COCKBURN CENTRAL EAST LOCAL STRUCTURE PLAN (CCE LSP) AREA, LEVEL 1 FLORA AND FAUNA ASSESSMENT NOVEMBER 2016 AND ADDENDUM - TARGETED CALADENIA HUEGELII SURVEY JANUARY 2018

CITY OF COCKBURN

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Table of Contents

Executive Summary v

1 Introduction 1

1.1 Background 1

1.2 Location 1

1.3 Scope of Work 1

2 Existing Environment 4

2.1 Climate 4

2.2 IBRA Region 4

2.3 Geology and Soils 4

2.4 Vegetation 4

3 Methodology 5

3.1 Desktop Review 5

3.2 Field Assessment 7

3.2.1 Flora and Vegetation Assessment 7

3.2.2 Fauna Assessment 9

4 Results 12

4.1 Desktop Review 12

4.1.1 Significant Species 12

4.1.2 Threatened and Priority Ecological Communities 14

4.1.3 Wetlands 14

4.2 Field Assessments 14

4.2.1 Flora 14

4.2.2 Vegetation 15

4.2.3 Fauna 18

4.2.4 Fauna Habitats 19

4.2.5 Black-cockatoo Habitat Assessment 24

5 Discussion 26

5.1 Flora 26

5.2 Vegetation 28

5.3 Conservation Significant Fauna Species 29

5.3.1 Carnaby's Black-cockatoo 32

5.3.2 Forest Red-tailed Black-cockatoo 33

5.3.3 Rainbow Bee-eater 33
5.3.4 Perth Lined Lerista 34
5.4 Fauna Habitats 34
5.5 Wetlands 35
5.6 Assessment Against the Ten Clearing Principles 36
6 Conclusion and Recommendations 39
7 References 41
Appendix A: NatureMap Species Report A1
Appendix B: EPBC Act Protected Matters (Matters of National Environmental Significance (MNES)) B1
Appendix C: Muir Structural Vegetation Classifications C1
Appendix D: Observed and Potential Fauna Species List D1
Appendix E: Flora Species List (by Community) E1
Appendix F: Site Descriptions F1
Appendix G: Habitat Tree Data G1

Tables

Table 1: Vegetation Condition Scale (adapted from Keighery (1994) and Trudgen (1988)) 8
Table 2: Black-cockatoo Habitats Surveyed 10
Table 3: Summary of Potential Vertebrate Fauna Species 18
Table 4: Summary of Potential Black-cockatoo Habitat Trees (DBH > 500 mm) Recorded 24
Table 5: Likelihood of Occurrence of Threatened and Priority Flora 27
Table 6: Inferred FCTs of the Intact Vegetation Communities Recorded 28
Table 7: Likelihood of Occurrence of Conservation Significant Fauna in the Study Area 31
Table 8: Summary of the Assessment against the Ten Clearing Principles 36

Figures

Figure 1 Study Area 2
Figure 2 CCE LSP Draft Concept 3
Figure 3 Vegetation Communities 16
Figure 4 Vegetation Condition 17
Figure 5 Fauna Habitats 22
Figure 6 Habitat Trees 23
Figure 7 Suggested Alternative Road Alignment 30

EXECUTIVE SUMMARY

Focused Vision Consulting Pty Ltd (FVC) was commissioned during September 2016 by the City of Cockburn (the City) to undertake a Level 1 flora, vegetation and fauna assessment of the Cockburn Central East Local Structure Plan (CCE LSP) area. The survey results are required in order to address the requirements of the Western Australian Planning Commission (WAPC) structure plan framework (WAPC 2015) for the preparation and implementation of the CCE LSP. A total of 31.21 hectares, encompassing a number of lots within the LSP were assessed for flora, vegetation and fauna values.

The biological assessment incorporated both desktop and field assessments of flora, vegetation, fauna and habitat values associated with the CCE LSP area. A single-phase Level 1 flora, vegetation, terrestrial vertebrate fauna and habitat assessment was carried out Kellie Bauer–Simpson (Principal Ecologist) and Greg Harewood (Senior Zoologist) and this report presents the findings of the assessment.

The key ecological values associated with the study area are summarised as follows:

- Several Threatened and Priority flora species were identified during the desktop review as potentially occurring at the site, although none were recorded during the assessment.
- None of the flora species recorded are of any conservation significance.
- Five intact vegetation communities and three degraded vegetation communities were described and mapped within the study area, consisting of four woodlands, two woodland/wetland vegetation types, one heath and one degraded community.
- Areas of Banksia woodland (vegetation communities BaEt and BaXp) are likely to be representative of the newly listed Commonwealth TEC; *Banksia woodlands of the Swan Coastal Plain*.
- Five fauna habitats, consisting of woodlands and woodland/wetlands, one open heath/scrub and degraded areas were described and mapped across the study area.
- Evidence of Threatened Black-cockatoos (Carnaby's Black-cockatoo and Forest Red-tailed Black-cockatoo) was recorded during the site survey, including a direct sighting of Forest Red-tailed Black-cockatoos overflying the site and evidence of both species feeding on native tree fruits.
- Evidence of the Priority 4 species, Southern Brown Bandicoot/Quenda was observed in the form of diggings and this species is likely to inhabit the areas of dense understorey within the Paperbark Woodland/Swamp habitat, as well as probably the Banksia Woodland habitat.
- Rainbow Bee-eater (*Merops ornatus*) was determined to have a moderate likelihood of occurrence in the study area, based on recorded sightings by GHD (2015) and the presence of potentially suitable habitat.
- The site supports a dampland classified as a Multiple Use wetland (UFI 5562).

Below is a summary of the outcomes of the assessment against the ten clearing principles and impact mitigation/management and/or further study recommendations and comments:

- The proposed clearing is at variance with principle 2 (b), due to the presence of suitable foraging habitat and potential breeding habitat for Threatened Black-cockatoos, and likely habitat for the migratory bird species, Rainbow Bee-eater.
    - Impact mitigating recommendations:
        - Avoid or minimise clearing areas of the Banksia Woodland habitat
        - Avoid clearing the habitat tree located at 392497 mE, 6445689 mN

        - Limit ground disturbing activities (clearing and earthworks) to between February and July, which is outside the breeding season for Rainbow Bee-eater.
- The proposed clearing is at variance with principle 6 (f), due to the presence of a wetland at the site.
    - Recommendations:
        - Obtain advice from the Department of Water once concept plans are drafted, in order to achieve environmentally sensitive development in association with the wetland.
- The proposed clearing is likely to be at variance with principle 4 (d), due to the likely presence of the Banksia Woodlands TEC at the site.
    - Recommendations:
        - Undertake a follow-up assessment to confirm the presence and extent of the Banksia Woodland TEC at the site, which will also better inform potential offset requirements.
- The proposed clearing is likely to be at variance with principle 7 (g), due to the likelihood that it will cause appreciable land degradation.
    - Recommendations:
        - Consider options to offset impacts of further degradation by enhancement of areas that are currently degraded and may be retained.
- The proposed clearing may be at variance with principle 9 (i), due to the potential impacts on surface water and groundwater.
    - Impact mitigating recommendations:
        - Minimise the areas of clearing of riparian/wetland vegetation where possible.
        - Ensure suitable drainage features are incorporated into developments to avoid potential adverse impacts from run-off, and on surface and groundwater quality.
- The proposed clearing is unlikely to be, but may be at variance with principle 3 (c), due to the potential (although unlikely) presence of Threatened orchid, *Caladenia huegelii.*
    - Recommendation:
        - Consider a follow-up flora survey during early to mid-September 2017, targeting *Caladenia huegelii*, to further confirm the absence of this species. This assessment could also target other potentially occurring conservation significant flora, in order to ascertain their absence at the site.
- The proposed clearing is unlikely to be, but may be at variance with principle 10 (j), due to the potential (although unlikely) to cause flooding.
    - Recommendation:
        - Ensure suitable drainage features are incorporated into developments to avoid potential flooding.

Avoidance of the majority of the Banksia woodland area, likely to represent the TEC could be achieved by realigning the proposed North Lake Road to Beeliar Drive road alignment. Other currently proposed road alignments are considered well-placed to minimise impacts on areas of best quality vegetation and habitat within the study area.

The DotEE has advised that development of the LSP itself would not require referral, but that any impacts to identified MNES (Banksia Woodland TEC or Black-Cockatoo foraging habitat) by the City of by third parties when developing the site would require referral to the Commonwealth DotEE.

1 INTRODUCTION

1.1 BACKGROUND

Focused Vision Consulting Pty Ltd (FVC) was commissioned during September 2016 by the City of Cockburn (the City) to undertake a Level 1 flora, vegetation and fauna assessment of the Cockburn Central East Local Structure Plan (CCE LSP) area. The survey results are required in order to address the requirements of the Western Australian Planning Commission (WAPC) structure plan framework (WAPC 2015) for the preparation and implementation of the CCE LSP. A total of 31.21 hectares, encompassing a number of lots within the LSP were assessed for flora, vegetation and fauna values, as shown in **Figure 1**.

1.2 LOCATION

The study area is located approximately 20 km south of the Perth CBD, directly adjacent to the Kwinana Freeway on both the western and eastern sides. On the western side of the Freeway, the area is bounded by Kentucky Court and North Lake Road. To the east of the Freeway, the study area is comprised of numerous lots between Cutler Road and Knock Place, Cockburn Central (**Figure 1**).

1.3 SCOPE OF WORK

The scope of work included:

- a desktop study to gather relevant background and biological information on the site
- a field assessment to determine the flora (both native and weeds), vegetation (including condition), vertebrate fauna and habitat values (including habitat trees) associated with the lots
- preparation of a report that summarises the results and includes:
    - a discussion on the results, including records of listed and conservation significant flora, fauna and communities
    - consideration of the findings of the *Wetland Management and Rehabilitation Strategy for Solomon Road Wetland* (Env Australia 2007)
    - incorporation of the findings of the *City of Cockburn North Lake Road Extension Ecological Assessment* (GHD 2015)
    - a discussion on the relevant considerations, including mitigations of the road layout and relevant lot location, considering of the draft concept identified within **Figure 2**.

The scope includes a Level 1 flora, vegetation and fauna assessment, carried out in accordance with:

- EPA (2014a) Guidance Statement 51, *Guidance for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*
- EPA & DPaW (2015) *Technical Guide for Flora and Vegetation Surveys for Environmental Impact Assessment*
- EPA (2014b) Guidance Statement 56, *Guidance for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*
- EPA & DEC (2010) *Technical Guide for Terrestrial Vertebrate Fauna Surveys*
- DSEWPaC (2012) *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered)* Calyptorhynchus latirostris; *Baudin's cockatoo (vulnerable)* Calyptorhynchus baudinii; *Forest red-tailed black cockatoo (vulnerable)* Calyptorhynchus banksii naso.

Figure 1 - Survey Area

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Figure 2 CCE LSP Draft Concept

2 EXISTING ENVIRONMENT

2.1 CLIMATE

The Swan Coastal Plain has a warm Mediterranean climate which is characterised by hot dry summers and cool to mild wet winters (Mitchell *et al.,* 2002). Jandakot Airport (009172) is the closest meteorological recording station to Cockburn Central and has recorded an average annual rainfall of 824 mm (BoM, 2016).

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 study area lies within the Swan Coastal Plain IBRA region and, at a finer scale, within the Perth subregion (Mitchell *et al.* 2002).

2.3 GEOLOGY AND SOILS

The study area lies within the Bassendean Dune System which consists of very old leached sands to various depths (GHD 2015) and are the oldest of the three dunes systems occurring on the Swan Coastal Plain. Sands within this system contain very little silt or clay and very low levels of nutrient elements (ESWA 2016).

Soils within the study area are mapped as three sub units of the Bassendean System (Schoknecht *et. al.* 2004). They are described as:

- 212Bs_B1 - Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with pale yellow B horizon
- 212Bs_B2 – Flat to very gently undulating sandplain with well to moderate well drained deep bleached grey sands with a pale yellow B horizon or weak iron organic hardpan
- 212Bs_B4 – Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depth generally greater than 1.5 m by clay or less frequently a strong iron organic hardpan.

2.4 VEGETATION

The study area is located on the Swan Coastal Plain and has been broadly characterised by Beard (1990) as "e2Mb cbLi - Medium very sparse woodland; jarrah, with low woodland; Banksia and Casuarina (Association 1001)".

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).

Vegetation complexes within the study area have been defined by Heddle *et al.* (1980) and are based on vegetation in association with landforms and underlying geology. One vegetation complex Bassendean *complex – central and south* as described by Heddle *et al.* (1980) occurs within the study area. This complex ranges from woodlands of *Eucalyptus marginata, Allocasuarina* and *Banksia* on sand dunes to a low woodland of *Melaleuca* species, and sedge lands on the low-lying depressions and swamps.

3 METHODOLOGY

The biological assessment incorporated both desktop and field assessments of flora, vegetation, fauna and habitat values associated with the CCE LSP area (**Figure 1**). A single-phase Level 1 flora, vegetation, terrestrial vertebrate fauna and habitat assessment was carried out Kellie Bauer–Simpson (Principal Ecologist) and Greg Harewood (Senior Zoologist) on 27 September, with a follow-up visit on 29 September 2016.

The assessments were carried out in accordance with all relevant legislation, including EPA policies, guidance statements and regulations relating to flora and fauna assessments in Western Australia, including:

- EPA (2002) Position Statement 3: *Terrestrial Biological Surveys as an Element of Biodiversity*
- EPA (2014a) Guidance Statement 51, *Guidance for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*
- EPA & DPaW (2015) *Technical Guide for Flora and Vegetation Surveys for Environmental Impact Assessment*
- EPA (2014b) Guidance Statement 56, *Guidance for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*
- EPA & DEC (2010) *Technical Guide for Terrestrial Vertebrate Fauna Surveys.*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Wildlife Conservation Act 1950* (WC Act).

3.1 DESKTOP REVIEW

A review of publicly available information and site-specific information provided by the City was undertaken. The information reviewed included:

- DPaW NatureMap Species Report (**Appendix A**); generated on 26 September 2016, providing:
    - flora and fauna species listed as rare (Threatened (T)) or likely to become extinct
    - flora and fauna species protected under international agreements (IA)
    - other specially protected fauna (Scheduled)
    - flora and fauna species listed as Priority 1 to 5 (P1, P2, P3, P4, P5)
    - other non-conservation taxa recorded or know to the area.
- EPBC Act Protected Matters (Matters of National Environmental Significance (MNES)) (**Appendix B**); search for the project area; generated on 26 September 2016, providing results relevant to:
    - the following MNES:
        - World Heritage Properties
        - National Heritage Places
        - Wetlands of International Importance
        - Great Barrier Reef Marine Park
        - Commonwealth Marine Areas
        - Listed Threatened Ecological Communities (TECs)
        - Listed Threatened Species (flora and fauna)
        - Listed Migratory Species
    - the following other matters protected by the EPBC Act:
        - Commonwealth Land
        - Commonwealth Heritage Places
        - Listed Marine Species
        - Whales and other Cetaceans

    - Critical Habitats
    - Commonwealth Reserves (Terrestrial)
    - Commonwealth Reserves (Marine).
- spatial data provided the City of Cockburn for:
    - known or previously recorded occurrences of Threatened flora across the entire City
    - regional data for geomorphic wetlands
- DPaW database search results for:
    - Threatened and Priority flora, searched for within a 5 km buffer of the study area
    - Threatened, Priority and conservation significant vertebrate fauna, searched for within a 3 km buffer of the study area
    - Threatened and Priority Ecological Communities, searched for within a 5 km buffer of the study area (*results not yet received at time of issue of this draft report*)
- relevant technical reports:
    - GHD (2015) North Lake Road Extension Ecological Assessment. Unpublished report for the City of Cockburn.
    - ENV Australia (2007) Wetland Management and Rehabilitation Strategy – Solomon Road Wetland. Unpublished report for the City of Cockburn.
    - 360 Environmental (2012). Lots 124 and 125 Frankland Avenue Hammond Park: Graceful Sun Moth Survey & Site Based (Lomandra) Habitat Assessment. Report prepared for WorldStyle Furniture Wholesaler, Perth.
    - Bamford Consulting Ecologists (2011). Threatened Fauna Assessment: Lots 42-44 Frankland Road, Hammond Park. Report prepared for Bayley Environmental Services.
    - Bamford Consulting Ecologists (2012). Lot 123 Wattleup Road, Hammond Park. Significant Fauna Assessment. Report prepared for Bayley Environmental Services.
    - Ecoscape (2009). Fauna Survey for Lots 13, 14 and 18 Barfield Road and Lots 48-51 Rowley Road, Hammond Park. Unpublished report for Gold Estates and the Department of Housing.
    - Emerge Associates (Emerge) (2011). Level 1 Fauna Survey and Habitat Assessment - Various Allotments, Mandogalup. Unpublished report prepared for Qube Mandogalup Land Development Company.
    - ENV (2009). Jandakot Airport Fauna Survey. Unpublished report for Jandakot Airport Holdings Pty Ltd.
    - GHD (2012). Report for Hammond Park Primary School. Flora and Fauna Assessment. Unpublished report for the Department of Education.
    - Harewood, G. (2005). Fauna Assessment, Mandogalup. Unpublished report for Cardno BSD.
    - Harewood, G. (2006). Fauna Assessment, Lot 121 Wattleup Road, Wattleup. Unpublished report for Cardno BSD.
    - Harewood, G. (2009). Fauna Survey (Level 2) East Rockingham WWTP Site & Pipeline Corridors. Unpublished report for ERM.
    - Harewood, G. (2011a). Fauna Assessment Lot 9001 and Lot 35 Barfield Road, Hammond Park. Unpublished report for Mainlake Holdings Pty Ltd.
    - Harewood, G. (2011b). Fauna Underpass Monitoring Spring 2010 – Perth Mandurah Rail Line. Unpublished report for the Public Transport Authority of Western Australia.
    - Harewood, G. (2014a). Fauna Assessment of Lot 33 Barfield Road, Hammond Park. Unpublished report for West Coast Plan (on behalf of the Passione Family).
    - Harewood, G. (2014b). Fauna Assessment of Lots 109 and 110 Wattleup Road, Hammond Park. Unpublished report for Emerge Associates.

- Harewood, G. (2014c). Fauna Assessment of Lots 1, 111 & 810 Wattleup Road, Hammond Park. Unpublished report for Emerge Associates.
- Phoenix Environmental Sciences (2011). Vertebrate Fauna Survey for the Roe Highway Extension Project. Unpublished report for South Metro Connect.
- Strategen (2013). Mandogalup Black Cockatoo Habitat Survey. Unpublished Report for Satterley Property Group.
- Terrestrial Ecosystems (2012). Level 1 Fauna Assessment for Hammond Park Primary School. Unpublished report for Taylor Robinson.

