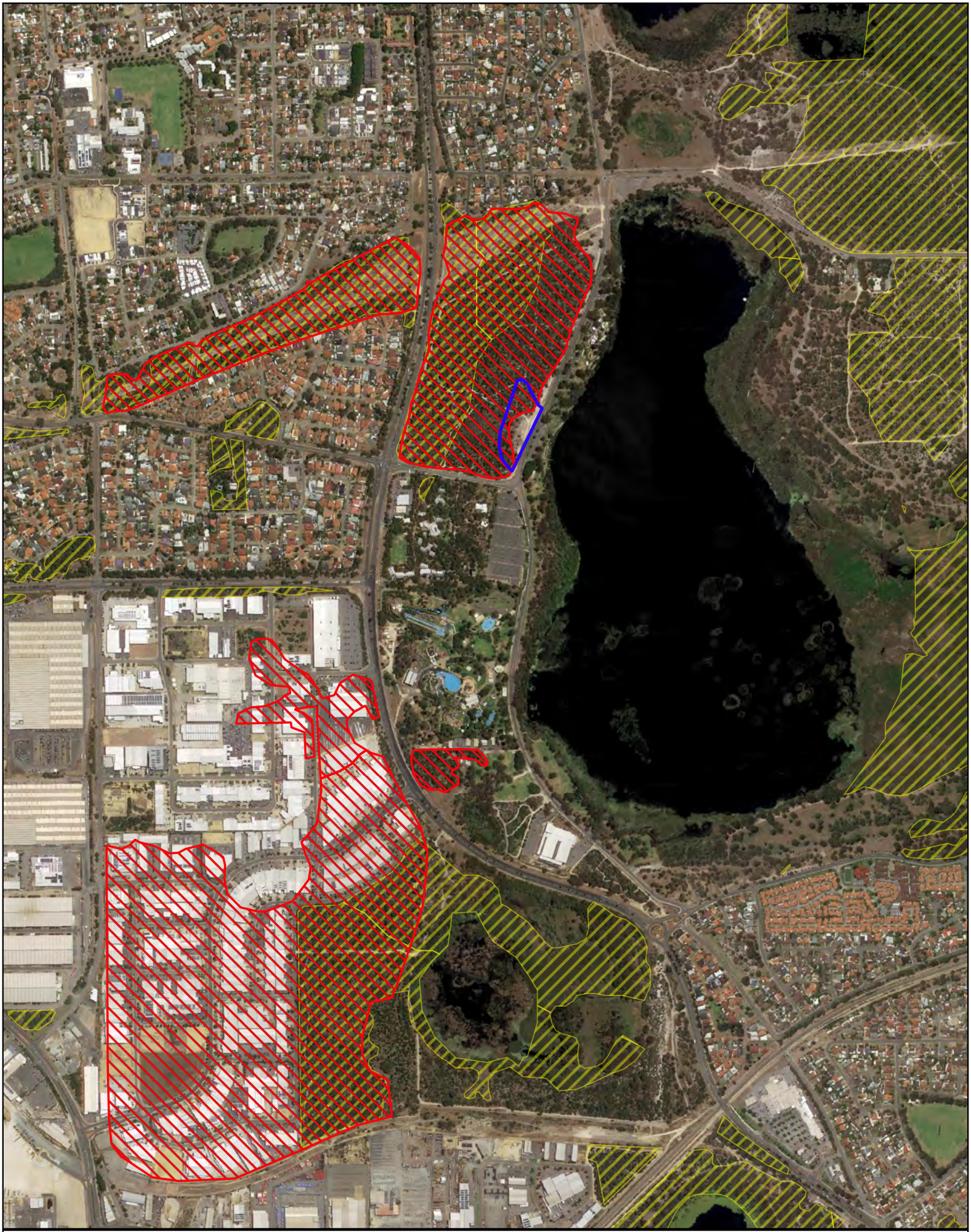

Figure 8 - Threatened and Priority Ecological Communities

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4.2 FIELD ASSESSMENT

4.2.1 Flora

A total of 70 flora species, from 58 genera and 22 families were recorded during the 2019 field survey. The dominant families were found to be Fabaceae (12 taxa), Asparagaceae (eight taxa) and Asteraceae (seven taxa). The total comprises of 56 (80%) native species and 14 (20%) introduced (weed) species. The full list of vascular flora species recorded within each quadrat (which includes opportunistic species records, additional to flora species recorded within quadrats) is presented in **Appendix C** and individual quadrat data is presented in **Appendix D**.

No species listed as Threatened flora under the BC Act or under the EPBC Act were recorded, and none of the recorded flora species are listed as Priority flora by DBCA.

None of the recorded flora are exhibiting an extension beyond their currently documented range, in accordance with records of the Western Australian Herbarium (DBCA 2019b).

One recorded weed species **Asparagus asparagoides* (Bridal Creeper) is a Declared Pest plant within the City of Cockburn, listed under the *Biosecurity and Agriculture Management Act 2007*. Bridal Creeper is also considered to be a Weed of National Significance (WoNS) (DEE 2019d).

4.2.2 Vegetation

The study area supports one vegetation unit (EmBaAfLOF), as previously defined by ELA (2018). This vegetation unit, broadly described as a *Eucalyptus marginata* and *Banksia attenuata* Low Open Forest/Woodlamnd is summared in **Table 8** and its extent in the study area is presented spatially presented in **Figure 9**.

Table 10 - Summary of Recorded Vegetation Unit

Vegetation Unit and Description	Study Area		Project Area	
	Area (ha)	% of Study Area	Area (ha)	% of Study Area
EmBaAfLOF *Eucalyptus marginata* and *Banksia attenuata* Low Woodland over *Macrozamia riedlei, Hibbertia hypericoides, Gompholobium tomentosum and Bossiaea eriocarpa* Open Shrubland	1.26	79.43	0.49	30.82
Cleared	0.33	20.57	0.19	11.95
TOTAL	**1.59**	**100**	**0.68**	**42.77**

The condition of the vegetation within the study area was found to range from 'Completely Degraded' to 'Good', with the majority observed to be in 'Degraded' condition (**Table 11**, **Figure 10**). The project area supports vegetation ranging from 'Completely Degraded' to 'Degraded - Good' condition.