Species lists produced from the abovementioned literature reviews contain observations/inferred distributions from a broader area than the subject site and therefore may include fauna species that would only ever occur as vagrants. The databases also often include or are based on very old records and in some cases, certain flora and fauna species have become locally or regionally extinct. Database errors and anomalies exist also, for example, results returned from DPaW for the Threatened and Priority Flora database search included a result for a Threatened species that occurs at Mt Success on the south coast of Western Australia, which has been confused with the locality of Success, within which some of the study area occurs.

Information from these sources is therefore only taken as indicative and local knowledge and information is taken into consideration when determining what actual species may be present within the specific area being investigated. Species considered errors or unlikely to be present even if resulting from database searches are not shown in the potential species lists or results.

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

3.2 FIELD ASSESSMENT

3.2.1 Flora and Vegetation Assessment

The single-phase Level 1 field flora and vegetation assessment was undertaken by Principal Ecologist, Kellie Bauer-Simpson on 27 and 29 September 2016, utilising non-permanent quadrats to characterise vegetation where it was determined to be in good or better condition. Observations and opportunistic data collection was also carried out continuously within and throughout the study area with a particular focus on Threatened and Priority flora and ecological communities, potentially supported by the sites.

Field data was collected from five quadrats, representing of each of the intact vegetation communities present. Each quadrat was recorded in accordance with Guidance Statement 51 to collect information to define the vegetation communities and the floristic diversity. Site-specific data was also collected from relevés in areas in poorer condition than good, to define the degraded vegetation types present.

The vegetation communities present within the study area was described to National Vegetation Information System (NVIS) Level 5, in accordance with the applicable methodologies (DEH 2003) in combination with the Muir (1977) Structural Vegetation Classifications (**Appendix C**).

The condition of the vegetation was documented at each quadrat and relevé and at appropriate locations between, in accordance with the Vegetation Condition Scale adapted from Keighery (1994) and Trudgen (1988), and as per the Technical Guide for Flora and Vegetation Assessments (EPA & DPaW 2015) (**Table 1**).

Table 1: Vegetation Condition Scale (adapted from Keighery (1994) and Trudgen (1988))

Vegetation Condition Rating	Description (for South West and Interzone Botanical Provinces)	Former Rating Category (Keighery 1994)
1	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	Pristine
2	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Excellent
3	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Very Good
4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Good
5	*NA for South West and Interzone Botanical Provinces*	NA
6	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Degraded
7	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Completely Degraded

Flora identifications were undertaken by specialist taxonomist, Udani Sirisena. Plant group specialist taxonomists may be consulted if required for challenging identifications. Taxonomy and nomenclature will follow current protocols of the WA Herbarium. The data processing task allows for the preparation of species lists, including those for collected flora specimens, once identified.

The spatial extent of each of the observed vegetation communities, varying vegetation condition within the site were mapped using an electronic tablet equipped with the mobile mapping software, MAPPT ™, using a customised data collection form, digitising spatial extents onto georeferenced aerial imagery and recording other information including geo-tagged photographs.

3.2.2 Fauna Assessment

A day time Level 1 fauna assessment was conducted by Senior Zoologist Greg Harewood, on 27 September 2016, in accordance with EPA (2014b) and EPA & DEC (2010), incorporating results of the desktop assessment in accordance with the guidelines, plus a field assessment addressing habitat mapping, targeted survey for relevant fauna species of conservation significance, and collection of a terrestrial vertebrate fauna species list, from all opportunistic observations made on site. The site was also visited at dusk on the same day to observe potential night roosting activities on Black-cockatoos.

Fauna species and direct evidence of fauna activity was observed and recorded continuously whilst on site. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted if observed/heard.

The fauna habitats present within the study area were described based on site observations and detailed vegetation community data, and taking into account aspects important to fauna such as soil, rocks, bare ground, leaf litter, wood (woody debris, logs, etc.), lower and ground strata density (cover), canopy height/cover/density and presence of or proximity to surface water.

3.2.2.1 Targeted Black-cockatoo Assessment

Particular attention was focused on Black-cockatoos and their suitable habitat within the study area. A targeted survey for Black-cockatoos was conducted utilising *Referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012), as endorsed by the Commonwealth Department of the Environment and Energy (DotEE), and as such required that the survey:

- be carried out by a suitably qualified person with experience in vegetation or cockatoo surveys, depending on the type of survey being undertaken
- maximise the chance of detecting the species' habitat and/or signs of use
- determine the context of the site within the broader landscape; for example, the amount and quality of habitat nearby and in the local region (for example, within 10 km)
- account for uncertainty and error (false presence and absences)
- include collation of existing data on known locations of breeding and feeding birds and night roost locations.

The targeted survey for Black-cockatoos aimed to record any observed individuals either at the site or as an overfly observation, any evidence of their activity (e.g. chewed Marri nuts or Banksia cones), as well as habitat suitable for nesting/breeding, roosting or foraging. Such suitable habitat was mapped, with areas quantified.

The various habitats suitable for Black-cockatoos were identified in accordance with the categories outlined in **Table 2**.

Table 2: Black-cockatoo Habitats Surveyed

Habitat	Examples
Foraging habitat	Food source plants for Black-cockatoos include Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Proteaceous species such as *Banksia, Hakea* and *Grevillea*; *Allocasuarina*, and *Anigozanthos* and introduced species such as Pines (*Pinus* spp.) and Cape Lilac (*Melia azedarach*), but also *Erodium* spp. and various species grown for fruit, nuts and seeds which grow in native shrubland, heathland, woodland or forest and agricultural areas.
Night roosting habitat	These habitats include suitable trees (*Eucalyptus* or *Corymbia*) within or near riparian environments or natural or artificial water sources.
Breeding/nesting habitat	Any patch of woodland or forest that contains *Eucalyptus* or *Corymbia* trees with either a diameter at breast height of greater than 500 mm or with suitable nest hollows. More specifically, all individual trees observed to support suitable hollows within the study area.

A tree habitat survey was also included to specifically observe suitable trees within the study area to assess their status as a breeding/nesting tree, with or without hollows, or as potential future nesting trees (with a diameter at breast height (DBH) of 500 mm or greater).

Target tree species included Tuart, Jarrah and Flooded Gum, or any other Corymbia/Eucalyptus species of a suitable size that may have been present. Banksia, Sheoak and Melaleuca tree species were not assessed as they typically do not develop suitably large hollows that are used by Black-cockatoos.

The location of each tree identified as being over the threshold DBH was recorded with a GPS and details on tree species, number and size of hollows (if any) were noted. Trees observed to contain hollows (of any size/type) were marked with "H" using spray paint for easy future reference.

Based on this assessment, trees present within the subject site have been place into one of four categories:

- Tree <50cm DBH or an unsuitable species (not recorded)
- Tree >50cm DBH, a habitat tree, but with no hollows observed
- Tree >50cm DBH, one or more hollows observed, none of which were considered suitable for Black-cockatoos to utilise for nesting
- Tree >50cm DBH, one or more hollows observed, with at least one hollow considered suitable for Black-cockatoos to utilise for nesting.

For the purposes of this assessment a tree containing a potential cockatoo nest hollow was defined as:

> *Generally, any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by a black cockatoo for the purpose of nesting/breeding. Hollows that had an entrance greater than about 10cm in diameter and would allow the entry of a black cockatoo into a suitably orientated and sized branch/trunk were recorded as a "potential black cockatoo nest hollow".*

Identified hollows were examined using binoculars for evidence of actual use by Black-cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Trees with possible nest hollows were also scratched and raked with a large stick/pole in attempt to flush any sitting birds from hollows and calls of chicks were also listened for.

The location and nature of Black-cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the reconnaissance survey was recorded. The nature and extent of potential foraging habitat

present was also documented irrespective of the presence of any actual foraging evidence, based on the broader habitat mapping.

Direct and indirect evidence of Black-cockatoos roosting within trees within the study area was noted if observed (e.g. branch clippings, droppings or moulted feathers). A visit to the site at dusk was also carried out to make relevant observations of night roosting activity.

4 RESULTS

4.1 DESKTOP REVIEW

4.1.1 Significant Species

The DPaW database search results, NatureMap Species Report and the MNES Report all returned results for the potential presence of conservation significant flora and fauna in the region of the study area. Of particular importance were the results for the potential occurrence of the following Threatened and Commonwealth listed species:

- flora:
    - *Andersonia gracilis*
    - *Caladenia huegelii*
    - *Diuris micrantha*
    - *Diuris purdiei*
    - *Drakaea elastica*
    - *Drakaea micrantha*
    - *Lepidosperma rostratum*
- fauna:
    - Australasian Bittern (*Botaurus poiciloptilus*)
    - Curlew Sandpiper (*Calidris ferruginea*) (also migratory)
    - Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*)
    - Carnaby's Black-cockatoo (*Calyptorhynchus latirostris*)
    - Malleefowl (*Leipoa ocellata*)
    - Numbat (*Myrmecobius fasciatus*)
    - Eastern Curlew (*Numenius madagascariensis)*
    - Australian Painted Snipe (*Rostratula australis*)
    - Chuditch (*Dasyurus geoffroii*)
    - Western Ringtail Possum (*Pseudocheirus occidentalis*)
- migratory birds:
    - Fork-tailed Swift (*Apus pacificus*)
    - Grey Wagtail (*Motacilla cinerea*)
    - Osprey (*Pandion haliaetus*)
    - Common Greenshank (*Tringa nebularia*)
    - Wood Sandpiper (*Tringa glareola*)
    - Marsh Sandpiper (*Tringa stagnatilis)*
    - Rainbow Bee-eater (*Merops ornatus*)
    - Eastern Curlew (*Numenius madagascariensis)*
    - Great Egret (*Ardea alba*)
    - Cattle Egret (*Ardea ibis*)
    - White-bellied Sea-Eagle (*Haliaeetus leucogaster*)
    - Sharp-tailed Sandpiper (*Calidris acuminata*)
    - Pectoral Sandpiper (*Calidris melanotos*)
    - Red-necked Stint (*Calidris ruficollis*)
    - Long-toed Stint (*Calidris subminuta*)
    - Little-ringed Plover (*Charadrius dubius curonicus*)
    - Black-tailed Godwit (*Limosa limosa*)
    - Glossy Ibis (*Plegadis falcinellus*)
    - Pacific Golden Plover (*Pluvialis fulva*)
    - Grey Plover (*Pluvialis squatarola*)

- Peregrine Falcon (*Falco peregrinus*).

The following Priority listed species also returned results:

- flora:
  - *Acacia lasiocarpa* var. *bracteolate* - long peduncle variant (G.J. Keighery 5026) (P1)
  - *Thelymitra variegata* (P2)
  - *Amanita drummondii* (P3)
  - *Amanita fibrillopes* (P3)
  - *Byblis gigantean* (P3)
  - *Cyathochaeta teretifolia* (P3)
  - *Dampiera triloba* (P3)
  - *Dodonaea hackettiana* (P3)
  - *Eryngium pinnatifidum* subsp. *palustre* (G.J. Keighery 13459) (P3)
  - *Jacksonia gracillima* (P3)
  - *Phlebocarya pilosissima subsp. pilosissima* (P3)
  - *Stylidium paludicola* (P3)
  - *Microtis quadrata* (P4)
  - *Ornduffia submerse* (P4)
  - *Stylidium longitubum* (P4)
  - *Thysanotus glaucus* (P4)
  - *Tripterococcus* sp. *Brachylobus* (A.S. George 14234) (P4)
  - *Verticordia lindleyi* subsp. *lindleyi* (P4).
- fauna:
  - Cricket (*Throscodectes xiphos*) (P1)
  - Lined Skink (*Lerista lineata*) (P3)
  - Western Brush Wallaby (*Macropus irma*) (P4)
  - Blue-billed Duck (*Oxyura australis*) (P4)
  - Graceful Sunmoth (*Synemon gratiosa*) (P4)
  - Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) (P4).

Spatial data for Threatened flora in the region provided by the City of Cockburn also shows previously recorded occurrences of *Caladenia huegelii* and an unnamed species (likely also *Caladenia huegelii*) in areas from 1.7 km to the east of the study area. The distance between these populations and the study area is such that any proposed development or clearing would have no impact, including indirect impacts, on these populations.

4.1.1.1 Fauna Literature Review Results

Given the mobile nature of fauna, greater efforts in building potential species lists are warranted. Therefore, a review of several relevant reports as listed in Section 3.1 was also carried out. The compiled list, which also incorporates observed and recorded species from the field assessment is presented in **Appendix D**.

The list of potential fauna presented in **Appendix D** assumes that each species listed is not known to be locally extinct and that suitable habitat for each species, as identified during the habitat assessment, is present within the study area. However, the list presented is likely to be an overestimation of the fauna species that actually use the site for some purpose.

With respect to native vertebrate fauna, 11 mammals (including eight bat species), 97 bird, 26 reptile and 10 frog species have previously been recorded in the general vicinity of the CCE LSP study area, some of which

have the potential to occur in or utilise sections of the study area at times. Twelve species of introduced animals could also frequent the area.

Of the 143 native animals that are listed as potentially occurring in the area, three are considered to be endangered/vulnerable or in need of special protection under State and/or Commonwealth legislation. In addition, two migratory and two DPaW priority species are also listed as potentially present (some likely only on a seasonal basis).

4.1.2 Threatened and Priority Ecological Communities

A DPaW database search for Threatened and Priority Ecological Communities within a 5 km buffer of the study area was requested on 20 September 2016. Results of search 15-01216EC showed that the recently listed Endangered ecological community of Commonwealth significance, *Banksia Woodlands of the Swan Coastal Plain* occurs within the study area. At a State level, various sub-types of this community type are also listed as Priority Ecological Communities (PECs). No other TECs or PECs are known to be supported by the study area, based on the database search results.

The MNES Report (**Appendix B**) identified the potential presence of one Threatened Ecological Community (TEC) within the study area. The Endangered TEC – *Banksia Woodlands of the Swan Coastal Plain,* is typically described as having a prominent tree layer of Banksias with scattered Eucalypts and a species rich understorey of sclerophyllous shrubs, graminoids and forbs (DotEE, 2016a).

4.1.3 Wetlands

The study area supports one geomorphic "Multiple Use" Dampland across approximately one third of the site, in the northern sections. This area is characterised by the damper vegetation types supporting Melaleuca and a higher density of *Xathorrhoea preissii.* No other water waterways or wetlands are present within the immediately adjacent areas or are linked to the study area through surface drainage (GHD, 2015).

The MNES report also included reference to the occurrence of Ramsar wetlands, Forrestdale and Thomsons Lakes, within 10 km. However, these results are not of significance as any proposed clearing or development would be unlikely to impact either of these Ramsar sites.

4.2 FIELD ASSESSMENTS

4.2.1 Flora

A total of 107 flora species from 90 genera and 44 families were recorded during the field survey. The total includes 62 (57.9%) native species and 45 (42.1%) introduced (weed) species. The most dominant families recorded were Fabaceae and Myrtaceae. The full list of vascular flora species recorded and representative communities in which they occur are detailed in **Appendix E**.

None of the recorded flora species are listed as Threatened under the WC Act or under the EPBC Act, nor are any listed as Priority Flora under the WC Act.

Four of the introduced (weed) species recorded are listed as Declared Pest plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). These are:

- **Asparagus asparagoides* (Bridal Creeper)
- **Echium plantagineum* (Paterson's Curse)
- **Zantedeschia aethiopica* (Arum Lily)
- **Gomphocarpus fruticosus* (Narrow-leaf Cotton Bush)

Declared Pest species require management under the BAM Act and are categorised as follows:

- C1 – Exclusion
- C2 – Eradication
- C3 – Management.

**Asparagus asparagoides* and **Zantedeschia aethiopica* require C3 management for the whole of the State. **Echium plantagineum* and **Gomphocarpus fruticosus* require C3 management in a variety of areas around the State but no specific management is required within the study area (DAFWA 2016).

4.2.2 Vegetation

Five intact and three degraded vegetation communities were described and delineated within the study area. This comprised of four woodlands, two woodland/wetland vegetation types, one heath and one degraded community/habitat which is a mosaic of shrublands (mostly introduced/non-endemic shrubs) and grasslands (introduced grasses/weeds). Each community is described in **Appendix F** and spatially mapped in **Figure 3**.

The condition of the vegetation was found to range from rating 3- 4 (Good to Very Good) to rating 7 (Completely Degraded). The majority of the study area is considered to be in Degraded to Good condition. The varying vegetation condition across the study area is presented in **Figure 4**.

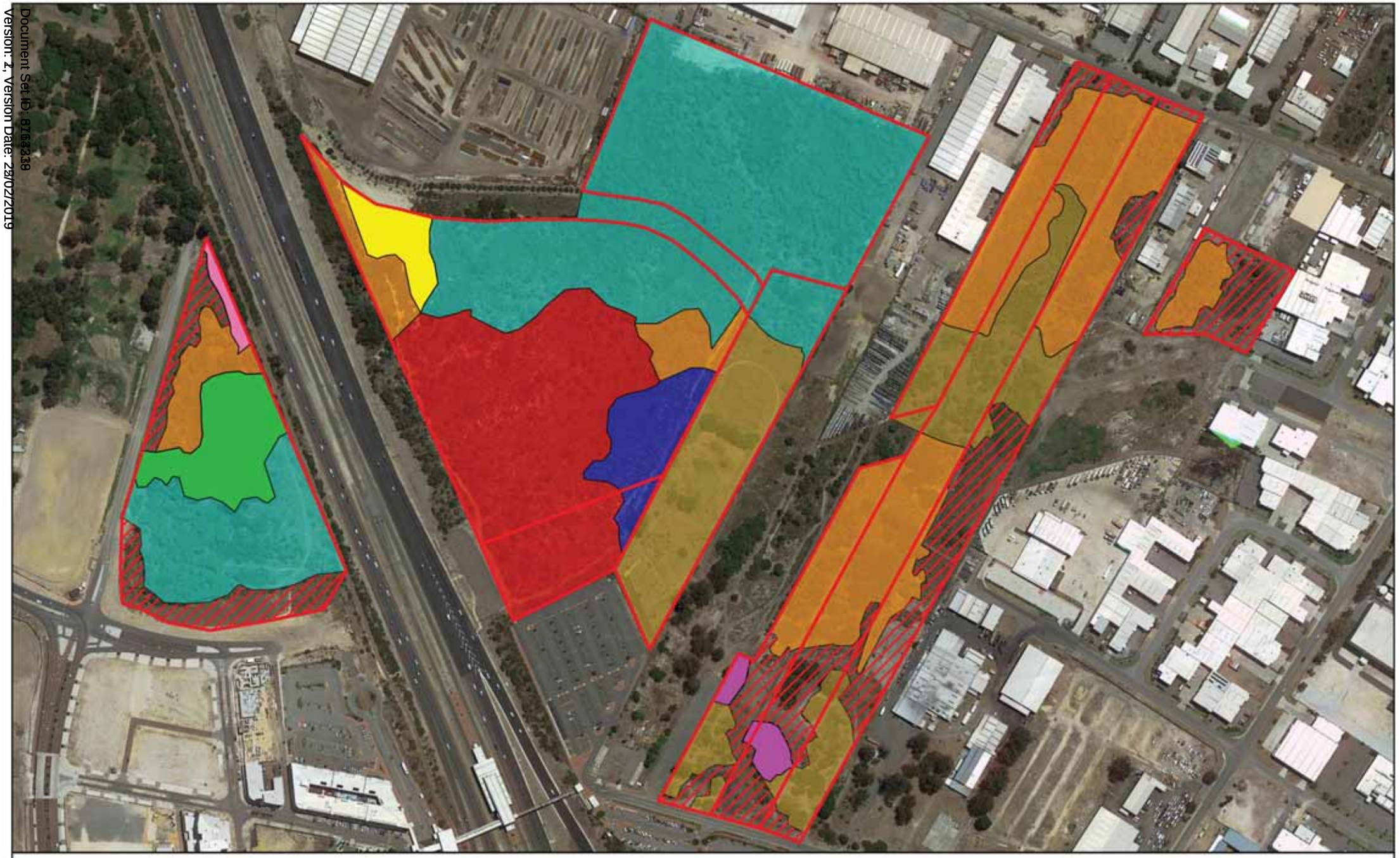

Figure 3 - Vegetation Communities

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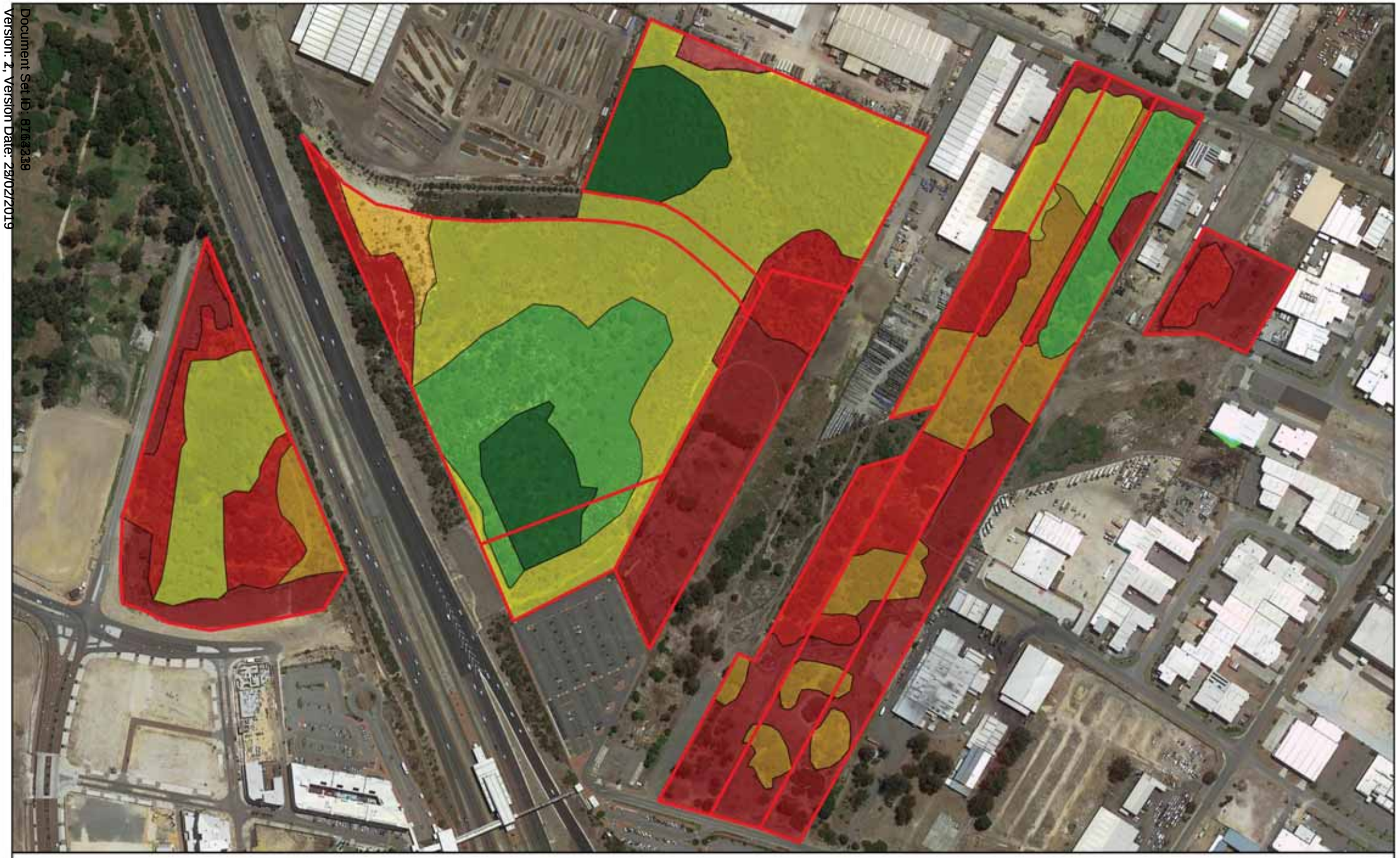

Figure 4 - Vegetation Condition

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4.2.3 Fauna

Opportunistic fauna observations made during the September 2016 field survey are listed in **Appendix D**. A total of 25 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the one day survey period. The use of the study area by five introduced species was also confirmed.

Evidence of three fauna species of conservation significance was observed during the field assessment. Carnaby's Black-cockatoo, listed as Endangered under the EPBC Act and as Schedule 2 under the WC Act was observed from evidence of chewed Banksia cones. The Forest Red-tailed Black-cockatoo, listed as Vulnerable under the EPBC Act and as Schedule 3 under the WC Act was observed flying overhead during the field survey and GHD also recorded this species flying over the area in 2015 (GHD 2015). Further evidence of this species' use of the site was evidenced from chewed Coastal Blackbutt (*Eucalyptus todtiana*) fruits. Diggings attributed to the Southern Brown Bandicoot/Quenda, a DPaW-listed Priority 4 species, were also found at several locations.

A fauna assessment of some areas of the currently defined study area was carried out by GHD in October 2015. During this assessment, which included a single day survey by a zoologist, in addition to several days by ornithologists from Birdlife Australia, 34 native fauna species were recorded. Eight introduced species were also observed.

GHD reported both Carnaby's and Forest Red-tailed Black-cockatoos as flying over the area, and the Rainbow Bee-eater (listed migratory species) was observed nesting in a sand embankment along North Lake Road. Evidence of the Southern Brown Bandicoot was also observed and the Perth Lined Lerista (skink; DPaW Priority 3 species) was also recorded.

Combining the results of the September 2016 field assessment and those of the GHD (2015) field assessment, a total of 47 fauna species have was recorded within the study area (as summarised in **Table 3**), these being comprised of:

- 34 birds (including four introduced species)
- five reptiles
- six mammals (including four introduced species)
- two frogs.

Table 3: Summary of Potential Vertebrate Fauna Species

Group	Total No. Potential Species	Potential No. Specially Protected Species	Potential No. Migratory Species	Potential No. Migratory Species	No. Species Recorded in Study Area During Survey
Amphibians	10	0	0	0	2
Reptiles	26	0	0	1	5
Birds	103[6]	3	2	0	34[4]
Non-Volant Mammals	9[6]	0	0	1	6[4]
Volant Mammals (Bats)	8	0	0	0	0
Total	**155[12]**	**3**	**2**	**2**	**47[8]**

NB: Detailed results presented in Appendix D

Superscript = No. of introduced species included in total

4.2.4 Fauna Habitats

Despite significant disturbance in some areas from past and current land uses, some sections of the study area are in relatively good condition and provide value as habitat to native fauna.

The study site was found to support five habitat types, consisting of woodlands and woodland/wetlands, one open heath/scrub and degraded areas. The five fauna habitats recorded are described below and their spatial extent across the study area is presented in **Figure 5**.

4.2.4.1 Banksia Woodland

The Banksia Woodland habitat consists of an overstorey of Banksia species (*Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia*), occasionally with Coastal Blackbutt (*Eucalyptus todtiana*), over native shrubs and herbs, as well as grassy weeds in more degraded areas. The soils are deep, loose sands, mostly pale grey, but also light brown with some more loamy constituents in lower lying areas. The overstorey layer is up to 7 m tall and sparse in some areas, but denser in areas of better condition. The native understorey is degraded in some areas, but annually (during late winter and spring) is quite densely covered in weeds, and provides a moderate leaf litter cover. Many of the mid-strata shrubs, such as Grasstrees which dominate throughout the habitat, have foliage mostly down to the ground, providing good coverage for ground dwelling mammals and reptiles and with spacing suitable to enable easy movement. The open sand lenses are known to provide suitable habitat for the Perth Lined Lerista (Priority 4). The composition of Proteaceous species and other food source plants (e.g. *Eucalyptus todtiana*) for Threatened Black-cockatoos is quite abundant and varied, including most significantly, the presence of consistent Banksia stands. This habitat type does not support large trees suitable for nesting or night roosting habitat for Black-cockatoos.

4.2.4.2 Paperbark Woodland/Swamp

The Paperbark Woodland/Swamp habitat occurs in lower lying areas of the study site and is dominated by *Melaleuca preissiana,* which occurs occasionally with the introduced shrub, **Acacia longifolia* and mostly occurs over native shrubs such as *Hypocalymma angustifolium* or over dense stands of weeds, commonly **Fumaria capreolata.* The understorey density is similar across the habitat during late winter and spring, regardless of whether it consists of native species or weeds, and in such densities, provides ideal habitat for small ground-dwelling mammals and reptiles, including Southern Brown Bandicoots, for which evidence was apparent during the field assessment. Soils in the Paperbark Woodland/Swamp habitat type range from grey sands to brown loamy sands in the lower lying and wetter areas in the centre of the section west of the freeway, and in the northern-most sections north of the train station carpark. Soils are heavier and more compact than in the Banksia Woodland habitat. The overstorey is up to 9 m tall, with some very old and tall *Melaleuca preissiana* specimens present. There are few species present that provide foraging habitat for Threatened Black-cockatoos and large trees suitable for nesting or night roosting habitat for Black-cockatoos are largely absent. However, a single stag (historic death) Flooded Gum (*Eucalyptus rudis*) tree with a hollow considered potentially suitable for Black-cockatoo nesting is present (**Figure 6**).

4.2.4.3 Tall Open Woodland

The Tall Open Woodland habitat consists of an overstorey of tall (to over 15 m) Eucalypts, over little or no native understorey, ranging from sparse stands of the introduced **Acacia longifolia* to areas of little more than introduced grasses and other weeds. In this habitat, the trees are mature and most present are habitat trees with a DBH greater than 500 mm (**Figure 6**). Although areas of this habitat type interface closely with infrastructure and human activity (train station carparks and the Kwinana Freeway), which limits habitat potential at a ground-level, the height of the canopy provides excellent habitat for birds, including potential

nesting and night-roosting opportunities for Black-cockatoos; although no evidence of either activity was observed during the field assessment, nor is considered likely. No Black-cockatoo foraging habitat is present within this habitat type.

4.2.4.4 Open Heath

The Open Heath habitat is represented in a small section of the study area and consists of Grasstrees over an understorey of native shrubs, sedges and rushes, predominantly *Dasypogon bromeliifolius* and *Phlebocarya ciliata,* also with a relatively high abundance of introduced grasses. There are very few trees present, consisting mostly of sparse Banksias. The bare ground proportion in this habitat type is low, providing excellent coverage for reptiles and to a lesser degree, small mammals. The substrate is relatively soft, loose grey sands, well-suited to burrowing fauna. There is a lack of suitable foraging, nesting and night-roosting habitat for Threatened Black-cockatoos in the Open Heath habitat.

4.2.4.5 Degraded Open Areas

The Degraded Open Areas provide very little habitat for native fauna, with a high potential for vulnerability to native and introduced predators in most areas. This habitat type consists of mostly cleared areas supporting dense areas of weeds. A section in the north, immediately east of the Freeway includes rehabilitation which is sparse and appears to be regeneration of the Paperbark Woodland/Wetland habitat. Some areas of the study area, in the east and north-eastern sections support this habitat type in the form of mostly introduced and disturbance shrubs; mostly **Leptospermum laevigatum* (Victorian Teatree) and *Adenanthos cygnorum,* a native disturbance opportunist. In such areas, although not naturally occurring nor endemic, better coverage, food sources and therefore habitat is provided, which is more akin to that of the intact woodland habitats. There is a lack of suitable foraging, nesting and night-roosting habitat for Threatened Black-cockatoos in the Open Degraded Areas.

Figure 5 - Fauna Habitats

Figure 6 - Habitat Trees

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4.2.5 Black-cockatoo Habitat Assessment

4.2.5.1 Breeding Habitat

The trees of the study area were assessed for their suitability in providing nesting habitat for Black-cockatoos, in accordance with DotEE criteria (DSEWPaC 2012). A number of trees were found to represent habitat trees, with a DBH of 500 mm or greater, consisting of representatives from the following suite of species, the locations of which are shown in **Figure 6**, with a summary provided in **Table 4**:

- Tuart - *Eucalyptus gomphocephala*
- Jarrah – *Eucalyptus marginata*
- Flooded Gum – *Eucalyptus rudis*
- planted, non-endemic *Eucalyptus* species.

One occurrence of a Flooded Gum which is an historic death (stag tree) provides a hollow considered suitably to potentially provide nesting/breeding habitat for Black-cockatoos (**Figure 6**).

Table 4: Summary of Potential Black-cockatoo Habitat Trees (DBH ≥ 500 mm) Recorded

Lot No.	Total No. Habitat Trees	No. Trees with no Hollows Observed	No. Trees with Hollows Considered Unsuitable for BC Nesting	No. Trees with Hollows Considered Possibly Suitable for BC Nesting	Tree Species			
					Tuart	Jarrah	Flooded Gum	Euc sp. (non-endemic)
33	8	6	2	0	8	0	0	0
36	4	4	0	0	4	0	0	0
801	1	0	1	0	0	0	1	0
802	1	0	0	1	0	0	1	0
9500	4	2	2	0	0	2	0	2
Total	**18**	**12**	**5**	**1**	**12**	**2**	**2**	**2**

The field assessment identified 18 habitat trees (trees with a DBH of >500 mm) (**Figure 6**). Most trees (12) appeared not to contain hollows of any size. Five trees appeared to contained small hollows or possible small hollows, considered by unlikely to be suitable for Black-cockatoos to use for nesting purposes. One of these hollows appeared to be in use by Galahs.

One tree was identified as containing a hollow that appeared possibly big enough to allow the entry of a Black-cockatoo into a suitably sized and orientated trunk, but no evidence of actual use was observed. The probability of this actually representing a hollow that would be used by black cockatoos can be regarded as being very low.

Additional details on each habitat tree observed can be found in **Appendix G**.

4.2.5.2 Foraging Habitat

Following is a list of the key flora species recorded within the study area during the fauna assessment that are known to be used as a direct food source (i.e. fruits or flowers) by one or more species of Black-cockatoo:

- Jarrah - *Eucalyptus marginata*
- Coastal Blackbutt - *Eucalyptus todtiana*
- Sheoak - *Allocasuarina fraseriana*
- Candlestick Banksia - *Banksia attenuata*
- Firewood Banksia - *Banksia menziesii*
- Holly-leaved Banksia - *Banksia ilicifolia*
- Grass Tree - *Xanthorrhoea preissii*.

A number of other tree/shrub species present (e.g. Tuart, Flooded Gum and Acacia species) are also utilised as a food source by Black-cockatoos, but to a much lesser degree than those listed.

Some evidence of Black-cockatoos foraging onsite was observed during the field assessment, in the form of chewed Banksia cones (*Banksia attenuata* and *Banksia menziesii*) and Coastal Blackbutt (*Eucalyptus todtiana*) fruits. This evidence was attributed to Carnaby's Black-cockatoo and the Forest Red-tailed Black-cockatoo, respectively.

Foraging habitat within the subject site is mainly comprised of the Banksia Woodland which occupies approximately 9.5 hectares (~32.4%) of the study area.

4.2.5.3 Roosting Habitat

No existing roosting trees (trees used at night by Black-cockatoos to rest) were positively identified during the field survey, and given the limited number of larger trees present, Black-cockatoos are considered very unlikely to use the study area for this purpose.

5 DISCUSSION

5.1 FLORA

The total of 62 (57.9%) native species and 45 (42.1%) introduced (weed) species recorded within the project area represents a large proportion of weeds. This is expected, due to the close proximity of the study area to infrastructure, and areas of busy human activity, such as major transport arteries and cleared industrial areas.

Of the 107 vascular flora species recorded, only one could not be identified to species level (*Opuntia* sp.; Prickly Pear). This species does not have the potential to be a Threatened or Priority flora, as all *Opuntia* species occurring within Western Australia are introduced (weed) species. *Optunia* species are not listed by DAFWA as Declared Pest weeds.

Four of the introduced (weed) species recorded are listed as Declared Pest plants under the *Biosecurity and Agriculture Management Act 2007*. **Asparagus asparagoides* (Bridal creeper) and **Zantedeschia aethiopica* (Arum Lily) require C3 management for the whole of the State, including within the project area. **Echium plantagineum* and **Gomphocarpus fruticosus* require C3 management in some areas around the State but not within the study area, where no specific control measures are required (DAFWA, 2016).

Asparagus asparagoides (Bridal Creeper) is regarded as one of Australia's worst weeds due to its invasiveness, potential for spread and economic and environmental impacts (DEE, 2016b). Rare native plants are threatened with extinction by Bridal Creeper. The species forms a thick mat of underground tubers which impedes the root growth of other native plants and often prevents seedling establishment (DEE, 2016b).