Table 11 - Summary of Vegetation Condition

Vegetation Condition Rating	Study Area		Project Area	
	Area (ha)	% of Study Area	Area (ha)	% of Project Area
Good (G)	0.09	5.66	0	0
Degraded - Good (D – G)	0.52	32.70	0.14	20.59
Degraded (D)	0.64	40.25	0.34	50.00
Completely Degraded (CD)	0.34	21.38	0.2	29.41
Total	**1.59**	**100**	**0.68**	**100**

Figure 9 - Vegetation Units

Figure 10 - Vegetation Condition

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4.2.3 Threatened Ecological Communities

4.2.3.1 Assessment of Floristic Community Types

Floristic analysis of recorded quadrat data against the Gibson *et al.* (1994) dataset for species presence/absence as well as multivariate cluster analysis of species presence/absence in the statistical analysis software, PATN™ was conducted in order to assign FCTs. Based on species presence/absence data and PATN analysis, the vegetation unit (EmBaAfLOF) is considered representative of FCT (SCP) 28, with some affinity to FCT 21a and FCT 24 (**Table 12**, **Figure 11**). FCT 28; Spearwood *Banksia attenuata* or *Banksia attenuata - Eucalyptus woodlands*, is representative of the Banksia woodlands TEC and the Tuart woodlands and forests TEC, as discussed in **Section 2.6**.

Table 12 - Summary of Recorded Vegetation Units

Floristic Community Type (FCT)	CC01		CC02		CC03	
	Common No. of Species	% of Common Species	Common No. of Species	% of Common Species	Common No. of Species	% of Common Species
20a	11	37.9	20	47.6	14	46.7
20b	11	37.9	19	45.2	13	43.3
20c	10	34.5	18	42.9	13	43.3
21a	17	58.6	27	64.3	19	63.3
21b	11	37.9	19	45.2	15	50.0
21c	15	51.7	23	54.8	18	60.0
23a	15	51.7	22	52.4	16	53.3
23b	9	31.0	17	40.5	12	40.0
22	8	27.6	15	35.7	10	33.3
24	18	62.1	25	59.5	18	60.0
25	16	55.2	22	52.4	18	60.0
28	19	65.5	29	69.0	20	66.7
23c	10	34.5	17	40.5	12	40.0
S09	9	31.0	17	40.5	11	36.7

	Highest affinity
	Some affinity

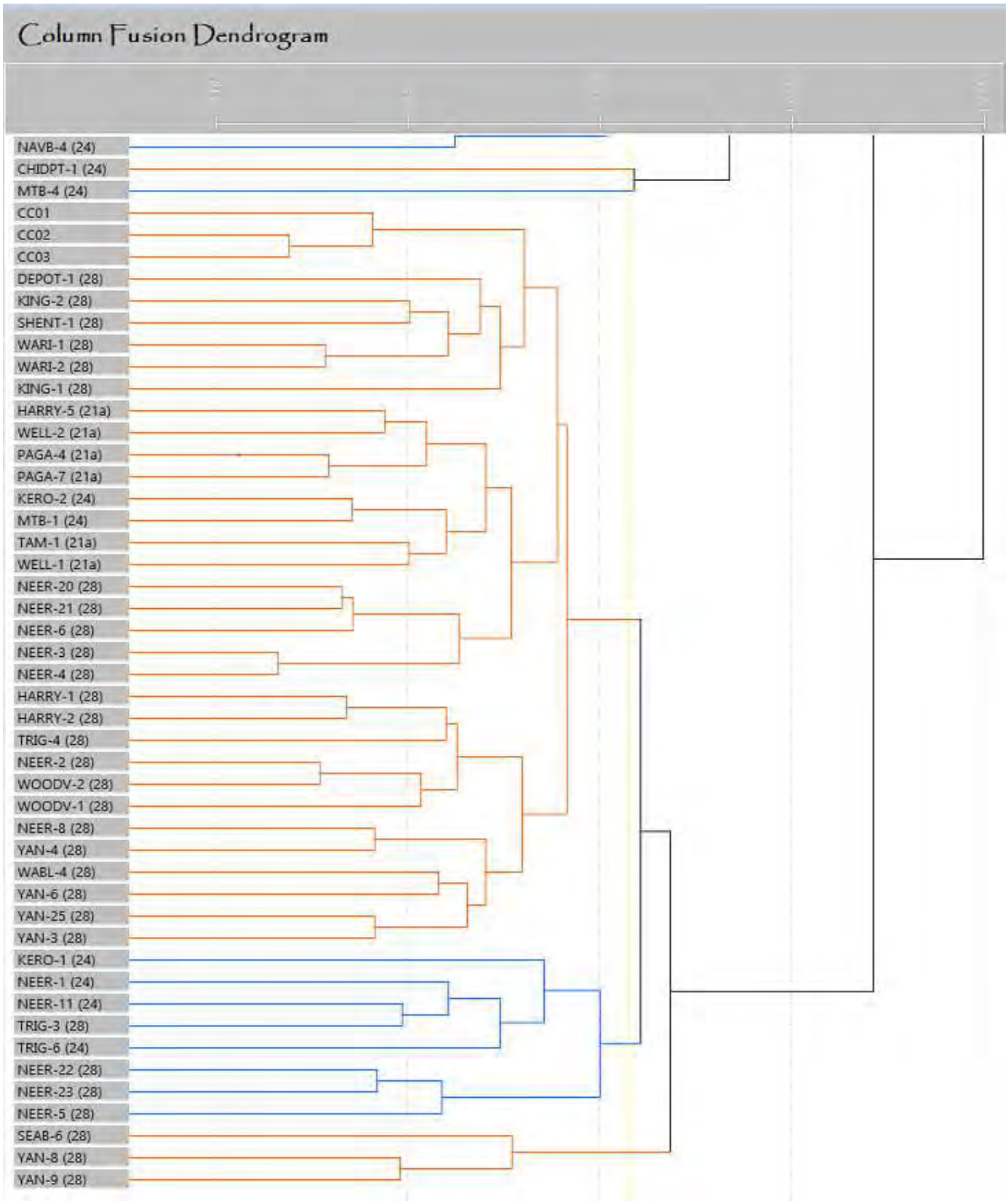

Figure 11 – Selection of Quadrat Cluster Analysis (Dendrogram)