Zantedeschia aethiopica (Arum Lily) occurs in pasture and bushland, particularly in damp areas. It is able to form large spreading monocultures that choke native species, reduce biodiversity and decrease habitat and food resources for native animals (Cape to Cape Catchment Group, 2016). The two aforementioned species are listed as Declared Pest plants under the BAM Act and as such, landholders are required to manage and control them to reduce the size of infestations and prevent the spread of these weeds.

None of the recorded flora species are listed as Threatened under the WC Act or under the EPBC Act, nor are any listed as Priority Flora under the WC Act. However, the site is considered to potentially be suitable habitat for a number of Threatened and Priority Flora that have the potential to occur, based on habitat requirements and habitat suitability in the project area as summarised in **Table 5**.

Table 5: Likelihood of Occurrence of Threatened and Priority Flora

Species	Conserv-ation Status	Habitat/Proximity and relevance of records	Likelihood of Occurrence
Andersonia gracilis	T	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps. Not resulting from DPaW records.	LOW
Caladenia huegelii	T	Grey or brown sand, clay loam. Jarrah, *Banksia* or (less likely) *Mealaleuca* woodland. Lower slopes. Recent records nearby.	MODERATE
Diuris micrantha	T	Brown loamy clay. Winter-wet swamps, in shallow water. Not resulting from DPaW records.	LOW
Diuris purdiei	T	Grey-black sand, moist. Winter-wet swamps. Not resulting from DPaW records.	LOW
Drakaea elastica	T	White or grey sand. Low-lying situations adjoining winter-wet swamps. Often with *Kunzea* spp.. Not resulting from DPaW records.	LOW
Drakaea micrantha	T	White-grey sand. *Banksia*, Jarrah woodlands. Lower slopes. Not resulting from DPaW records.	LOW
Lepidosperma rostratum	T	Peaty sand, clay. Swamps.	LOW
Acacia lasiocarpa var. *bracteolate* (long peduncle)	P1	Grey or black sand over clay. Swampy areas, winter wet lowlands. Records in Jandakot.	MODERATE
Thelymitra variegata	P2	Sandy clay, sand, laterite.	LOW
Byblis gigantea	P3	Sandy-peat swamps. Seasonally wet areas. Records in Jandakot.	MODERATE
Cyathochaeta teretifolia	P3	Grey sand, sandy clay. Swamps, creek edges.	MODERATE
Dampiera triloba	P3	No habitat information found. Recorded from North Lake and Roe Highway extension area.	MODERATE
Dodonaea hackettiana	P3	Grey sands, peats, outcropping limestone. Locally recorded amongst weeds. Records in Jandakot.	MODERATE
Eryngium pinnatifidum subsp. *palustre*	P3	Claypans.	LOW
Jacksonia gracillima	P3	Grey-pale brown sands. Coastal Plain.	MODERATE
Phlebocarya pilosissima subsp. *pilosissima*	P3	White or grey sand, sand ridges, lateritic gravel. Banksia woodland.	MODERATE
Stylidium paludicola	P3	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	LOW
Microtis quadrata	P4	Habitat preference not able to be located. Records in Jandakot.	MODERATE
Ornduffia submersa	P4	Aquatic herb.	LOW
Stylidium longitubum	P4	Sandy clay, clay. Seasonal wetlands. Records in Jandakot.	MODERATE
Thysanotus glaucus	P4	White, grey or yellow sand, sandy gravel. Open lenses.	LOW
Tripterococcus sp. *Brachylobus*	P4	No habitat information found.	MODERATE
Verticordia lindleyi subsp. *lindleyi*	P4	Sand, sandy clay. Winter-wet depressions.	MODERATE

None of the Threatened or Priority flora species with the potential to occur in the project area are considered to be highly likely to occur. Rather all such species are considered to have a low, or moderate likelihood of occurrence, based on known habitat preferences and the proximity and currency of previous records.

Of the species considered to have a moderate likelihood of occurrence, only one is listed as Threatened, *Caladenia huegelii.* This species is known from several local populations, and the study area provides the preferred habitat for the species. Based on this, it is recommended that follow-up surveys be carried out to target this species during the appropriate season (early September), prior to specific development activities that would require clearing, to ensure avoidance of impacts to populations which may yet to be defined.

The survey was considered to have been conducted during optimal spring flowering period to identified the majority of species occurring within the study area. If possible within the timing constraints of the planning and development aspects of the project, it is recommended that an additional, second phase assessment be conducted during the complimentary season (autumn), to capture alternative-season flowering species and ephemerals, and/or during spring 2017, to compliment the results of the 2016 spring survey, and to best inform planning and development decisions regarding the wider CCE LSP area.

5.2 VEGETATION

The study area supports five intact and three degraded vegetation communities. Areas of the higher quality vegetation are found in the larger pocket of remnant vegetation, adjacent to the east side of the Kwinana Freeway, and this may be attributed to the proximity to the impacts of edge effects from current activities, as well as historic land uses.

All of the intact vegetation communities have been analysed in relation to species presence/absence and landform/soil types, in comparison to the Gibson *et al* (1994) dataset, in order to assign inferred Floristic Community Types (FCTs). A summary of the results of this analysis is presented below in **Table 6**, including the conservation status with regards to current TEC and PEC status, and the Gibson *et al* (1994) reservation and risk of extinction classification.

Table 6: Inferred FCTs of the Intact Vegetation Communities Recorded

Community Code	Brief Community Description	Inferred FCT	FCT Title	Conservation Significance
BaEt	Banksia over *Eucalyptus todtiana* woodland	23a	Central *Banksia attenuata – Banksia menziesii* woodlands	Likely a Commonwealth TEC FCT: well reserved; low risk
BaXp	Banksia over *Xanthorrhoea preissii* woodland	21a	Central *Banksia attenuata – Eucalyptus marginata* woodlands	Likely a Commonwealth TEC FCT: well reserved; low risk
Xp	*Xanthorrhoea preissii* heath	23a	Central *Banksia attenuata – Banksia menziesii* woodlands	Likely a Commonwealth TEC FCT: well reserved; low risk
Mp	*Melaleuca preissiana* woodland/swamp	4	*Melaleuca preissiana* damplands	Not a TEC or PEC FCT: well reserved; low risk
MpAl	*Melaleuca preissiana* over **Acacia longifolia* woodland/swamp	4	*Melaleuca preissiana* damplands	Not a TEC or PEC FCT: well reserved; low risk

All inferred FCTs were documented in Gibson *et al* (1994) as "well reserved" and at "low risk" of extinction, and although none of the community types have been previously listed as a TEC or PEC, the recent Commonwealth listing of the Banksia woodlands of the Swan Coastal Plain TEC (DotEE 2016a) encompasses a number of *Banksia* woodlands, including those equivalent to FCTs 21a and 23a. This community type is typically described as having a prominent tree layer of Banksias with scattered Eucalypts and a species rich understorey. However, diagnosis of the presence of this TEC is more complicated than analysing results of a Level 1 or Level 2 flora and vegetation assessment. Specific information including patch size and regional context requires assessment and analysis, as well as plot-based data, in order to determine the presence of the TEC. However, based on the information collected as part of this study, it is considered highly likely that the areas mapped as *Banksia* woodland (communities BaEt and BaXp) are representative of the Commonwealth listed TEC. Some further assessment on patch size and quality on the vicinity, as well as analysis of replicate plot-based quadrat data within the *Banksia* woodland areas would appropriately confirm this, and would accurately define areas subject to Commonwealth protection.

Avoidance of the majority of the Banksia woodland area, likely to represent the TEC could be achieved by realigning the proposed North Lake Road to Beeliar Drive road alignment, as shown in **Figure 7**. Other currently proposed road alignments are considered well-placed to minimise impacts on areas of best quality vegetation and habitat within the study area.

The condition of the vegetation was found to range from rating 3- 4 (Good – Very Good) to rating 7 (Completely Degraded) in the Keighery (1994) scale. The majority of the study area is considered to be in Degraded to Good condition.

One of the EPA's objectives is to retain at least 10% of the pre-European extent of vegetation types in constrained areas in the Perth and peel regions (EPA, 2015). The study area supports the Bassendean Complex-Central and South, which, according to the Local Biodiversity Program study (Western Australian Local Government Association 2013), is represented by 27.70% of its pre-European extent. This percentage exceeds the EPA threshold, based on a pre-European extent of 87,392.73 ha and 24,206.24 ha documented by WALGA in 2013 as remaining.

5.3 CONSERVATION SIGNIFICANT FAUNA SPECIES

The desktop review determined that 17 terrestrial fauna species of conservation significance have previously been recorded within the vicinity of the study area. The likelihood of the occurrence of these species in the study areas has been assessed, which is summarised below in **Table 7**.

Figure 7 - Sugegsted Alternative Road Alignment

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Table 7: Likelihood of Occurrence of Conservation Significant Fauna in the Study Area

Species	Common Name	Conservation Category			Habitat Preference	Likelihood of Occurrence
		EPBC	WC Act	DPaW		
Botaurus poiciloptilus	Australasian Bittern	EN	S1	T(EN)	Permanent and seasonal freshwater wetlands, rarely estuarine habitats. Wetlands with tall, dense vegetation, particularly sedges/rushes/reeds.	LOW
Calidris ferruginea	Curlew Sandpiper	EN	S1	T(EN)	Intertidal mudflats, sheltered coastal areas; estuaries, bays, inlets, non-tidal swamps, lakes, lagoons near coast. Less in inland ephemeral/permanent lakes.	LOW
Calyptorhynchus latirostris	Carnaby's Black-cockatoo	EN	S2	T(EN)	Eucalypt woodland; Salmon Gum, Wandoo, Marri, Jarrah. Heath; Kwongan, Banksia/Hakea, other Proteaceous shrubs. Pines, Cape lilac.	MODERATE
Calyptorhynchus banksia naso	Forest Red-tailed Black-cockatoo	EN	S3	T(VU)	Eucalypt woodland; Salmon Gum, Wandoo, Marri, Jarrah. Heath; Kwongan, Banksia/Hakea, other Proteaceous shrubs. Pines, Cape lilac.	MODERATE
Leipoa ocellata	Malleefowl	VU	S1	T(VU)	Dry inland scrub, mallee. Large, contiguous areas of Mallee, woodlands with moderate to high levels of leaf litter.	LOW
Rostratula australis	Australian Painted Snipe	M/VU	S5	IA/T(VU)	Shallow freshwater (occasionally brackish) temporary or permanent wetlands; inundated grassland, dams. Grass, sedges/rushes/reeds, or samphire; Melaleuca.	LOW
Numenius madagascariensis	Eastern Curlew	EN	S1	IA/T(EN)	Sheltered coasts, mangrove swamps, bays, harbours and lagoons that contain mudflats and sandflats.	LOW
Oxyura australis	Blue-billed Duck	-	-	P4	Well vegetated freshwater swamps, large dams and lakes, winters on more open water. Occasionally salt lakes and estuaries freshened by floodwaters.	LOW
Merops ornatus	Rainbow Bee-eater	M	S5	IA	Open country, most vegetation types, dunes, banks; prefer lightly wooded, preferably sandy, country near water.	HIGH
Lerista lineata	Perth Lined Lerista	-	-	P3	White sands under areas of shrubs and heath where it inhabits loose soil and leaf litter particularly in association with Banksias.	HIGH
Macropus irma	Western Brush Wallaby	-	-	P4	Open forest, woodland, favouring open, seasonally wet flats with low grasses and open scrubby thickets. Mallee and heathland, uncommon in karri forest.	LOW
Dasyurus geoffroii	Chuditch	VU	S1	T(VU)	Jarrah (*Eucalyptus marginata*) forest	LOW
Pseudocheirus occidentalis	Western Ringtail Possum	VU	S1	T(VU)	Unburnt Peppermint woodland but also Jarrah, Wandoo and Marri forest	LOW
Myrmecobius fasciatus	Numbat	VU	S1	T(VU)	Upland Jarrah forest, open eucalypt woodland, Banksia woodland and tall closed shrublands with termites in the soil, hollow logs and branches for shelter.	LOW
Isoodon obesulus fusciventer	Quenda, Southern Brown Bandicoot	-	-	P4	Scrubby, dense vegetation; forest, woodland. Jarrah and Wandoo forests associated with water or wetlands.	LOW
Throscodectes xiphos	Cricket	EN	-	P1	Not known. Possibly heathlands and woodlands	LOW
Synemon gratiosa	Graceful Sunmoth	-	-	P4	Coastal dunes and woodlands supporting *Lomandra maritima* or *hermaphrodita*.	LOW

The results of the likelihood of occurrence analysis determined that all but four of the 17 conservation significant terrestrial fauna species assessed are unlikely to occur within or utilise the study area. A number of the species listed in **Table 7** may however utilise the habitats of the study areas as occasional visitors, but are unlikely to rely on it for their ongoing survival.

Whilst the likelihood of occurrence analysis did not incorporate a detailed literature review to ascertain the location and currency of previously recorded or known populations of each species, this can be applied to the species resulting in moderate or high likelihood scores, to further conclude risk of impact to these species.

5.3.1 Carnaby's Black-cockatoo

Carnaby's Black-cockatoo is listed as Schedule 2 under the WC Act and as Endangered under the EPBC Act. The species is confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km east south-east of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

The habitat of Carnaby's Black-cockatoo includes forests, woodlands, heathlands, farms. The species feeds preferentially on Banksia, Hakeas and Marri, but also other Proteaceous species and fruits from introduced trees such as Pines and Cape Lilac.

Carnaby's Black-cockatoo has specific nesting site requirements, with nests mostly in smoothed-barked eucalypts and in hollows ranging from 2.5 to 12 m above the ground, an entrance from 23 to 30 cm in diameter and a depth of 0.1 to 2.5 m (Johnstone and Storr, 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2003). Judging from records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forest of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain, including the region between Mandurah and Bunbury. Carnaby's Black-cockatoo has been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (Ron Johnstone *pers. comm.)* and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

Carnaby's Black-cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders 1986). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28 to 29 days. The young depart the nest 10 to 12 weeks after hatching (Saunders 1977; Smith & Saunders 1986).

Evidence of foraging activity was observed at the study site during the September 2016 field assessment in the form of chewed banksia cones. Most of the remnant vegetation containing banksia and jarrah within the site represents potential foraging habitat. Carnaby's Black-cockatoo was also recorded flying over the study area by GHD in 2015 (GHD 2015), and overfly activity of the species is regularly observed in the Cockburn region (Kellie Bauer-Simpson, *pers. comm*.).

All of the 18 large trees (>500 mm DBH) recorded during the field survey would be considered by the DotEE as potential Black-cockatoo breeding habitat, though only one appears to possibly contain a hollow of a size potentially suitable for this purpose. The possibility of this tree or any others being used for breeding proposes now or in the future would be considered to be extremely low.

No evidence of Black-cockatoo night roosting on site was observed during a dusk observation on 27 September 2016.

The potential impact of future development at the site on Carnaby's Black-cockatoo would be loss and/or modification of some areas of foraging and potential (unlikely) breeding habitat.

5.3.2 Forest Red-tailed Black-cockatoo

The Forest Red-Tailed Black-cockatoo is listed as Schedule 3 under the WC Act and as Vulnerable under the EPBC Act. The species is found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Preferred habitat for Forest Red-Tailed Black-cockatoos is Eucalypt forests. The species feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble and nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby 1999). In Marri, the nest hollows of the Forest Red-tailed Black-cockatoo range from 8 to 14 m above ground, the entrance 12 to 41 cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding for the species commences in winter/spring. There are few records of breeding in the Forest Red-tailed Black-cockatoo (Johnstone and Storr 1998), but eggs are known to be laid in October and November (Johnstone 1997; Johnstone and Storr 1998). Recent data however indicates that breeding in all months of the year occurs with peaks in spring and autumn–winter (Ron Johnstone *pers. comm.*). The incubation period is 29 to 31 days and young fledge at eight to nine weeks (Simpson and Day 2010).

Individuals of this species were observed flying overhead during the field survey and GHD also recorded this species flying over the area in 2015 (GHD 2015). Some foraging evidence (chewed Coastal Blackbutt fruits) was also attributed to this species, though Carnaby's Black-cockatoos also utilise this food source. All areas of remnant vegetation containing Jarrah, Coastal Blackbutt and Sheoak (The Banksia Woodland habitat) within the site represent potential foraging habitat.

The potential impact of future development at the site on the Forest Red-tailed Black-cockatoo would be loss and/or modification of some areas of foraging and potential (unlikely) breeding habitat.

5.3.3 Rainbow Bee-eater

One species, Rainbow Bee-eater (*Merops ornatus*) was determined to have a high likelihood of occurrence, based on the presence of suitable habitat, and as it was recorded by GHD (2015) breeding in a sand embankment along North Lake Road in 2015. The Rainbow Bee-eater is likely to utilise the study area in small numbers during the summer migratory period. This species is a common seasonal visitor to south west. Population numbers at any one location would however never be significant as the species usually breeds in pairs and only rarely in small colonies (Johnstone and Storr 1998). This species is a migratory bird, protected under international agreements (Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA)).

The Rainbow Bee-eater is not considered globally threatened. There are no published estimates of the global population size, but it is assumed to be quite large as the Rainbow Bee-eater is widely distributed throughout all of Australia (except Tasmania) and eastern Indonesia, including Bali, the Lesser Sundas and Sulawesi, and east to Papua New Guinea, the Bismarck Archipelago and, rarely, the Solomon Islands. It is a vagrant visitor to locations further north including Palau, south-western Micronesia, Saipan, the northern Mariana Islands, and Miyako Island and the southern Ryuku Islands in Japan (del Hoyo *et al.* 2001; Higgins 1999). The species breeds mostly in Australia, which occurs between August to January, at which time the birds will be found mostly in their subterranean nests. The chosen habitats of the species are widely varied and versatile, and

include mainly open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). Thus, utilisation of the habitats of the study area, including open sandy ground, is possible. However, no nests were observed during the field survey. Minimisation of impacts could be achieved by limiting ground disturbing activities to February to July, outside the breeding season.

5.3.4 Perth Lined Lerista

Lerista lineata is listed as Priority 3 by DPaW and is found along the lower west coast from north of Perth and south to Leschenault Peninsula/Kemerton. It has also been found at Rottnest Island and Garden Island (Storr *et al.* 1999), but is most typically found in the southern suburbs of Perth (Bush *et al.* 2002).

Habitat: This small species of skink inhabits white sands (Storr *et al.* 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter (Nevill 2005) particularly in association with banksias (Bush *et al.* 2002).

Lerista lineata was recorded within the study area by GHD (2015) and has been recorded in other nearby bush remnants (ENV 2009, Phoenix 2010). Most of the Banksia dominated habitat appears to be suitable for this species to persist. This species is also known to inhabit gardens (Nevill 2005, Bush *et al.* 2010) so may persist in degraded areas and subsequent to development.

The potential impact of future development at the site on *Lerista lineata* would be loss and/or modification of some areas of habitat.

5.4 FAUNA HABITATS

The five habitat types defined and mapped for the study area vary in quality and value in terms of providing for native fauna, including species of conservation significance.

The Open Degraded Areas habitat provides very little value for native fauna, whilst the Heath habitat provides some, but less than the woodland habitats. The Tall Open Woodland habitats are also of lesser value, given their typically degraded nature, although given the mature trees, are an important resource for birds.

The Paperbark Woodland/Swamp habitat provides for a number of native birds, small mammals and reptiles, in particular in better quality sections east of the Kwinana Freeway. This habitat type is likely to support populations of the Priority 4 species, Southern Brown Bandicoot/Quenda. Additionally, within this habitat is a single Flooded Gum stag which supports a hollow potentially suitable for Threatened Black-cockatoo nesting.

Of greatest significance with regards to habitat is the Banksia Woodland habitat which occupies a total of 9.5 hectares of the study area. This habitat type includes some of the best quality vegetation in the study area and is suitable foraging habitat for Threatened Black-cockatoos. Clearing of areas greater than one hectare of this habitat would require referral to the Commonwealth DotEE.

5.5 WETLANDS

The study area supports one geomorphic "Multiple Use" Wetland, (Unique Feature Identifier UFI) 6652) which has been classified as a dampland (WA Atlas, 2016). Multiple Use (M category) wetlands have been evaluated to be poor in natural and human attribute. As such the key management objective for Multiple Use wetlands is to use, develop and manage the wetland in the context of water, town and environmental planning. Some of the revegetation recommendations provided in ENV (2008) for the rehabilitation of the Solomon Road Wetland could be considered as part of the CCE LSP, in order to enhance the natural and aesthetic value of areas retained as part of the ultimate development of the site. Such actions could include appropriate management of drainage and stormwater, suitable fire risk management and rehabilitation/landscaping treatments in the form of weed management and revegetation with locally endemic species.

The MNES report also included reference to the occurrence of Ramsar wetlands, Forrestdale and Thomsons Lakes, within 10 km. However, these results are not of significance as the proposed clearing will not impact either of these Ramsar sites.

5.6 ASSESSMENT AGAINST THE TEN CLEARING PRINCIPLES

The project has been broadly assessed against the Department of Environment Regulation (DER) ten clearing principles, based on information collected during the assessment. A summary of this assessment (assuming the entire study site would be cleared) and recommendations for impact avoidance are provided below in **Table 8**.

Table 8: Summary of the Assessment against the Ten Clearing Principles

Principle	Assessment	Outcome	Avoidance or Mitigation Recommendation/ Comment
1 (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	A total five intact vegetation communities and three degraded vegetation communities in varying condition, comprising 107 vascular flora species (57.9% native) were recorded. Five different vertebrate fauna habitats were found to be supported by the site, with 47 vertebrate fauna species recorded during the field assessment. This diversity is considered moderately low. No species of Priority flora were recorded during the field survey conducted in September 2016. The vegetation communities present at the site are not equivalent to any listed Priority Ecological Communities.	Proposed clearing is not at variance with this principle.	Follow-up flora survey during complimentary season (autumn) or during spring 2017 to further confirm the native flora species which indicates that no Priority Flora are present.
2 (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.	Five fauna habitats were defined and mapped across the study site, which includes the Banksia Woodland habitat. This habitat occupies 9.5 hectares of the study site and is suitable for foraging by Threatened Black-cockatoos. A number of potential habitat trees were also recorded across the study site, with one located at 392497 mE, 6445689 mN supporting a hollow that could potentially be suitable for Black-cockatoo nesting.	Proposed clearing is at variance with this principle.	Avoid clearing areas of the Banksia Woodland habitat and avoid clearing the habitat tree located at 392497 mE, 6445689 mN.
3 (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora	A number of Threatened flora species were determined to potentially be supported by the study area, based on the results of the desktop review. The site is considered suitable habitat for the Threatened orchid, *Caladenia huegelii*. However, no rare (Threatened) flora were recorded during the field assessment.	Proposed clearing is not likely to be at variance with this principle.	Follow-up flora survey during early to mid-September 2017, targeting *Caladenia huegelii*, to further confirm the absence of this species.
4 (d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a Threatened Ecological Community (TEC).	Previous assessments have not determined the presence of TECs within a 5km radius of the study area (GHD, 2015). However, the recent listing of the Banksia Woodlands TEC by the Commonwealth DotEE is likely to apply to the entire extent of Banksia woodland (communities BaEt and BaXp) within the study area. Further qualitative assessment would be required to confirm the presence of this TEC.	Proposed clearing is likely to be at variance with this principle.	Undertake a follow-up assessment to diagnose the Banksia Woodland with regards to equivalence to the TEC.

Principle	Assessment	Outcome	Avoidance or Mitigation Recommendation/ Comment
5 (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in areas that have been extensively cleared.	The study area supports the Bassendean Complex-Central and South, which, according to the Local Biodiversity Program study (Western Australian Local Government Association 2013), is represented by 27.70% of its pre-European extent. This percentage exceeds the 10% EPA threshold for constrained areas of the Perth and Peel regions ((EPA, 2015), based on a pre-European extent of 87,392.73 ha and 24,206.24 ha documented by WALGA in 2013 as remaining.	Proposed clearing is not at variance with this principle.	NA
6 (f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	The study area traverses one geomorphic "Multiple Use" Wetland, which has been classified as a dampland (WA Atlas, 2016). No other water waterways or wetlands are present within the immediately adjacent areas or are linked to the study area through surface drainage (GHD, 2015). Multiple Use (M category) allow for development in conjunction with and management of wetland values, in the context of water, town and environmental planning.	Proposed clearing is at variance with this principle.	Although the site supports a wetland, the classification of that wetland should allow for development in conjunction with suitable management. Obtaining further advice from the Department of Water once concept plans are drafted is recommended.
7 (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The extent of existing clearing in the region of the study area is significant, comprising adjacent infrastructure and light commercial developments. The remnant vegetation present within the study area is mostly very degraded, although some better quality areas exist. Proposed clearing would result in further land degradation, although in the context of existing degradation, this is not considered significantly appreciable.	Proposed clearing is likely to be at variance with this principle.	Further degradation from clearing could be offset by enhancement of areas that are currently degraded, via appropriate management of weeds, bush fire risk, drainage and storm water, and by implementation of an appropriate rehabilitation/revegetation plan for any natural areas retained.
8 (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The nearest conservation reserve to the study area is Thomsons Lake Nature Reserve, located approximately 3 km to the south-west of the study site. Any proposed clearing would not impact on this conservation area.	Proposed clearing is not at variance with this principle.	NA

Principle	Assessment	Outcome	Avoidance or Mitigation Recommendation/ Comment
9 (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Data relating to groundwater (depth to) in the study area has not been made available and an analysis of surface water and groundwater has not been carried out as part of the flora and fauna assessment. However, generally, clearing of riparian and wetland vegetation that interacts with groundwater may have impacts on groundwater levels and potentially quality. Some areas of vegetation in the study area are specifically growing in association with surface or groundwater features, particularly the Mp and MpAl vegetation communities. Clearing vegetation can have impacts on surface water flows from rainfall run-off and this could impact the quality of surface water. However, there are no apparent areas of surface water in the study area, and the free draining sands present would be expected to result in negligible effects on surface run-off.	Proposed clearing may be at variance with this principle.	Minimise the areas of clearing of riparian/wetland vegetation where possible. Ensure suitable drainage features are incorporated into developments to avoid potential adverse impacts from run-off, and on surface and groundwater quality.
10 (j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate the incidence or intensity of flooding.	Proposed clearing has the potential to cause flooding within and around the proposed development area, however, the free draining sands of the study area are likely to limit this. Furthermore, any proposed development would incorporate suitable drainage features that would suitably direct surface water and avoid any flooding in adjacent natural areas, if retained.	Proposed clearing is unlikely to be at variance with this principle.	Ensure suitable drainage features are incorporated into developments to avoid potential flooding.

6 CONCLUSION AND RECOMMENDATIONS

The key ecological values associated with the study area are summarised as follows:

- Several Threatened and Priority flora species were identified during the desktop review as potentially occurring at the site, although none were recorded during the assessment.
- None of the flora species recorded are of any conservation significance.
- Five intact vegetation communities and three degraded vegetation communities were described and mapped within the study area, consisting of four woodlands, two woodland/wetland vegetation types, one heath and one degraded community.
- Areas of Banksia woodland (vegetation communities BaEt and BaXp) are likely to be representative of the newly listed Commonwealth TEC; *Banksia woodlands of the Swan Coastal Plain*.
- Five fauna habitats, consisting of woodlands and woodland/wetlands, one open heath/scrub and degraded areas were described and mapped across the study area.
- Evidence of Threatened Black-cockatoos (Carnaby's Black-cockatoo and Forest Red-tailed Black-cockatoo) was recorded during the site survey, including a direct sighting of Forest Red-tailed Black-cockatoos overflying the site and evidence of both species feeding on native tree fruits.
- Evidence of the Priority 4 species, Southern Brown Bandicoot/Quenda was observed in the form of diggings and this species is likely to inhabit the areas of dense understorey within the Paperbark Woodland/Swamp habitat, as well as probably the Banksia Woodland habitat.
- Rainbow Bee-eater (*Merops ornatus*) was determined to have a moderate likelihood of occurrence in the study area, based on recorded sightings by GHD (2015) and the presence of potentially suitable habitat.
- The site supports a dampland classified as a Multiple Use wetland (UFI 5562).

Below is a summary of the outcomes of the assessment against the ten clearing principles and impact mitigation/management and/or further study recommendations and comments:

- The proposed clearing is at variance with principle 2 (b), due to the presence of suitable foraging habitat and potential breeding habitat for Threatened Black-cockatoos, and likely habitat for the migratory bird species, Rainbow Bee-eater.
    - Impact mitigating recommendations:
        - Avoid or minimise clearing areas of the Banksia Woodland habitat
        - Avoid clearing the habitat tree located at 392497 mE, 6445689 mN
        - Limit ground disturbing activities (clearing and earthworks) to between February and July, which is outside the breeding season for Rainbow Bee-eater.
- The proposed clearing is at variance with principle 6 (f), due to the presence of a wetland at the site.
    - Recommendations:
        - Obtain advice from the Department of Water once concept plans are drafted, in order to achieve environmentally sensitive development in association with the wetland.
- The proposed clearing is likely to be at variance with principle 4 (d), due to the likely presence of the Banksia Woodlands TEC at the site.
    - Recommendations:
        - Undertake a follow-up assessment to confirm the presence and extent of the Banksia Woodland TEC at the site, which will also better inform potential offset requirements.

- The proposed clearing is likely to be at variance with principle 7 (g), due to the likelihood that it will cause appreciable land degradation.
    - Recommendations:
        - Consider options to offset impacts of further degradation by enhancement of areas that are currently degraded and may be retained.
- The proposed clearing may be at variance with principle 9 (i), due to the potential impacts on surface water and groundwater.
    - Impact mitigating recommendations:
        - Minimise the areas of clearing of riparian/wetland vegetation where possible.
        - Ensure suitable drainage features are incorporated into developments to avoid potential adverse impacts from run-off, and on surface and groundwater quality.
- The proposed clearing is unlikely to be, but may be at variance with principle 3 (c), due to the potential (although unlikely) presence of Threatened orchid, *Caladenia huegelii.*
    - Recommendation:
        - Consider a follow-up flora survey during early to mid-September 2017, targeting *Caladenia huegelii*, to further confirm the absence of this species. This assessment could also target other potentially occurring conservation significant flora, in order to ascertain their absence at the site.
- The proposed clearing is unlikely to be, but may be at variance with principle 10 (j), due to the potential (although unlikely) to cause flooding.
    - Recommendation:
        - Ensure suitable drainage features are incorporated into developments to avoid potential flooding.

Avoidance of the majority of the Banksia woodland area, likely to represent the TEC could be achieved by realigning the proposed North Lake Road to Beeliar Drive road alignment, as shown in **Figure 7**. Other currently proposed road alignments are considered well-placed to minimise impacts on areas of best quality vegetation and habitat within the study area.

The findings of the study suggest that any impacts to areas of the Banksia Woodland TEC or Black-Cockatoo foraging habitat would require referral to the Commonwealth DotEE. The DotEE has advised that development of the LSP itself would not require referral and that the City would only be required to refer for impacts to such areas that would result from road developments. Third parties who may develop the land within the LSP area would be required to refer the project under the EPBC Act where those developments may impact on the identified MNES (Small 2016 *pers. comm.*).

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APPENDIX A: NATUREMAP SPECIES REPORT

NatureMap Species Report

Created By Guest user on 26/09/2016

Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Polygon'
Vertices	32° 07' 45" S,115° 50' 59" E 32° 07' 45" S,115° 50' 60" E 32° 07' 18" S,115° 51' 03" E 32° 06' 42" S,115° 51' 09" E 32° 06' 47" S,115° 51' 28" E 32° 07' 11" S,115° 52' 36" E 32° 07' 42" S,115° 52' 13" E 32° 07' 36" S,115° 51' 56" E 32° 07' 40" S,115° 51' 32" E 32° 07' 45" S,115° 50' 59" E
Group By	Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	89	137
Priority 1	1	3
Priority 5	2	9
Protected under international agreement	1	1
Rare or likely to become extinct	2	2
TOTAL	**95**	**152**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
2.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
Protected under international agreement					
3.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
Priority 1					
4.	33994	*Throscodectes xiphos (cricket)*		P1	
Priority 5					
5.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P5	
6.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
Non-conservation taxon					
7.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
8.	25536	*Accipiter fasciatus (Brown Goshawk)*			
9.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
10.	44629	*Anilios australis*			
11.	24561	*Anthochaera carunculata (Red Wattlebird)*			
12.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
13.	17737	*Azolla pinnata*			
14.		*Barnardius zonarius*			
15.	741	*Baumea articulata (Jointed Rush)*			
16.	744	*Baumea laxa*			
17.	16636	*Boronia crenulata subsp. viminea*			
18.	5458	*Calytrix flavescens (Summer Starflower)*			
19.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
20.		*Calytrix sp.*			
21.	2794	*Carpobrotus aequilaterus (Angular Pigface)*	Y		
22.	6214	*Centella asiatica*			
23.	43380	*Chelodina colliei (Oblong Turtle)*			
24.	24980	*Christinus marmoratus (Marbled Gecko)*			
25.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
26.	25592	*Corvus coronoides (Australian Raven)*			
27.	25595	*Cracticus tibicen (Australian Magpie)*			
28.	25399	*Crinia glauerti (Clicking Frog)*			
29.	25400	*Crinia insignifera (Squelching Froglet)*			
30.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
31.	25027	*Ctenotus australis*			
32.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain pop P3), skink)*			
33.	40660	*Cycnogeton huegelii*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
34.	24322	*Cygnus atratus (Black Swan)*			
35.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
36.		*Descolea maculata*			
37.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
38.	11105	*Echinochloa crus-galli*	Y		
39.		*Eolophus roseicapillus*			
40.	20483	*Gastrolobium linearifolium*			
41.	3921	*Gastrolobium reticulatum*			
42.	6161	*Gonocarpus pithyoides*			
43.	24443	*Grallina cyanoleuca (Magpie-lark)*			
44.	25410	*Heleioporus eyrei (Moaning Frog)*			
45.	25119	*Hemiergis quadrilineata*			
46.	5173	*Hibbertia subvaginata*			
47.	24491	*Hirundo neoxena (Welcome Swallow)*			
48.	921	*Isolepis producta*			
49.	1188	*Juncus pallidus (Pale Rush)*			
50.	15498	*Kunzea glabrescens (Spearwood)*			
51.		*Latrodectus hasseltii*			
52.	8099	*Leontodon saxatilis (Hairy Hawkbit)*	Y		
53.	25661	*Lichmera indistincta (Brown Honeyeater)*			
54.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
55.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
56.	25388	*Litoria moorei (Motorbike Frog)*			
57.	7408	*Lobelia tenuior (Slender Lobelia)*			
58.	6458	*Lysinema elegans*			
59.	25654	*Malurus splendens (Splendid Fairy-wren)*			
60.	25758	*Megalurus gramineus (Little Grassbird)*			
61.	34676	*Meionectes brownii (Swamp Raspwort)*			
62.		*Metaballus litus*			
63.	15419	*Microtis media subsp. media*			
64.	25192	*Morethia obscura*			
65.	24223	*Mus musculus (House Mouse)*	Y		
66.	25252	*Notechis scutatus (Tiger Snake)*			
67.	14293	*Oenothera indecora subsp. bonariensis*	Y		
68.	16347	*Oenothera laciniata*	Y		
69.	24409	*Phaps chalcoptera (Common Bronzewing)*			
70.	1478	*Phlebocarya ciliata*			
71.	1479	*Phlebocarya filifolia*			
72.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
73.	4141	*Phyllota gracilis*			
74.		*Phytophthora cinnamomi*			
75.	4524	*Platytheca galioides*			
76.	25722	*Polytelis anthopeplus (Regent Parrot)*			
77.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
78.	25732	*Porzana pusilla (Baillon's Crake)*			
79.	24771	*Porzana tabuensis (Spotless Crake)*			
80.	25511	*Pseudonaja affinis (Dugite)*			
81.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
82.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
83.	4181	*Pultenaea reticulata*			
84.		*Purpureicephalus spurius*			
85.	24245	*Rattus rattus (Black Rat)*	Y		
86.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
87.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
88.	24844	*Threskiornis molucca (Australian White Ibis)*			
89.	25519	*Tiliqua rugosa*			
90.	25207	*Tiliqua rugosa subsp. rugosa*			
91.	4383	*Tribulus terrestris (Caltrop)*	Y		
92.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
93.	150	*Triglochin stowardii*			
94.	98	*Typha domingensis (Bulrush, Djandjid)*			
95.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