4.2.3.2 Banksia Woodland TEC

The Conservation Advice (Threatened Species Scientific Committee 2016) states that the Banksia woodlands TEC "typically occurs on well drained, low nutrient soil on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands", and that the community "is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau; and may also occur in other limited scenarios".

Banksia Woodland Characterisation

All of the sampled quadrats within the vegetation unit, EmBaAfLOF are considered likely to be equivalent to the Banksia woodlands TEC and were characterised using a checklist developed based on the Conservation Advice (Threatened Species Scientific Committee 2016). The checklist includes the key characteristics of the TEC, including botanical region, soil and landform types and required or typical species for each stratum (**Table 13**).

Table 13 - Banksia Woodland TEC Characterisation of the Recorded Quadrats

Key Character (see key)	Plot/Quadrat No.		
	CC01	CC02	CC03
a).	+	+	+
b).	+	+	+
c).	+	+	+
d).	+	+	+
e).		+	
f).	+	+	+
g).	+	+	+
Confirmed	**+**	**+**	**+**

Key:

a) Swan Coastal Plain or Jarrah Forest location
b) Soils and landform either deep Bassendean, Spearwood or occasionally Quindalup sands, sandy colluvium, Aeolian sands of the Ridge Hill Shelf or Whicher Scarp
c) Distinctive upper sclerophyllous layer dominated by *Banksia attenuata, Banksia menziesii, Banksia ilicifolia* or *Banksia prionotes*
d) With (although can be without) an emergent tree layer of *Corymbia calophylla, Eucalyptus marginata* or *Eucalyptus gomphocephala*
e) With (although can be without) other trees including *Eucalyptus todtiana, Nuytsia floribunda, Allocasuarina fraseriana, Callitris arenaria, Callitris pyramidalis* or *Xylomelum occidentale*
f) Understorey/mid-ground sclerophyllous shrub layer including mostly Asteraceae, Dilleniaceae, Droseraceae, Ericaceae, Fabaceae, Haemodoraceae, Iridaceae, Myrtaceae, Orchidaceae, Proteaceae, Restionaceae
g) Herbaceous ground layer including mostly Apiaceae, Asteraceae, Cyperaceae, Haemodoraceae, Poaceae, Restionaceae, Stylidiaceae

Banksia Woodland Extent

The extent of Banksia woodland across the study area was determined to be all areas supporting remnant native vegetation (vegetation unit EmBaAfLOF), as presented in **Figure 12**.

Banksia Woodland Patch

The area of Banksia woodland mapped within the project area has been grouped with adjacent areas of Banksia woodland to form a patch, in accordance with the methodologies and requirements described in the Conservation Advice (Threatened Species Scientific Committee 2016). Areas of Banksia woodland in 'Degraded' or worse condition are not considered to be a matter of MNES unless they are part of a patch; that is, connected to or located closely to (separated by less than a 30 m gap, with gaps being cleared areas, infrastructure, areas of another vegetation type, or any other interruption) other areas of applicable Banksia woodland.

Based on the above logic, a single, medium-sized Banksia woodland patch of 37 ha exists around the project area, as presented in **Figure 13**.

Figure 12 - Banksia Woodland Extent

Figure 13 - Banksia Woodland Patch

Banksia Woodland Condition

Within the project area, the area of Banksia woodland (the majority of the study area) ranges from 'Degraded' to 'Degraded – Good' condition, in accordance with an adaptation of the Keighery (1994) and Trudgen (1991) condition scales.

Banksia Woodland Patch and Condition Threshold

The grouping of the area of Banksia woodland within and surrounding the project area resulted in a single medium-sized patch of 37 ha. Within the project area, the area of Banksia woodland ranges from 'Degraded' to 'Degraded – Good' condition and within the study area, the condition ranges from 'Degraded' to 'Good' condition. Within the broader Banksia woodland patch, a conservative average condition across the patch of 'Good' is considered applicable.

The Conservation Advice (Threatened Species Scientific Committee 2016) specifies minimum patch sizes based on vegetation condition as follows:

- Pristine - no minimum patch size
- Excellent – 0.5 ha
- Very Good – 1 ha
- Good – 2 ha.

To be considered a MNES protectable under the EPBC Act, a Banksia woodland patch the must meet at least the 'Good' condition category as outlined in the Conservation Advice (Threatened Species Scientific Committee 2016). Based on the condition and size of the patch mapped and grouped within the Banksia woodland present adjacent to the project area, the entire patch (37 ha) and the Banksia woodland within both the study area and project area are considered eligible for inclusion as the TEC.

4.2.3.3 Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain TEC

The primary defining feature of the Tuart woodlands and forests TEC, is the presence of *Eucalyptus gomphocephala* (Tuart) in the uppermost canopy (DEE 2019b). The ecological community intergrades and/or interacts with other ecological communities of the Swan Coastal Plain, including the Banksia woodlands of the Swan Coastal Plain TEC, where tuart occurs as an occasional emergent above a stratum dominated or co-dominated by Banksia species *including Banksia attenuata, B. menziesii*, *B. prionotes* or *B. ilicifolia* (DEE 2019b).

Tuart Woodland and Forests Characterisation

All of the sampled quadrats within the mapped vegetation unit, EmBaAfLOF, were characterised using a checklist developed based on the Conservation Advice (DEE 2019b). The checklist includes the key characteristics of the TEC, including botanical region, soil and landform types and required or typical species for each stratum (**Table 14**).