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

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

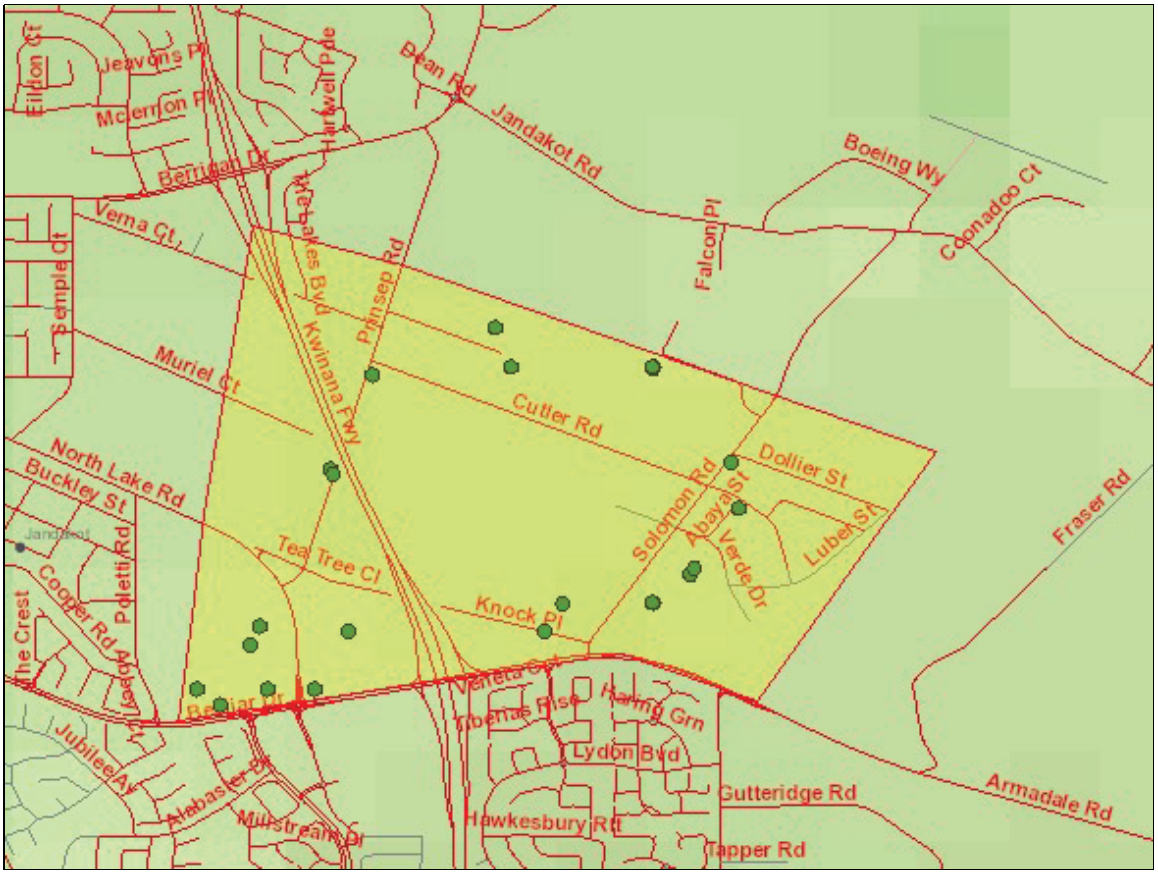
[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only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

NatureMap
Mapping Western Australia's biodiversity

CCE LSP Project Area

Printed by Guest user on 26/9/2016

Query details : Current Names Only=Yes; Core Datasets Only=Yes; Method='By Polygon';Vertices=32° 07' 45" S,115° 50' 59" E 32° 07' 45" S,115° 50' 60" E 32° 07' 18" S,115° 51' 03" E 32° 06' 42" S,115° 51' 09" E 32° 06' 47" S,115° 51' 28" E 32° 07' 11" S,115° 52' 36" E 32° 07' 42" S,115° 52' 13" E 32° 07' 36" S,115° 51' 56" E 32° 07' 40" S,115° 51' 32" E 32° 07' 45" S,115° 50' 59" E ;



Search Results

Selected

- Selected Species

All Results

- Non-conservation taxon
- Priority 1
- Priority 5
- Protected under international agreement
- Rare or likely to become extinct

Reference Layers

Major WA Towns

Major WA Towns

Major WA Towns

Roads

- Sealed
- Unsealed
- Track

State Borders

Australian Continent

NatureMap is a collaborative project of the Department of Parks and Wildlife, Western Australia, and the Western Australian Museum.

APPENDIX B: EPBC ACT PROTECTED MATTERS (MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (MNES))

Australian Government
Department of the Environment

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.

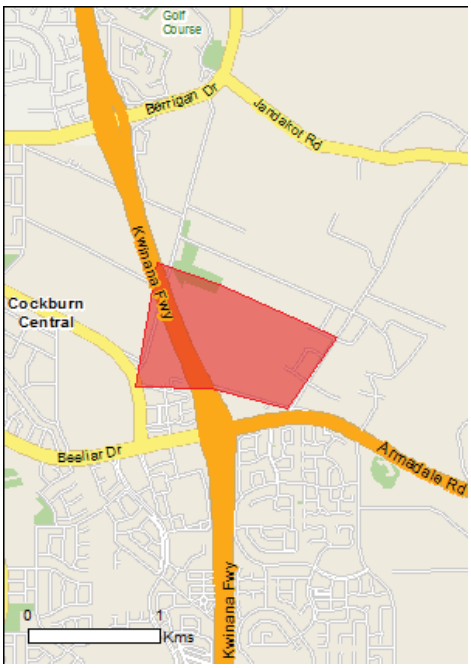
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 26/09/16 19:59:27

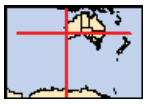
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 0.0Km



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:	None
Listed Threatened Species:	16
Listed Migratory Species:	6

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:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	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:	None
Regional Forest Agreements:	None
Invasive Species:	40
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 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 ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Black-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 may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
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]	Vulnerable	Species or species habitat may 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 likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species

Name	Status	Type of Presence
		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, Praying Virgin [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
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to 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
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

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		
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

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely 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 may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

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
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

Name	Status	Type of Presence
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 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

Name	Status	Type of Presence
		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
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to 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, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species

Name	Status	Type of Presence
		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.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

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

-32.125249 115.858998,-32.125268 115.858998,-32.125122 115.853741,-32.117944 115.855308,-32.119216 115.859492,-32.122269 115.867603,-32.126431 115.864213,-32.125249 115.858998

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
-Parks and Wildlife Commission NT, Northern Territory Government
-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, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-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: MUIR STRUCTURAL VEGETATION CLASSIFICATIONS

Life Form/Height Class	Canopy Cover			
	Dense 70-100%	Mid-dense 30-70%	Sparse 10-30%	Very sparse 2-10%
Trees >30m Trees 15-30m Trees 5-15m Trees <5m	Dense tall forest Dense forest Dense low forest A Dense low forest B	Tall forest Forest Low forest A Low forest B	Tall woodland Woodland Low woodland A Low woodland B	Open tall woodland Open woodland Open low woodland A Open low woodland B
Mallee Tree Form Mallee Shrub form	Dense tree mallee Dense shrub mallee	Tree mallee Shrub mallee	Open tree mallee Open shrub mallee	Very open tree mallee Very open shrub mallee
Shrubs >2m Shrubs 1.5-2m Shrubs 1-1.5m Shrubs 0.5-1m Shrubs <0.5m	Dense thicket Dense heath A Dense heath B Dense low heath C Dense low heath D	Thicket Heath A Heath B Low heath C Low heath D	Scrub Low scrub A Low scrub B Dwarf scrub C Dwarf scrub D	Open scrub Open low scrub A Open low scrub B Open dwarf scrub C Open dwarf scrub D
Mat plants Hummock grass Bunch grass >0.5m Bunch grass <0.5m Herbaceous spp.	Dense mat plants Dense hummock grass Dense tall grass Dense low grass Dense herbs	Mat plants Mid-dense hummock grass Tall grass Low grass Herbs	Open mat plants Hummock grass Open tall grass Open low grass Open herbs	Very open mat plants Open hummock grass Very open tall grass Very open low grass Very open herbs
Sedges >0.5m Sedges <0.5m	Dense tall sedges Dense low sedges	Tall sedges Low sedges	Open tall sedges Open low sedges	Very open tall sedges Very open low sedges
Ferns Mosses, Liverwort	Dense ferns Dense mosses	Ferns Mosses	Open ferns Open mosses	Very open ferns Very open mosses

Source: (Muir 1977)

APPENDIX D: OBSERVED AND POTENTIAL FAUNA SPECIES LIST

Observed and Potential Vertebrate Fauna List

Cockburn Central East - Local Structure Plan Area

Compiled by Greg Harewood - November 2016
Approximate centroid = 32.21492°S and 115.85916°E
Recorded (Sighted/Heard/Signs/Captured) = X

A = Harewood, G. (2016). Fauna Assessment of Cockburn Central East - Local Structure Plan Area. Unpublished report for Focused Vison Consulting.

B = GHD (2015). North Lake Road Extension Ecological Assessment. Unpublished report for the City of Cockburn

C = ENV (2009). Jandakot Airport Fauna Survey. Unpublished report for Jandakot Airport Holdings Pty Ltd.

D = Phoenix Environmental Sciences (2011). Vertebrate Fauna Survey for the Roe Highway Extension Project. Unpublished report for South Metro Connect.

E = Harewood, G. (2009) Fauna Survey (Level 2) East Rockingham WWTP Site and Pipeline Corridors. Unpublished report for ERM.

F = DPaW (2016). NatureMap Database search. “By Circle” 115° 51' 36" E, 32° 07' 18" S – Study area (plus 8km buffer), 06/0102016.

Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Amphibia								
Myobatrachidae Ground or Burrowing Frogs								
Crinia georgiana	Quacking Frog	LC			X	X		X
Crinia glauerti	Clicking Frog	LC				X		X
Crinia insignifera	Squelching Froglet	LC				X		X
Geocrinia leai	Ticking Frog	LC						
Heleioporus eyrei	Moaning Frog	LC		X		X		X
Limnodynastes dorsalis	Western Banjo Frog	LC		X	X	X		X
Myobatrachus gouldii	Turtle Frog	LC				X		X

WC Act Status - S1 to S7, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DPaW Priority Status - P1 to P4, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Pseudophryne guentheri	Crawling Toadlet	LC						X
Hylidae Tree or Water-Holding Frogs								
Litoria adelaidensis	Slender Tree Frog	LC			X	X		X
Litoria moorei	Motorbike Frog	LC				X		X
Reptilia								
Diplodactylidae Geckoes								
Strophurus spinigerus	Soft Spiny-tailed Gecko						X	X
Gekkonidae Geckoes								
Christinus marmoratus	Marbled Gecko					X	X	X
Pygopodidae Legless Lizards								
Aprasia repens	Sandplain Worm Lizard					X		X
Delma fraseri	Fraser's Legless Lizard				X		X	X
Lialis burtonis	Burton's Legless Lizard					X	X	X
Pygopus lepidopodus	Common Scaly Foot				X	X		X

WC Act Status - S1 to S7, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DPaW Priority Status - P1 to P4, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Agamidae Dragon Lizards								
Ctenophorus adelaidensis	Southern Heath Dragon							X
Pogona minor	Western Bearded Dragon			X	X	X	X	X
Varanidae Monitor's or Goanna's								
Varanus gouldii	Gould's Sand Monitor			X				X
Varanus tristis	Racehorse Monitor						X	

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Scincidae Skinks								
Acritoscincus trilineatum	Southwestern Cool Skink				X	X		
Cryptoblepharus buchananii	Fence Skink				X	X	X	X
Ctenotus australis	Western Ctenotus					X	X	X
Ctenotus fallens	West Coast Ctenotus					X	X	X
Ctenotus impar	Odd-striped Ctenotus							X
Egernia napoleonis	Salmon-bellied Skink					X		X
Hemiergis quadrilineata	Two-toed Mulch Skink				X	X	X	X
Lerista elegans	West Coast Four-toed Lerista				X	X	X	X
Lerista lineata	Perth Lined Lerista	P3		X		X		X
Menetia greyii	Dwarf Skink				X	X	X	X
Morethia lineoocellata	West Coast Pale-flecked Morethia					X	X	X
Morethia obscura	Shrubland Pale-flecked Morethia					X	X	X
Tiliqua rugosa	Bobtail		X		X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Elapidae Elapid Snakes								
Notechis scutatus	Tiger Snake					X		X
Pseudonaja affinis	Dugite			X	X	X	X	X
Simoselaps bertholdi	Jan's Banded Snake							X
Aves								
Phasianidae Quails, Pheasants								
Coturnix pectoralis	Stubble Quail	LC						X
Coturnix ypsilophora	Brown Quail	LC			X			X
Anatidae Geese, Swans, Ducks								
Anas gracilis	Grey Teal	LC				X		X
Anas superciliosa	Pacific Black Duck	LC			X	X		X
Chenonetta jubata	Australian Wood Duck	LC						X
Tadorna tadornoides	Australian Shelduck	LC				X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Ardeidae Herons, Egrets, Bitterns								
Ardea alba	Great Egret	S5 Mig CA JA				X		X
Ardea novaehollandiae	White-faced Heron	LC				X		X
Ardea pacifica	White-necked Heron	LC						X
Threskiornithidae Ibises, Spoonbills								
Platalea flavipes	Yellow-billed Spoonbill	LC				X		X
Threskiornis molucca	Australian White Ibis	LC	X	X	X	X		X
Threskiornis spinicollis	Straw-necked Ibis	LC	X		X	X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Accipitridae Kites, Goshawks, Eagles, Harriers								
Accipiter cirrocephalus	Collared Sparrowhawk	Bp LC			X		X	X
Accipiter fasciatus	Brown Goshawk	Bp LC		X		X	X	X
Aquila audax	Wedge-tailed Eagle	Bp LC				X		X
Aquila morphnoides	Little Eagle	Bp LC			X		X	X
Circus approximans	Swamp Harrier	LC				X		X
Circus assimilis	Spotted Harrier	LC						X
Elanus caeruleus	Black-shouldered Kite	LC			X	X	X	X
Haliastur sphenurus	Whistling Kite	Bp LC				X	X	X
Hamirostra isura	Square-tailed Kite	Bp LC						

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Falconidae Falcons								
Falco berigora	Brown Falcon	Bp LC						X
Falco cenchroides	Australian Kestrel	LC	X	X	X	X	X	X
Falco longipennis	Australian Hobby	LC			X	X	X	X
Falco peregrinus	Peregrine Falcon	S7 Bp LC					X	X
Rallidae Rails, Crakes, Swamphens, Coots								
Fulica atra	Eurasian Coot	LC				X		X
Gallinula tenebrosa	Dusky Moorhen	Bh LC				X		X
Gallinula ventralis	Black-tailed Native-hen	LC				X		X
Gallirallus philippensis	Buff-banded Rail	LC						X
Porphyrio porphyrio	Purple Swamphen	LC				X		X
Porzana fluminea	Australian Spotted Crake	LC						X
Porzana pusilla	Baillon's Crake	LC						X
Porzana tabuensis	Spotless Crake	LC						X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Turnicidae Button-quails								
Turnix varia	Painted Button-quail	Bp LC						X
Columbidae Pigeons, Doves								
Columba livia	Domestic Pigeon	Introduced				X		X
Ocyphaps lophotes	Crested Pigeon	LC			X	X		X
Phaps chalcoptera	Common Bronzewing	Bh LC			X		X	X
Streptopelia chinensis	Spotted Turtle-Dove	Introduced		X	X	X		X
Streptopelia senegalensis	Laughing Turtle-Dove	Introduced		X	X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Psittacidae Parrots								
Cacatua roseicapilla	Galah	LC	X	X	X	X	X	X
Cacatua sanguinea	Little Corella	LC			X	X		X
Cacatua tenuirostris	Eastern Long-billed Corella	Introduced						X
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	S3 VU Bp VU A2c+3c+4c	X	X	X	X		X
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	S2 EN Bp EN A2bcde+3bcde+4bcde	X	X	X	X	X	X
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	LC						X
Neophema elegans	Elegant Parrot	LC				X		X
Platycercus icterotis icterotis	Western Rosella (western ssp)	Bp LC						
Platycercus spurius	Red-capped Parrot	LC	X	X	X	X	X	X
Platycercus zonarius	Australian Ringneck Parrot	LC	X	X	X	X	X	X
Polytelis anthopeplus	Regent Parrot	LC						X
Trichoglossus haematodus	Rainbow Lorikeet	Introduced	X	X	X	X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Cuculidae Parasitic Cuckoos								
Cacomantis flabelliformis	Fan-tailed Cuckoo	LC		X	X			X
Chrysococcyx basalis	Horsfield's Bronze Cuckoo	LC			X		X	
Chrysococcyx lucidus	Shining Bronze Cuckoo	LC	X		X	X		X
Cuculus pallidus	Pallid Cuckoo	LC						
Strigidae Hawk Owls								
Ninox novaeseelandiae	Boobook Owl	LC				X		X
Tytonidae Barn Owls								
Tyto alba	Barn Owl	LC					X	X
Podargidae Frogmouths								
Podargus strigoides	Tawny Frogmouth	LC						X
Caprimulgidae Nightjars								
Eurostopodus argus	Spotted Nightjar	LC						X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Aegothelidae Owlet-nightjars								
Aegotheles cristatus	Australian Owlet-nightjar	LC				X		X
Halcyonidae Tree Kingfishers								
Dacelo novaeguineae	Laughing Kookaburra	Introduced	X	X		X	X	X
Todiramphus sanctus	Sacred Kingfisher	LC				X		X
Meropidae Bee-eaters								
Merops ornatus	Rainbow Bee-eater	S5 Mig JA LC		X		X	X	X
Maluridae Fairy Wrens, GrassWrens								
Malurus splendens	Splendid Fairy-wren	Bh LC	X	X	X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Acanthizidae Thornbills, Geryones, Fieldwrens & Whitefaces								
Acanthiza apicalis	Broad-tailed Thornbill	Bh LC				X	X	X
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Bh LC			X	X		X
Acanthiza inornata	Western Thornbill	Bh LC				X	X	X
Gerygone fusca	Western Gerygone	LC	X	X	X	X	X	X
Sericornis frontalis	White-browed Scrubwren	Bh LC				X	X	X
Smicrornis brevirostris	Weebill	Bh LC				X	X	X
Pardalotidae Pardalotes								
Pardalotus punctatus	Spotted Pardalote	LC				X		X
Pardalotus striatus	Striated Pardalote	LC		X	X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Meliphagidae Honeyeaters, Chats								
Acanthorhynchus superciliosus	Western Spinebill	LC			X	X		X
Anthochaera carunculata	Red Wattlebird	LC	X	X	X	X	X	X
Anthochaera lunulata	Western Little Wattlebird	Bp LC		X	X	X		X
Epthianura albifrons	White-fronted Chat	LC			X			X
Lichenostomus virescens	Singing Honeyeater	LC	X	X	X	X	X	
Lichmera indistincta	Brown Honeyeater	LC	X	X	X	X	X	X
Phylidonyris melanops	Tawny-crowned Honeyeater	Bp LC						X
Phylidonyris nigra	White-cheeked Honeyeater	Bp LC			X	X		X
Phylidonyris novaehollandiae	New Holland Honeyeater	Bp LC	X	X	X	X	X	X
Petroicidae Australian Robins								
Petroica multicolor	Scarlet Robin	Bh LC					X	X
Neositтidae Sitellas								
Daphoenositta chrysoptera	Varied Sittella	Bh LC				X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Pachycephalidae Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers								
Colluricincla harmonica	Grey Shrike-thrush	Bh LC			X	X	X	X
Pachycephala pectoralis	Golden Whistler	Bh LC			X			X
Pachycephala rufiventris	Rufous Whistler	LC	X	X	X	X	X	X
Dicruridae Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo								
Grallina cyanoleuca	Magpie-lark	LC		X	X	X	X	X
Rhipidura fuliginosa	Grey Fantail	LC	X			X	X	X
Rhipidura leucophrys	Willie Wagtail	LC	X	X	X	X	X	X
Campephagidae Cuckoo-shrikes, Trillers								
Coracina novaehollandiae	Black-faced Cuckoo-shrike	LC	X	X	X	X	X	X
Lalage tricolor	White-winged Triller	LC						

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Artamidae Woodswallows, Butcherbirds, Currawongs								
Artamus cinereus	Black-faced Woodswallow	Bp LC						X
Artamus cyanopterus	Dusky Woodswallow	Bp LC				X		X
Cracticidae Currawongs, Magpies & Butcherbirds								
Cracticus tibicen	Australian Magpie	LC	X	X	X	X	X	X
Cracticus torquatus	Grey Butcherbird	LC	X	X	X	X	X	X
Corvidae Ravens, Crows								
Corvus coronoides	Australian Raven	LC	X	X	X	X	X	X
Motacillidae Old World Pipits, Wagtails								
Anthus australis	Australian Pipit	LC					X	
Dicaeidae Flowerpeckers								
Dicaeum hirundinaceum	Mistletoebird	LC						X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Hirundinidae Swallows, Martins								
Hirundo neoxena	Welcome Swallow	LC				X	X	X
Hirundo nigricans	Tree Martin	LC		X	X	X	X	X
Sylviidae Old World Warblers								
Cincloramphus cruralis	Brown Songlark	LC						X
Cincloramphus mathewsi	Rufous Songlark	LC						X
Zosteropidae White-eyes								
Zosterops lateralis	Silvereye	LC	X	X	X	X	X	X
Mammalia								
Peramelidae Bandicoots								
Isoodon obesulus fusciventer	Southern Brown Bandicoot	P4 LC	X	X	X	X	X	
Phalangeridae Brushtail Possums, Cuscuses								
Trichosurus vulpecula	Common Brushtail Possum	LC				X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Molossidae Freetail Bats								
Austronomus australis	White-striped Freetail-bat	LC			X	X		X
Ozimops kitcheneri	Southern Freetail-bat	LC				X	X	
Vespertilionidae Ordinary Bats								
Chalinolobus gouldii	Gould's Wattled Bat	LC			X	X	X	X
Chalinolobus morio	Chocolate Wattled Bat	LC						
Nyctophilus geoffroyi	Lesser Long-eared Bat	LC				X		X
Nyctophilus gouldi	Gould's Long-eared Bat	LC						
Nyctophilus major	Western Long-eared Bat	LC					X	
Vespadelus regulus	Southern Forest Bat	LC			X	X	X	X
Muridae Rats, Mice								
Mus musculus	House Mouse	Introduced		X	X	X	X	X
Rattus rattus	Black Rat	Introduced			X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Canidae Dogs, Foxes								
Canis lupus familiaris	Dog	Introduced	X	X			X	
Vulpes vulpes	Red Fox	Introduced	X		X	X	X	X
Felidae Cats								
Felis catus	Cat	Introduced		X	X	X	X	X
Leporidae Rabbits, Hares								
Oryctolagus cuniculus	Rabbit	Introduced	X	X	X	X	X	X

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APPENDIX E: FLORA SPECIES LIST (BY COMMUNITY)

* denotes introduced (weed) species
DP denotes Declared Pest plants

			Vegetation Community							
Family	**Species**	**N/I**	**BaEt**	**BaXp**	**Xp**	**Mp**	**MpAl**	**ErAl (d)**	**Eg (d)**	**i**
Aizoaceae	*Carpobrotus edulis*	*	+	+	+					+
Apiaceae	*Daucus glochidiatus*	*	+	+						
Apocynaceae	*Gomphocarpus fruticosus*	DP		+						
Araceae	*Zantedeschia aethiopica*	DP				+				
Asparagaceae	*Asparagus asparagoides*	DP	+			+	+			
Asphodelaceae	*Trachyandra divaricata*	*								+
Asteraceae	*Arctotheca calendula*	*			+	+	+	+	+	+
	Hypochaeris glabra	*	+	+	+	+	+	+	+	+
	Osteospermum ecklonis	*								+
	Sonchus oleraceus	*		+						+
	Ursinia anthemoides	*	+	+						+
Boraginaceae	*Echium plantagineum*	DP		+						
Brassicaceae	*Brassica tournefortii*	*	+							+
Cactaceae	*Opuntia* sp.	*								+
Campanulaceae	*Wahlenbergia capensis*	*	+							
Caryophyllaceae	*Petrorhagia dubia*	*			+					
Casuarinaceae	*Allocasuarina fraseri*			+	+					
	Allocasuarina humilis		+							
Colchicaceae	*Burchardia congesta*		+							
Crassulaceae	*Crassula colorata*		+		+					+
Cyperaceae	*Isolepis marginata*			+						+
	Lepidosperma longitudinale					+				
Dasypogonaceae	*Dasypogon bromeliifolius*			+	+					
Dilleniaceae	*Hibbertia hypericoides*		+							
	Hibbertia subvaginata		+			+	+			
Ecdeiocoleaceae	*Ecdeiocolea monostachya*									+
Elaeocarpaceae	*Tetratheca hirsuta*					+				
Ericaceae	*Conostephium minus*				+					
	Leucopogon australis					+				
	Leucopogon conostephioides		+							
Euphorbiaceae	*Euphorbia terracina*	*			+					+
	Ricinus communis	*		+					+	
Fabaceae	*Acacia longifolia*	*	+				+	+		+
	Acacia pulchella					+	+	+		
	Acacia saligna			+						
	Bossiaea eriocarpa		+							
	Chamaecytisus palmensis	*		+						+
	Daviesia triflora		+							
	Gastrolobium capitatum		+							
	Gompholobium tomentosum		+							
	Hovea pungens		+							
	Jacksonia furcellata		+	+						
	Lupinus cosentinii	*								+
	Medicago polymorpha	*				+		+	+	
	Trifolium campestre	*		+						+
	Vicia hirsuta	*								+
	Vicia sativa subsp. *nigra*	*		+						+
Geraniaceae	*Erodium botrys*	*		+						
	Pelargonium capitatum	*		+						+
Goodeniaceae	*Dampiera linearis*		+							

* denotes introduced (weed) species
DP denotes Declared Pest plants

			Vegetation Community							
Family	**Species**	**N/I**	**BaEt**	**BaXp**	**Xp**	**Mp**	**MpAl**	**ErAl (d)**	**Eg (d)**	**i**
Haemodoraceae	*Anigozanthos humilis*		+							
	Anigozanthos manglesii		+							
	Conostylis aculeata subsp. *aculeata*		+							
	Phlebocarya ciliata		+		+					
Iridaceae	*Freesia alba × leichtlinii*	*								+
	Gladiolus caryophyllaceus	*	+	+	+					+
	Patersonia occidentalis	*	+							
	Romulea rosea	*	+							
	Watsonia meriana	*								+
Lauraceae	*Cassytha racemosa*					+	+			
Loranthaceae	*Nuytsia floribunda*		+	+						+
Malvaceae	*Brachychiton diversifolius*									+
Meliaceae	*Melia azedarach*	*								+
Myrtaceae	*Aotus gracillima*		+							
	Astartea scoparia					+	+			
	Eremaea pauciflora var. *pauciflora*		+							
	Eucalyptus gomphocephala								+	+
	Eucalyptus marginata			+						
	Eucalyptus petiolaris									+
	Eucalyptus rudis				+	+		+		
	Eucalyptus todtiana			+						
	Hypocalymma angustifolium		+	+		+	+			
	Hypocalymma robustum		+							
	Kunzea glabrescens					+	+			+
	Leptospermum laevigatum	*				+	+	+	+	+
	Melaleuca preissiana			+			+			+
	Pericalymma ellipticum					+				
	Regelia inops			+						
	Scholtzia involucrata		+		+					
Oleaceae	*Olea europaea*	*								+
Orchidaceae	*Caladenia flava*		+							
	Diuris brumalis		+							
	Thelymitra crinita		+			+				
Orobanchaceae	*Orobanche minor*	*		+						
Oxalidaceae	*Oxalis pes-caprae*	*		+						+
Papaveraceae	*Fumaria capreolata*	*	+	+	+	+	+	+	+	+
Poaceae	*Briza maxima*	*	+	+	+	+	+	+	+	
	Briza minor	*			+	+	+	+	+	
	Bromus arenarius	*		+	+					+
	Cynodon dactylon	*								+
	Ehrharta calycina	*					+	+	+	+
	Ehrharta longiflora	*		+	+	+	+	+	+	+
	Lagurus ovatus	*								+
	Lolium rigidum	*		+	+					+
Primulaceae	*Lysimachia arvensis*	*		+						
Proteaceae	*Adenanthos cygnorum*		+							+
	Adenanthos obovatus		+	+	+					
	Banksia attenuata				+					+
	Banksia ilicifolia		+							
	Banksia menziesii		+	+	+					
	Petrophile linearis		+							
	Stirlingia latifolia		+							

* denotes introduced (weed) species
DP denotes Declared Pest plants

			Vegetation Community							
Family	**Species**	**N/I**	**BaEt**	**BaXp**	**Xp**	**Mp**	**MpAl**	**ErAl (d)**	**Eg (d)**	**i**
Restionaceae	*Leptocarpus scariosus*		+							
	Lyginia imberbis		+							
Solanaceae	*Solanum linnaeanum*	*								+
Xanthorrhoeaceae	*Xanthorrhoea preissii*				+		+			+
Zamiaceae	*Macrozamia riedlei*		+							
	Total	45	48	35	22	22	18	12	11	43

APPENDIX F: SITE DESCRIPTIONS

BaEt

Low Woodland A of *Banksia attenuata* and *Eucalyptus todtiana* over *Xanthorrhoea preissii* over *Dasypogon bromeliifolius* and *Phlebocarya ciliata* in pale grey sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	10 m x 10 m
Habitat	Woodland
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Pale Grey
Soil Texture	Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	3-4 (Good to Very Good)
Disturbance Type	Weeds
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 25**%**

Species	Dominant Height (m)	Form	% cover
Banksia attenuata	6	Tree	7
Eucalyptus todtiana	5	Tree	5
Banksia ilicifolia		Tree	1
Banksia menziesii		Tree	1
Xanthorrhoea preissii	2	Shrub	3
Acacia longifolia		Shrub	1

Species	Dominant Height (m)	Form	% cover
Adenanthos cygnorum subsp. *cygnorum*		Shrub	1
Adenanthos obovatus		Shrub	1
Allocasuarina humilis		Shrub	1
Bossiaea eriocarpa		Shrub	1
Eremaea pauciflora var. *pauciflora*		Shrub	1
Gastrolobium capitatum		Shrub	1
Gompholobium tomentosum		Shrub	1
Hibbertia hypericoides		Shrub	1
Hibbertia subvaginata		Shrub	1
Hovea pungens		Shrub	1
Hypocalymma angustifolium		Shrub	1
Hypocalymma robustum		Shrub	1
Jacksonia furcellata		Shrub	1
Daviesia triflora		Shrub	1
Aotus gracillima		Shrub	1
Leucopogon conostephioides		Shrub	1
Nuytsia floribunda		Shrub	1
Petrophile linearis		Shrub	1
Scholtzia involucrata		Shrub	1
*Asparagus asparagoides** (DP)		Climber	1
*Fumaria capreolata**		Climber	1
Dasypogon bromeliifolius	0.4	Herb	10
Phlebocarya ciliata	0.3	Herb	10
Anigozanthos humilis		Herb	1
Anigozanthos manglesii		Herb	1
*Brassica tournefortii**		Herb	1
Burchardia congesta		Herb	1
Caladenia flava		Herb	1
*Carpobrotus edulis**		Herb	1
Conostylis aculeata subsp. *aculeata*		Herb	1
Crassula colorata		Herb	1
Dampiera linearis		Herb	1
*Daucus glochidiatus**		Herb	1
Diuris brumalis		Herb	1
*Gladiolus caryophyllaceus**		Herb	1
*Hypochaeris glabra**		Herb	1
Leptocarpus scariosus		Herb	1
Macrozamia riedlei		Shrub	1
Patersonia occidentalis		Herb	1
*Romulea rosea**		Herb	1

Species	Dominant Height (m)	Form	% cover
Stirlingia latifolia		Herb	1
Thelymitra crinita		Herb	1
*Ursinia anthemoides**		Herb	1
*Wahlenbergia capensis**		Herb	1
Lyginia imberbis		Sedge	1
*Briza maxima**		Grass	1

BaXp

Low Woodland A of *Banksia attenuata* and *Banksia ilicifolia* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longifolia*, over mostly weeds, dominated by **Ehrharta calycina* and **Actotheca calendula*, in grey sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	10 m x 10 m
Habitat	Woodland
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Grey
Soil Texture	Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	4 (Good)
Disturbance Type	Weeds; Vehicle tracks
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 25**%**

Species	Dominant Height (m)	Form	% cover
Banksia attenuata	6	Tree	6
Banksia ilicifolia	7	Tree	3
Allocasuarina fraseriana		Tree	1
Banksia menziesii		Tree	1
Eucalyptus marginata		Tree	1
Eucalyptus todtiana		Tree	1
Melaleuca preissiana		Tree	1

Species	Dominant Height (m)	Form	% cover
Xanthorrhoea preissii	1.5	Shrub	3
Kunzea glabrescens	3	Shrub	2
*Acacia longifolia**	3	Shrub	1
Acacia saligna		Shrub	1
Adenanthos obovatus		Shrub	1
*Chamaecytisus palmensis**		Shrub	1
*Gomphocarpus fruticosus** (DP)		Shrub	1
Hypocalymma angustifolium		Shrub	1
Jacksonia furcellata		Shrub	1
Nuytsia floribunda		Shrub	1
Regelia inops		Shrub	1
*Ricinus communis**		Shrub	1
*Fumaria capreolata**		Climber	1
*Arctotheca calendula**	0.2	Herb	10
*Carpobrotus edulis**		Herb	1
Dasypogon bromeliifolius		Herb	1
*Daucus glochidiatus**		Herb	1
*Echium plantagineum** (DP)		Herb	1
*Erodium botrys**		Herb	1
*Gladiolus caryophyllaceus**		Herb	1
*Hypochaeris glabra**		Herb	1
*Lysimachia arvensis**		Herb	1
*Orobanche minor**		Herb	1
*Oxalis pes-caprae**		Herb	1
*Pelargonium capitatum**		Herb	1
*Raphanus raphanistrum**		Herb	1
*Sonchus oleraceus**		Herb	1
*Trifolium campestre**		Herb	1
*Ursinia anthemoides**		Herb	1
Vicia sativa subsp. *nigra**		Herb	1
Isolepis marginata		Sedge	1
*Ehrharta calycina**	1	Grass	40
*Briza maxima**		Grass	1
*Bromus arenarius**		Grass	1
*Ehrharta longiflora**		Grass	1
*Lolium rigidum**		Grass	1

Xp

Low Scrub A of *Xanthorrhoea preissii* over *Dasypogon bromeliifolius, Phlebocarya ciliata* and **Ehrharta calycina*, in grey sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	10 m x 10 m
Habitat/Waterway	Heath/Scrub
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Grey
Soil Texture	Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	4 (Good)
Disturbance Type	Weeds
Time since fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 20**%**

Species	Dominant Height (m)	Form	% cover
Allocasuarina fraseriana		Tree	1
Eucalyptus rudis		Tree	1
Xanthorrhoea preissii	2	Shrub	30
Adenanthos obovatus		Shrub	1
Conostephium minus		Shrub	1
Scholtzia involucrata		Shrub	1
*Fumaria capreolata**		Climber	1

Species	Dominant Height (m)	Form	% cover
Dasypogon bromeliifolius	0.4	Herb	25
Phlebocarya ciliata	0.3	Herb	7
*Arctotheca calendula**		Herb	1
*Carpobrotus edulis**		Herb	1
Crassula colorata		Herb	1
*Euphorbia terracina**		Herb	1
*Gladiolus caryophyllaceus**		Herb	1
*Hypochaeris glabra**		Herb	1
*Lolium rigidum**		Herb	1
*Petrorhagia dubia**		Herb	1
*Ehrharta calycina**	1	Grass	50
*Briza maxima**		Grass	1
*Briza minor**		Grass	1
*Bromus arenarius**		Grass	1
*Ehrharta longiflora**		Grass	1

Mp

Low Woodland A of occasional *Eucalyptus rudis* over *Melaleuca preissiana* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longifolia*, over mostly weeds, dominated by **Ehrharta calycina*, in brown loamy sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	10 m x 10 m
Habitat/Waterway	Woodland/Wetland
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Brown
Soil Texture	Loamy Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	3-4 (Good to Very Good)
Disturbance Type	Weeds
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 40**%**

Species	Dominant Height (m)	Form	% cover
Melaleuca preissiana	9	Tree	9
Eucalyptus rudis	12	Tree	2
Kunzea glabrescens	3	Shrub	20
*Acacia longifolia**	4	Shrub	4
Xanthorrhoea preissii	2	Shrub	3
Acacia pulchella		Shrub	1
Astartea scoparia		Shrub	1