Table 14 - Tuart Woodland TEC Characterisation of the Recorded Quadrats

Key Character (see key)	Plot/Quadrat No.		
	CC01	CC02	CC03
a).	+	+	+
b).	+	+	+
c).	+		
d).	+	+	+
e).	+	+	+
f).	+	+	+
Confirmed	**+**		

Key:

a) Swan Coastal Plain bioregion

b) Soils and landform either Spearwood or Quindalup dune systems, occasionally occurring on Bassendean dunes and Pinjarra plains

c) Contains a minimum of two *Eucalyptus gomphocephala* (Tuart) situated within 60 m of each tree's canopies

d) Occurs as woodland but can occur as forest, open forest, open woodland and various mallee forms

e) Other tree species include: *Agonis flexuosa, Banksia grandis, Banksia attenuata, Eucalyptus marginata,* less commonly *Corymbia calophylla, Banksia menziesii, Banksia prionotes.*

f) Understorey is structurally variable. Common species include: *Hardenbergia comptoniana*, *Daucus glochidiatus* and *Trachymene pilosa* (although can be without)

Tuart Woodlands and Forests Extent

The confirmed extent of Tuart woodlands and forests TEC within the study area was determined to be all areas containing a continuous Tuart canopy (incorporating a 30 m buffer around each of the canopies) within the remnant native vegetation present (EmBaAfLOF), as presented in **Figure 14**.

Tuart Woodlands and Forests Patch

The Tuart woodlands and forests TEC patch within the project area has been classified in accordance with the methodologies and requirements described in the approved Conservation Advice (DEE 2019b). The key characteristics for an area to be considered for inclusion into the patch is the presence of Tuarts in the upper canopy and no more than 60 m distance between the canopy of two trees (which allows for a 30 m buffer around each canopy).

A review of DBCA TEC and PEC database and the EPBC PMST identified the Tuart woodlands and forests TEC as occurring and extending beyond the boundary of the study area (**Figure 8**). Confirmation of the occurrence of the Tuart woodland and Forest outside the study area was beyond the scope of the current study. However, based on the extent of the Tuart woodland and forest TEC as defined by FVC for within the study area, combined with the extent of the TEC as per the DBCA dataset, the Tuart woodlands and forests TEC patch has been inferred (**Figure 15**). This inference has determined that medium-sized Tuart woodland and forest TEC patch of 26 ha exists around the project.

Tuart Woodlands and Forests Condition

Within the project area, the area of Tuart woodlands and forests (the majority of the study area) ranges from 'Degraded – Completely Degraded' to 'Good' condition, in accordance with an adaptation of the Keighery (1994) and Trudgen (1991) condition scales. Within the adjoining Tuart woodlands and forests patch, a conservative average condition across the patch of 'Good' is considered applicable.

Tuart Woodlands and Forests Woodland Patch and Condition Threshold

The grouping of the area of Tuart woodlands and forest within and surrounding the project area resulted in a single medium-sized patch of 26 ha. The Conservation Advice (DEE 2019b) specifies requirements for information on condition of the patch, in order to determine whether it is considered part of the nationally protected ecological community. The following criteria apply to the patch:

- <0.5 ha – NOT part of the nationally protected ecological community
- At least 0.5 ha to <5 ha - patches in this range are presumed to be part of the nationally protected ecological community unless they do not meet the minimum condition (across the patch)
- ≥5 ha – that meet the key diagnostic characteristics are part of the nationally protected ecological community (DEE 2019b).

The conservation advice (DEE 2019b) states that all patches ≥5 ha are part of the nationally protected ecological, regardless of their understorey condition. Threshold conditions do not apply as long as the vegetation meets the key diagnostic characteristics and patch definition.

Based on this and DBCA database search results adjacent to the study area, the entire patch (26 ha) to considered to be representative of the Tuart woodland and forests TEC.

Figure 14 - Tuart Woodlands and Forests Extent

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Figure 15 - Tuart Woodlands and Forests Patch

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5. DISCUSSION

5.1 FLORA

A total of 70 flora species were recorded during the survey which comprised of 56 (80%) native species and 14 (20%) introduced (weed) species. The dominant families were found to be Fabaceae (12 taxa), Asparagaceae (eight taxa) and Asteraceae (seven taxa). Due to the degraded nature of the majority of the study area, the vegetation quadrats sampled to define the small area of 'Good' condition vegetation were established within 'Good' or better condition outside of the study area. Despite the better condition of the vegetation in the areas where quadrats were sampled, a relatively large proportion of weeds were recorded. The large proportion of weeds can be attributed to the close proximity of the study area to existing disturbances, such as roads, cleared parkland, recreation areas and the existing disturbance to the adjacent road verge along Bibra Drive.

No species listed as Threatened flora under the BC Act or under the EPBC Act were recorded and none of the recorded flora species are listed by DBCA as Priority flora. The study area is however, considered to potentially be suitable habitat for a number of Threatened and Priority Flora, based on habitat preferences and the habitat provided by the study area. Suitable habitat for the Threatened flora species, *Caladenia huegelii* is considered to be present within the study area. This species is known from several populations within the City of Cockburn, with the closest know occurrence 1.2 km north-east of the study area. One Priority 3 flora (species not disclosed) was identified from DBCA database searches as occurring approximately 200 m west of the study area.

A selective targeted survey for *Caladenia huegelii* and other Threatened and Priority flora was carried out as part of the assessment. The small proportion of better quality vegetation within the study area has been collectively inspected over numerous field assessments conducted by FVC (six separate visits to the site by experienced ecological assessors for the flora and vegetation assessment and other related assessments) throughout spring 2019 which has contributed to a significant inspection of the full study area extent, with no evidence of conservation-significant flora species. *Caladenia huegelii* and other conservation significant species could occur at the site, since suitable habitat is present, although none were observed during the multiple field surveys and it is considered unlikely that any flora of conservation significance occur.

None of the recorded flora are exhibiting an extension beyond their currently documented range, in accordance with records of the Western Australian Herbarium (DBCA 2019b).

One recorded weed species **Asparagus asparagoides* (Bridal Creeper) is a Weed of National Significance and is listed as a Declared Pest plant within the City of Cockburn under the *Biosecurity and Agriculture Management Act 2007*. Bridal creeper is listed as a prohibited plant in Western Australia and cannot be brought into the state (DEE 2019d). It is regarded as one of the worst weeds in Australia due to its invasiveness, potential to spread and economic and environmental impacts (DEE 2019d).

5.2 VEGETATION

One intact vegetation unit (EmBaAfLOF) was recorded across the study area, described from three quadrats as:

> *Eucalyptus marginata* and *Banksia attenuata* Low Woodland over *Macrozamia riedlei, Hibbertia hypericoides, Gompholobium tomentosum and Bossiaea eriocarpa* Low Open Forest/Woodland.

The intact vegetation unit was analysed in relation to species presence/absence and landform/soil types, in comparison to the Gibson *et. al.* (1994) dataset using PATN™ analysis, in order to assign FCTs, which has identified that the vegetation unit (EmBaAfLOF) is representative of FCT SCP 28.

The single described and mapped vegetation unit and the FCT it represents (SCP 28) is considered representative of the Endangered Banksia woodlands TEC and the Critically Endangered Tuart woodlands and forests TEC.

The condition of the vegetation within the study area was found to range from 'Completely Degraded' to 'Good', with the majority in 'Degraded' condition. Areas of better quality vegetation exist towards the western edge of the study area. A large proportion of the eastern side of the study area has been extensively cleared, with numerous walk tracks meandering through the site. And adjacent to the cleared areas, vegetation is in much poorer condition, likely attributable to the proximity of edge effects from current activities and infrastructure, including existing roads, tracks, parklands and recreation.

5.3 THREATENED ECOLOGICAL COMMUNITIES

A review of the DBCA TEC and PEC database and the EPBC PMST identified the presence of two Commonwealth-listed TEC's as occurring within or within close proximity to the study area, these being:

- *Banksia Woodlands of the Swan Coastal Plain IBRA Region ecological community* (Banksia woodlands TEC) (Endangered)
- *Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain* ecological community' (Tuart Woodlands and Forests TEC) (Critically Endangered).

Floristic and multivariate cluster analysis of recorded quadrat data against the Gibson *et. al.* (1994) dataset for species presence/absence in PATN™ was conducted in order to assign FCTs to the vegetation. The results of the analysis determined that vegetation unit (EmBaAfLOF) is representative of FCT SCP 28, with some affinity also to FCT 21a and FCT 24. This indicates that these FCTs (SCP 28, 21a and 24) have some species affinity to each other, with similar species composition.

Further interrogation of each FCT, identified that the vegetation was representative of SCP28. It was not considered to be representative of SCP21a or SCP24 due to soil type, location and dominant species.

FCT SCP 28; Spearwood *Banksia attenuata* or *Banksia attenuata - Eucalyptus woodlands*, is considered to be representative of the Banksia Woodland TEC and the Tuart Woodlands and Forests TEC, as discussed in **Section 2.6**. The Tuart woodlands and forest TEC intergrades and/or interacts with other ecological communities of the Swan Coastal Plain, including the Banksia Woodlands TEC, where Tuart occurs as an occasional emergent above a stratum dominated or co-dominated by Banksia species including *B. attenuata, B. menziesii*, *B. prionotes* or *B. ilicifolia* (DEE 2019b).

7. CONCLUSIONS

The key findings of the flora and vegetation assessment within the study area are as follows:

- No flora of conservation significance was recorded during the field assessments, despite extensive traverses and assessment within the study area across multiple site visits during spring 2019.
- One intact vegetation unit, EmBaAfLOF, was described and mapped within the study area and defined as a Banksia Woodland, and representative of FCT SCP 28 (Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus* woodlands), which is considered to be representative of the Banksia woodland TEC and the Tuart woodlands and forest TEC.
- Three targeted quadrats sampled within areas of intact remnant native vegetation adjacent to the study area, supporting vegetation unit EmBaAfLOF, have been confirmed to be representative of the Banksia woodland TEC.
- One targeted quadrat (CC01) within areas of intact remnant native vegetation adjacent to the study area, supporting vegetation unit EmBaAfLOF has been confirmed to be representative of the Tuart woodland and forest TEC.
- The Banksia woodland within and surrounding the study area is part of a medium-sized patch of 37 ha.
- The Tuart woodland and forest within and surrounding the study area is part of a medium-sized patch of 26 ha.
- The Banksia woodland and Tuart woodlands and forests TEC vegetation within the project area is in mostly 'Degraded' or 'Degraded – Good' condition and based on the condition and size of the patches mapped for each TEC, in accordance with the respective conservation advice, a large proportion of the vegetation within the study area is considered eligible as both TECs.

8. LIST OF PARTICIPANTS

The personnel who contributed to the project are summarised in **Table 15**.

Table 15 - Project Team

Name	Qualification	Years of Relevant Experience	Role
Kellie Bauer–Simpson Principal Ecologist	BSc. (Biological Science)	20	Project manager, initial field inspection, report technical and authorisation review
Lisa Chappell Senior Botanist/Environmental Scientist	BEnvSc. (Hons) (Environmental Science)	15	Flora and vegetation field assessment, data analysis, GIS mapping, report preparation
Adrian Barrett Botanist/Ecologist	BSc. (Biology)(Hons)	6	Flora and vegetation field assessment, PATN analysis, report preparation
Will Bauer–Simpson Technician/Advisor	Cert IV (Health and Safety)	7	GIS mapping, spatial data management, report figures

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APPENDIX A - DBCA NATUREMAP SEARCH REPORT

NatureMap Species Report

Created By Guest user on 02/09/2019

Kingdom Plantae
Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 49' 12" E,32° 05' 24" S
Buffer 5km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	14932	*Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)*		P1	
2.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
3.	16245	*Cyathochaeta teretifolia*		P3	
4.	7485	*Dampiera triloba*		P3	
5.	10796	*Diuris drummondii (Tall Donkey Orchid)*		T	
6.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
7.	20462	*Jacksonia gracillima*		P3	
8.	4027	*Jacksonia sericea (Waldjumi)*		P4	
9.	33742	*Microtis quadrata*		P4	
10.	11557	*Phlebocarya pilosissima subsp. pilosissima*		P3	
11.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
12.	25800	*Stylidium paludicola*		P3	
13.	48297	*Styphelia filifolia*		P3	
14.	1717	*Thelymitra variegata (Queen of Sheba)*		P2	

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

APPENDIX B – EPBC PROTECTED MATTERS SEARCH REPORT

Australian Government
Department of the Environment and Energy

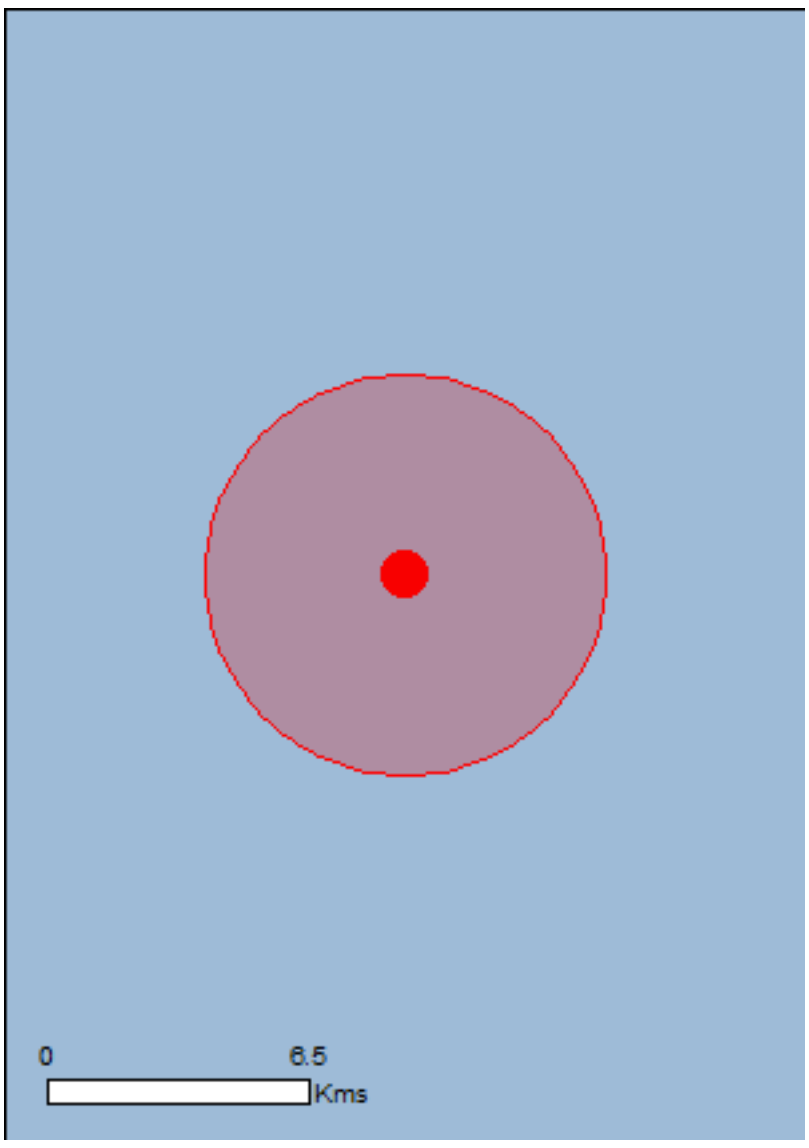
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

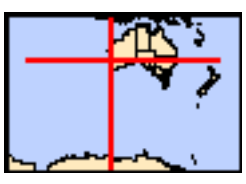
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/09/19 17:41:39



Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	21
Listed Migratory Species:	19

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	28
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	38
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within 10km of Ramsar

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Mammals		

Name	Status	Type of Presence
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei		
Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica		
Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis keigheryi		
Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Lepidosperma rostratum		
Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696)		
Selena's Synaphea [82881]	Critically Endangered	Species or species habitat may occur within area
Thelymitra dedmaniarum		
Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]		
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Sterna dougallii		
Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		

Name	Threatened	Type of Presence
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Thomsons Lake	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss,		Species or species

Name	Status	Type of Presence
Kariba Weed [13665] Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		habitat likely to occur within area Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.09 115.82

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX C – FLORA SPECIES BY QUADRAT

*denotes introduced (weed) species

Family		Species	Quadrat		
			CC01	CC02	CC03
Apiaceae		*Daucus glochidiatus*	+	+	+
Apiaceae		*Eryngium pinnatifidum* subsp. *pinnatifidum*		+	
Araliaceae		*Trachymene pilbarensis*		+	
Araliaceae		*Trachymene pilosa*			+
Asparagaceae	*	*Asparagus asparagoides*	+		
Asparagaceae		*Chamaescilla corymbosa*	+	+	+
Asparagaceae		*Dianella revoluta*	+	+	
Asparagaceae		*Lomandra caespitosa*	+		
Asparagaceae		*Lomandra hermaphrodita*		+	+
Asparagaceae		*Lomandra preissii*		+	
Asparagaceae		*Sowerbaea laxiflora*	+		+
Asparagaceae		*Thysanotus manglesianus*	+	+	+
Asteraceae	*	*Conyza* sp.	+		+
Asteraceae	*	*Hypochaeris glabra*	+	+	+
Asteraceae		*Lagenifera huegelii*		+	+
Asteraceae		*Podolepis gracilis*			+
Asteraceae		*Senecio condylus*	+		+
Asteraceae	*	*Sonchus oleraceus*	+		
Asteraceae	*	*Ursinia anthemoides*	+	+	+
Caryophyllaceae	*	*Silene gallica*		+	
Casuarinaceae		*Allocasuarina fraseriana*		+	
Colchicaceae		*Burchardia congesta*	+	+	+
Crassulaceae		*Crassula colorata*	+	+	+
Cyperaceae		*Cyathochaeta avenacea*	+	+	+
Cyperaceae	*	*Isolepis marginata*	+	+	+
Cyperaceae		*Lepidosperma pubisquameum*		+	+
Cyperaceae		*Lepidosperma squamatum*	+	+	+
Cyperaceae		*Mesomelaena pseudostygia*	+	+	
Dilleniaceae		*Hibbertia huegelii*		+	
Dilleniaceae		*Hibbertia hypericoides*	+	+	+
Droseraceae		*Drosera stolonifera*		+	+
Ericaceae		*Conostephium pendulum*	+		
Ericaceae		*Leucopogon propinquus*		+	
Fabaceae		*Acacia huegelii*		+	

Family		Species	Quadrat		
			CC01	CC02	CC03
Fabaceae		*Acacia saligna*		+	
Fabaceae		*Acacia stenoptera*		+	
Fabaceae		*Bossiaea eriocarpa*		+	+
Fabaceae		*Daviesia nudiflora*		+	
Fabaceae		*Gastrolobium capitatum*	+	+	
Fabaceae		*Gastrolobium villosum*			+
Fabaceae		*Gompholobium tomentosum*	+	+	+
Fabaceae		*Hardenbergia comptoniana*	+	+	+
Fabaceae		*Hovea trisperma*	+		+
Fabaceae		*Jacksonia furcellata*	+		
Fabaceae		*Kennedia prostrata*			+
Geraniaceae	*	*Pelargonium capitatum*		+	
Goodeniaceae		*Scaevola canescens*	+		
Haemodoraceae		*Conostylis aculeata*		+	+
Haemodoraceae		*Conostylis juncea*	+		
Iridaceae	*	*Freesia alba* x *leichtlinii*	+		
Iridaceae	*	*Gladiolus caryophyllaceus*	+	+	+
Juncaceae		*Luzula meridionalis*		+	+
Myrtaceae		*Corymbia calophylla*		+	
Myrtaceae		*Eucalyptus gomphocephala*	+		
Myrtaceae		*Eucalyptus marginata*	+	+	+
Myrtaceae		*Hypocalymma robustum*	+	+	+
Orchidaceae		*Caladenia flava*	+	+	+
Orchidaceae		*Caladenia* sp.		+	
Oxalidaceae	*	*Oxalis pes-caprae*	+		
Papaveraceae	*	*Fumaria capreolata*		+	
Poaceae	*	*Briza maxima*	+	+	
Poaceae	*	*Ehrharta calycina*	+	+	+
Proteaceae		*Banksia attenuata*	+	+	+
Proteaceae		*Banksia menziesii*		+	
Proteaceae		*Petrophile linearis*		+	
Restionaceae		*Desmocladus flexuosus*		+	+
Rubiaceae		*Opercularia vaginata*		+	
Thymelaeaceae		*Pimelea rosea*		+	+
Xanthorrhoeaceae		*Xanthorrhoea preissii*	+	+	+
Zamiaceae		*Macrozamia riedlei*	+	+	+

APPENDIX D – VEGETATION QUADRAT DATA

Site CC01

Date	13/09/2019
Botanist	Adrian Barrett and Lisa Chappell
Quadrat Size	10 x 10 m
NW Corner Coordinates	388646 mE 6449121 mN
Vegetation Unit	EmBaAfLOF - *Eucalyptus marginata* and *Banksia attenuata* Low Woodland over *Macrozamia riedlei, Hibbertia hypericoides, Gompholobium tomentosum and Bossiaea eriocarpa* Open Shrubland
Slope	Flat
Landform	Lower Slope
Soil Colour	Grey/white
Soil Type	sand
Litter	5%
Bare Ground	3%
Fire Age	1-3yrs
Vegetation Condition	Good - Very Good
Disturbances/Impacts	weeds, possible dieback, human disturbances

Species	Height (m)	% Cover
Eucalyptus marginata	8	6
Banksia attenuata	6	20
Jacksonia furcellata	2.2	2
Macrozamia riedlei	1.4	9
Ehrharta calycina	1.2	10
Hibbertia hypericoides	1	7
**Ursinia anthemoides*	0.2	3
**Hypochaeris glabra*	0.02	20
Hardenbergia comptoniana	Climber	4
**Asparagus asparagoides*		+
**Briza maxima*		+
Burchardia congesta		+
Caladenia flava		+
Chamaescilla corymbosa		+
**Conyza* sp.		+
Crassula colorata		+
Cyathochaeta avenacea		+
Daucus glochidiatus		+
Dianella revoluta		+
**Freesia alba x leichtlinii*		+
**Gladiolus caryophyllaceus*		+
Gompholobium tomentosum		+
Hovea trisperma		+
Hypocalymma robustum		+
Indet. weed		+
Isolepis marginata		+
Lomandra caespitosa		+
Mesomelaena pseudostygia		+
**Oxalis pes-caprae*		+
Scaevola canescens		+
Senecio condylus		+
**Silene gallica*		+
**Sonchus oleraceus*		+
Sowerbaea laxiflora		+
Thysanotus manglesianus		+
Xanthorrhoea preissii		+
Eucalyptus gomphocephala		Associated
Conostephium pendulum		Associated
Conostylis juncea		Associated
Gastrolobium capitatum		Associated
Lepidosperma squamatum		Associated

Site CC02

Date	13/09/2019
Botanist	Adrian Barrett and Lisa Chappell
Quadrat Size	10 x 10 m
NW Corner Coordinates	388609 mE 6449148 mN
Vegetation Unit	EmBaAfLOF - *Eucalyptus marginata* and *Banksia attenuata* Low Woodland over *Macrozamia riedlei, Hibbertia hypericoides, Gompholobium tomentosum and Bossiaea eriocarpa* Open Shrubland
Slope	Flat
Landform	Mid Slope
Soil Colour	Pale yellow/white
Soil Type	sand
Litter	10%
Bare Ground	3%
Fire Age	3-5yrs
Vegetation Condition	Very Good
Disturbances/Impacts	weeds

Species	Height (m)	% Cover
Banksia attenuata	10	13
Eucalyptus marginata	6	20
Macrozamia riedlei	1	2
Hibbertia hypericoides	0.8	16
Gompholobium tomentosum	0.7	6
Mesomelaena pseudostygia	0.6	4
Lepidosperma squamatum	0.5	8
**Ehrharta calycina*	0.5	15
Acacia huegelii		+
Acacia stenoptera		+
Bossiaea eriocarpa		+
**Briza maxima*		+
Burchardia congesta		+
Caladenia flava		+
Caladenia sp.		+
Chamaescilla corymbosa		+
Conostylis aculeata		+
Crassula colorata		+
Cyathochaeta avenacea		+
Daucus glochidiatus		+
Daviesia nudiflora		+
Desmocladus flexuosus		+
Dianella revoluta		+
Drosera stolonifera		+
**Fumaria capreolata*		+
Gastrolobium capitatum		+
**Gladiolus caryophyllaceus*		+
Hardenbergia comptoniana		+
Hypocalymma robustum		+
**Hypochaeris glabra*		+
Isolepis marginata		+
Lagenifera huegelii		+
Lepidosperma pubisquameum		+
Leucopogon propinquus		+
Lomandra hermaphrodita		+
Lomandra preissii		+
Luzula meridionalis		+
**Pelargonium capitatum*		+
Pimelea rosea		+
**Silene gallica*		+
Thysanotus manglesianus		+
Trachymene pilbarensis		+
**Ursinia anthemoides*		+
Acacia saligna		Associated

Species	Height (m)	% Cover
Allocasuarina fraseriana		Associated
Banksia menziesii		Associated
Corymbia calophylla		Associated
Hibbertia huegelii		Associated
Petrophile linearis		Associated
Xanthorrhoea preissii		Associated

Site CC03

Date	13/09/2019
Botanist	Adrian Barrett and Lisa Chappell
Quadrat Size	10 x 10 m
NW Corner Coordinates	388570 mE 6449144 mN
Vegetation Unit	EmBaAfLOF - *Eucalyptus marginata* and *Banksia attenuata* Low Woodland over *Macrozamia riedlei, Hibbertia hypericoides, Gompholobium tomentosum and Bossiaea eriocarpa* Open Shrubland
Slope	Flat
Landform	Mid Slope
Soil Colour	Grey/white
Soil Type	sand
Litter	10%
Bare Ground	3%
Fire Age	1-3yrs
Vegetation Condition	Good -Very Good
Disturbances/Impacts	weeds, possibly dieback, human disturbances, rabbits

Species	Height (m)	% Cover
Eucalyptus marginata	11	12
Banksia attenuata	6	6
Xanthorrhoea preissii	1	2
Macrozamia riedlei	1	3
Gompholobium tomentosum	0.8	8
Hibbertia hypericoides	0.7	7
Bossiaea eriocarpa	0.6	3
Hardenbergia comptoniana	Climber	6
Burchardia congesta		+
Caladenia flava		+
Chamaescilla corymbosa		+
Crassula colorata		+
Conostylis aculeata		+
**Conyza* sp.		+
Cyathochaeta avenacea		+
**Daucus glochidiatus*		+
Desmocladus flexuosus		+
Drosera stolonifera		+
**Ehrharta calycina*		+
Gastrolobium villosum		
**Gladiolus caryophyllaceus*		+
Hovea trisperma		+
Hypocalymma robustum		+
**Hypochaeris glabra*		+
Isolepis marginata		+
Kennedia prostrata		+
Lagenifera huegelii		+
Lepidosperma pubisquameum		+
Lepidosperma squamatum		+
Lomandra hermaphrodita		+
Luzula meridionalis		+
Pimelea rosea		+
Podolepis gracilis		+
Senecio condylus		+
Sowerbaea laxiflora		+
Thysanotus manglesianus		+
Trachymene pilosa		+
**Ursinia anthemoides*		+

APPENDIX E – HABITAT QUALITY SCORE SCALE

Aspect	Description	Potential Scores
Condition	Keighery (1994) average condition rating: • Pristine (4) • Excellent (3) • Very Good (2) • Good (1) • Degraded or poorer (0)	4, 3, 2, 1, or 0, respectively
Context	• Woodland within the site is part of a large patch equal to or greater than 100 ha and is therefore of regional importance (1) • Woodland within the site is not part of patch that is greater than 100 ha (0)	1 or 0, respectively
	• Woodland within the site represents or is part of an isolated patch that is significant in the local region due to being the only representation within a 15 km radius (1) • Woodland within the site does not represent, nor is it part of an isolated patch as there are other representations of Banksia woodland within a 15 km radius (0)	1 or 0, respectively
Stocking rate	Site (or Woodland patch) size: • large (>100 ha) (3) • medium (20-100 ha) (2) • small (1-19 ha) (1) • very small (<1 ha) (0) *OR* Area to boundary ratio: • large (>100:1) (3) • medium (20-100:1) (2) • small (5-100:1) (1) • very small (<5:1) (0)	3, 2, 1, 0, respectively
	Site (or Woodland patch) supports: • one or more floristic community types that are highly restricted, under threat and listed in Western Australia as a TEC or PEC (1) • floristic community types (or one floristic community type) that are not listed in Western Australia as a TEC or PEC (0)	1 or 0, respectively
Total possible score		**10**