Species	Dominant Height (m)	Form	% cover
Hibbertia subvaginata		Shrub	1
Hypocalymma angustifolium		Shrub	1
*Leptospermum laevigatum**		Shrub	1
Leucopogon australis		Shrub	1
Pericalymma ellipticum		Shrub	1
Tetratheca hirsuta		Shrub	1
*Asparagus asparagoides** (DP)		Climber	1
Cassytha racemosa		Climber	1
*Fumaria capreolata**		Climber	1
*Arctotheca calendula**		Herb	1
*Hypochaeris glabra**		Herb	1
*Medicago polymorpha**		Herb	1
Thelymitra crinita		Herb	1
*Zantedeschia aethiopica** (DP)		Herb	1
Lepidosperma longitudinale		Sedge	1
*Ehrharta calycina**	1	Grass	50
*Briza maxima**		Grass	1
*Briza minor**		Grass	1
*Ehrharta longiflora**		Grass	1

MpAl

Low Woodland A of *Melaleuca preissiana* over **Acacia longifolia*, over mostly weeds, dominated by **Ehrharta calycina* and **Ehrharta longiflora* in brown loamy sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	10 m x 10 m
Habitat/Waterway	Woodland/Wetland
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Brown
Soil Texture	Loamy Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	4-6 (Degraded to Good)
Disturbance Type	Weeds
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 40**%**

Picture

Species	Dominant Height (m)	Form	% cover
Melaleuca preissiana	6	Tree	12
Kunzea glabrescens		Shrub	2
*Acacia longifolia**	5	Shrub	10
Xanthorrhoea preissii		Shrub	2
Acacia pulchella		Shrub	1
Astartea scoparia		Shrub	1
Hibbertia subvaginata		Shrub	1
Hypocalymma angustifolium		Shrub	1
*Leptospermum laevigatum**		Shrub	1
*Asparagus asparagoides** (DP)		Climber	1
Cassytha racemosa		Climber	1
*Fumaria capreolata**		Climber	1
*Arctotheca calendula**		Herb	1
*Hypochaeris glabra**		Herb	1
*Medicago polymorpha**		Herb	1
*Ehrharta calycina**	1	Grass	50
*Ehrharta longiflora**	1	Grass	4
*Briza maxima**		Grass	1
*Briza minor**		Grass	1

ErAl (d)

Degraded areas of *Eucaluptus rudis* over **Acacia longifolia* over weeds, dominated by **Ehrharta calycina* and **Ehrharta longiflora* in brown loamy sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	Relevé
Habitat/Waterway	Woodland
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Brown
Soil Texture	Loamy Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	6 (Degraded)
Disturbance Type	Weeds
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 40**%**

Species	Form	% cover
Eucalyptus rudis	Tree	10
*Acacia longifolia**	Shrub	10
Acacia pulchella	Shrub	1
*Leptospermum laevigatum**	Shrub	1
*Fumaria capreolata**	Climber	1
*Arctotheca calendula**	Herb	1
*Hypochaeris glabra**	Herb	1
*Medicago polymorpha**	Herb	1
*Ehrharta calycina**	Grass	50
*Ehrharta longiflora**	Grass	4
*Briza maxima**	Grass	1
*Briza minor**	Grass	1

Eg (d)

Degraded areas of *Eucaluptus gomphocephala* over weeds, dominated by **Ehrharta calycina* and **Ehrharta longiflora* in brown loamy sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	Relevé
Habitat/Waterway	Woodland
Slope	Moderate
Surface Layer	Loose Soil
Soil Colour	Grey
Soil Texture	Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	4-6 (Degraded to Completely Degraded)
Disturbance Type	Weeds, tracks
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 40**%**

Species	Form	% cover
Eucalyptus gomphocephala	Tree	10
*Leptospermum laevigatum**	Shrub	1
*Ricinnis communis**	Shrub	1
*Fumaria capreolata**	Climber	1
*Arctotheca calendula**	Herb	1
*Hypochaeris glabra**	Herb	1
*Medicago polymorpha**	Herb	1
*Ehrharta calycina**	Grass	30
*Ehrharta longiflora**	Grass	10
*Briza maxima**	Grass	1
*Briza minor**	Grass	1

i

Completely degraded areas of planted trees and shrubs and weeds, or weeds only, with occasional *Adenanthos cygnorum* subsp. *cygnorum* and *Xanthorrhoea preissii,* in grey or brown sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	Relevé
Habitat/Waterway	Degraded; Shrubland/Grassland Mosaic
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Grey/brown
Soil Texture	Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	6 (Completely Degraded)
Disturbance Type	Weeds; Vehicle tracks
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 5**%**

Typical Species	Form	% cover
*Brachychiton diversifolius**	Tree	1
*Eucalyptus petiolaris**	Tree	1
*Melia azedarach**	Tree	1
*Olea europaea**	Tree	1
*Leptospermum laevigatum**	Shrub	15
Adenanthos cygnorum subsp. *cygnorum*	Shrub	10
*Acacia longifolia**	Shrub	1
Opuntia sp.*	Shrub	1
*Solanum linnaeanum**	Shrub	1
Xanthorrhoea preissii	Shrub	1
*Fumaria capreolata**	Climber	1
*Arctotheca calendula**	Herb	1
*Brassica tournefortii**	Herb	1
*Chamaecytisus palmensis**	Herb	1
*Euphorbia terracina**	Herb	1
*Freesia alba × leichtlinii**	Herb	1
*Gladiolus caryophyllaceus**	Herb	1
*Hypochaeris glabra**	Herb	1
*Lupinus cosentinii**	Herb	1
*Osteospermum ecklonis**	Herb	1
*Oxalis pes-caprae**	Herb	1
*Pelargonium capitatum**	Herb	1
*Sonchus oleraceus**	Herb	1
*Trachyandra divaricata**	Herb	1
*Trifolium campestre**	Herb	1

Typical Species	Form	% cover
*Ursinia anthemoides**	Herb	1
*Vicia hirsuta**	Herb	1
Vicia sativa subsp. *nigra**	Herb	1
*Watsonia meriana**	Herb	1
Ecdeiocolea monostachya	Sedge	1
Isolepis marginata	Sedge	1
*Ehrharta calycina**	Grass	60
*Bromus arenarius**	Grass	1
*Carpobrotus edulis**	Grass	1
*Cynodon dactylon**	Grass	1
*Ehrharta longiflora**	Grass	1
*Lagurus ovatus**	Grass	1
*Lolium rigidum**	Grass	1

APPENDIX G: HABITAT TREE DATA

mE	mN	Lot No.	Tree Species	Tree Height (m)	No. Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
392023	6445500	9500	Jarrah	15-20	1	Knot Hole	5-10			No Signs	No Signs	No	Depth of hollows unknown
392058	6445521	9500	Jarrah	15-20	2	Knot Hole	5-10	Spout Branch	5-10	Bees	No Signs	No	Partly dead – Hollow depths unknown
392054	6445367	9500	Non-endemic Eucalypt	20+	0					No Signs	No Signs	No	Planted Non-endemic
392024	6445383	9500	Non-endemic Eucalypt	20+	0					No Signs	No Signs	No	Planted Non-endemic
392547	6445161	33	Dead Tuart	20+	1	Knot Hole	10-20			Galahs	Galahs	No	Galah present - Hollow depth unknown
392552	6445161	33	Tuart	20+	0					No Signs	No Signs	No	
392556	6445152	33	Tuart	20+	0					No Signs	No Signs	No	
392557	6445147	33	Tuart	20+	0					No Signs	No Signs	No	
392614	6445213	33	Tuart	20+	0					No Signs	No Signs	No	
392597	6445225	33	Tuart	20+	0					No Signs	No Signs	No	
392590	6445226	33	Tuart	15-20	1	Spout Branch	5-10			No Signs	No Signs	No	Depth of hollows unknown
392571	6445205	33	Tuart	20+	0					No Signs	No Signs	No	
392571	6445204	36	Tuart	15-20	0					No Signs	No Signs	No	
392515	6445202	36	Tuart	20+	0					No Signs	No Signs	No	
392524	6445224	36	Tuart	20+	0					No Signs	No Signs	No	
392524	6445222	36	Tuart	20+	0					No Signs	No Signs	No	
392436	6445361	801	Flooded Gum	20+	1	Fissure	5-10			No Signs	No Signs	No	Depth of hollows unknown
392497	6445689	802	Dead Flooded Gum	10-15	2	Knot Hole	5-10	Spout Trunk	20+	No Signs	No Signs	Yes	Depth of hollows unknown

COCKBURN CENTRAL EAST LOCAL STRUCTURE PLAN (CCE LSP) AREA, TARGETED CALADENIA HUEGELII SURVEY

JANUARY 2018

CITY OF COCKBURN

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Table of Contents

Executive Summary iv

1 Introduction 1

1.1 Background 1

1.2 Location 1

1.3 Scope of Work 1

2 Existing Environment 3

2.1 Climate 3

2.2 IBRA Region 3

2.3 Geology and Soils 3

2.4 Vegetation 3

3 Species Profile 4

3.1 Caladenia huegelii 4

3.1.1 Conservation Significance 4

3.1.2 Ecology, Habitat and Distribution 4

4 Methodology 5

5 Results 8

6 Discussion and Conclusion 9

7 References 10

Figures

Figure 1 Cockburn Central East Local Structure Plan Project Area 2

Figure 2 Study Areas 6

Figure 3 Search Traverses 7

EXECUTIVE SUMMARY

Focused Vision Consulting Pty Ltd (FVC) was commissioned during September 2017 by the City of Cockburn (the City) to undertake a targeted *Caladenia huegelii* survey within the Cockburn Central East Local Structure Plan (CCE LSP) area (study area).

A targeted survey of the study area was conducted by FVC on 27 September 2017. Two experienced botanists, Kellie Bauer-Simpson and Gabriela Martinez with an experienced field assistant, Will Bauer-Simpson, systematically assessed the suitable habitat areas of the study area for *Caladenia huegelii*. The searches were conducted via a series of parallel transects in accordance with the Department of the Environment (2013) Guidelines for Detecting Orchids Listed as 'Threatened'.

The timing of the survey (September) was considered optimal to conduct a targeted flora survey for *Caladenia huegelii*, and other Spider Orchid species such as *Caladenia longicauda* were also observed in flower during the survey.

Although a detailed search was carried out, no *Caladenia huegelii* plants were recorded.

1 INTRODUCTION

1.1 BACKGROUND

Focused Vision Consulting (FVC) was commissioned during September 2017 by the City of Cockburn (the City) to undertake a targeted *Caladenia huegelii* survey within the Cockburn Central East Local Structure Plan (CCE LSP) area (study area). This work is following a spring flora, vegetation, fauna and habitat assessment completed by FVC during 2016. The results of that study identified that the site provides suitable habitat for the species, and therefore *Caladenia huegelii* may be present within the study area. The study area encompasses a number of Lots, totalling 31.21 ha as shown in **Figure 1**, much of which was included in the targeted search, depending on habitat suitability, also shown in **Figure 1**.

This report provides the results of the Targeted *Caladenia huegelii* survey undertaken within the study area during September 2017.

1.2 LOCATION

The study area is located approximately 20 km south of the Perth CBD, directly adjacent to the Kwinana Freeway on both the western and eastern sides. On the western side of the freeway, the area is bounded by Kentucky Court and North Lake Road. To the east of the freeway, the study area is comprised of numerous lots between Cutler Road and Knock Place, Cockburn Central (**Figure 1**).

1.3 SCOPE OF WORK

The scope included a targeted *Caladenia huegelii* survey. The tasks required to be carried out included:

- undertaking systematic traverses of the study area, within suitable habitat, to search for *Caladenia huegelii* plants, where (if) plants were observed, recording the:
    - GPS location of each individual *Caladenia huegelii* allowing an inventory of the number of plants/population size
    - vegetation type and condition at the recorded location
    - condition of plants/populations recorded
- the preparation of a report that summarises results and includes:
    - a discussion on the results, including identification and spatial mapping of all occurrences of *Caladenia huegelii* within the study area
    - identification of any potential environmental impacts and develop management recommendations for the protection of the Threatened flora species.

The survey was carried out in accordance with:

- Department of the Environment (2013) Guidelines for Detecting Orchids Listed as 'Threatened' under the *Environment and Biodiversity Conservation Act 1999* (EPBC Act).

Figure 1 - Cockburn Central East Local Structure Plan Project Area

2 EXISTING ENVIRONMENT

2.1 CLIMATE

The Swan Coastal Plain has a warm Mediterranean climate which is characterised by hot dry summers and cool to mild wet winters (Mitchell *et al.* 2002). Jandakot Airport (009172) is the closest meteorological recording station to Cockburn Central and has recorded an average annual rainfall of 823.5 mm (BoM 2017).

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 study area lies within the Swan Coastal Plain IBRA region and, at a finer scale, within the Perth subregion (Mitchell *et al.* 2002).

2.3 GEOLOGY AND SOILS

The study area lies within the Bassendean Dune System which consists of very old leached sands to various depths (GHD 2015) and are the oldest of the three dunes systems occurring on the Swan Coastal Plain. Sands within this system contain very little silt or clay and very low levels of nutrient elements (ESWA 2016).

Soils within the study area are mapped as three sub units of the Bassendean System (Schoknecht *et. al.* 2004). They are described as:

- 212Bs_B1 - Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with pale yellow B horizon
- 212Bs_B2 – Flat to very gently undulating sandplain with well to moderate well drained deep bleached grey sands with a pale yellow B horizon or weak iron organic hardpan
- 212Bs_B4 – Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depth generally greater than 1.5 m by clay or less frequently a strong iron organic hardpan.

2.4 VEGETATION

The study area is located on the Swan Coastal Plain and has been broadly characterised by Beard (1990) as "e2Mb cbLi - Medium very sparse woodland; jarrah, with low woodland; Banksia and Casuarina (Association 1001)".

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).

Vegetation complexes within the study area have been defined by Heddle *et al.* (1980) and are based on vegetation in association with landforms and underlying geology. One vegetation complex Bassendean *complex – central and south* as described by Heddle *et al.* (1980) occurs within the study area. This complex ranges from woodlands of *Eucalyptus marginata, Allocasuarina* and *Banksia* on sand dunes to a low woodland of *Melaleuca* species, and sedge lands on the low-lying depressions and swamps.

3 SPECIES PROFILE

3.1 CALADENIA HUEGELII

3.1.1 Conservation Significance

Caladenia huegelii was classified as Threatened (Declared Rare Flora – Extant) in November 1990 under the *Wildlife Conservation Act, 1950* (WC Act) and listed under Schedules 1 to 4 of the Wildlife Conservation (Rare Flora) Notice for Threatened Flora. It is a species of flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F (20) of the WC Act. *Caladenia huegelii* is also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The species is also ranked Critically Endangered (CR) under World Conservation Union (IUCN 2001) criterion B2ab (i, ii, iii, iv) due to the severe fragmentation of populations and the continuing decline in the extent of its occurrence, area of occupancy, quality of habitat and number of locations.

3.1.2 Ecology, Habitat and Distribution

Caladenia huegelii grows up to 60 cm tall with a single erect, pale green, hairy leaf and one or two (rarely three) predominantly pale greenish-cream flowers 7-10 cm across, with variable suffusions, lines and spots of red-maroon. Floral odour is absent. The sepals end in slender light brown to yellow clubs. The large labellum is prominently two coloured with a pale greenish-cream base and a uniformly dark maroon recurved apex. The leaf is densely hirsute to 4 mm long. Leaves are visible from May to November. Flowering occurs from September to October, with not all adult plants producing a flower each year. Some plants have been recorded not to produce a leaf each year and remain as a dormant tuberoid below ground (Hopper and Brown 2001).

Correct identification of *Caladenia huegelii* can only be carried out when it is in flower as a range of *Caladenia* species produce similar leaves (DEC 2009).

The preferred habitat of *Caladenia huegelii* is well drained, deep sandy soils in areas of mixed woodland of Jarrah (*Eucalyptus marginata*), Candlestick Banksia (*Banksia attenuata*), Holly Banksia (*Banksia ilicifolia*) and Firewood Banksia (*Banksia menziesii*) with scattered Sheoak (*Allocasuarina fraseriana*) and Marri (*Corymbia calophylla*) over dense Blueboy (*Stirlingia latifolia*), Swan River Myrtle (*Hypocalymma robustum*), Yellow buttercups (*Hibbertia hypericoides*), Buttercups (*Hibbertia subvaginata*), Balga (*Xanthorrhoea preissii*), coastal jugflower (*Adenanthos cuneatus*) and *Conostylis* species (DEC 2009).

Caladenia huegelii is found in the Jarrah Forest and Swan Coastal Plain Bioregions of Western Australia. A review of available information on populations held by the Department of Biodiversity Conservation and Attractions (DBCA) in 2017 indicated that 41 known records of the species are held at the Western Australian Herbarium (DBCA 2017).

4 METHODOLOGY

The areas of suitable habitat within the CCE LSP study area were determined based on previous vegetation mapping (FVC 2016). Suitable habitat was determined to encompass the two Banksia woodland units (BeEt and BaXp, as mapped by FVC (2016)) in better than degraded condition (Degraded to Good, or better). On a finer scale, some sections of the suitable habitat (Banksia woodland) were found to be either cleared since the 2016 spring survey, or not specifically suitable habitat for *Caladenia huegelii,* due to domination of dense stands of introduced Victorian Tea-tree (*Leptospermum laevigatum*). These areas were therefore not searched in detail (mostly impenetrable) and are presented in **Figure 2**.

A targeted flora survey of the suitable habitat areas within the, study area was carried out on 27 September 2017 during the optimal flowering period for *Caladenia huegelii*. The survey was conducted in accordance with the Department of the Environment (2013) Guidelines for Detecting Orchids Listed as 'Threatened'.

Two experienced FVC botanists, Kellie Bauer-Simpson and Gabriela Martinez and an experienced field assistant, Will Bauer-Simpson, systematically assessed the suitable habitat areas for the presence of *Caladenia huegelii* individuals. A series of parallel transects, spaced approximately 10 m apart were traversed for the search, to ensure all areas of suitable habitat was inspected. Where the habitat is in poorer condition, the spacing of traverses was made broader, as the occurrence of *Caladenia huegelii* was considered much less likely, since native understorey in these locations is greatly reduced, mostly due to weed domination.

Navigation of the sweeps were carried out using a combination of Garmin handheld Global Positioning System (GPS), tablets using the customized software program Mappt™ and magnetic compasses. The traverses made by field personnel for the searches are shown in **Figure 3**.

If individuals or suspected individuals of *Caladenia huegelii* flora were observed, the following data was to be recorded:

- GPS location of each individual plant allowing an inventory of the number of plants/population size
- vegetation type and condition at the recorded location
- condition of plants/populations recorded.

Figure 2 - Study Areas

Figure 3 - Search Traverses

5 RESULTS

No flowering *Caladenia huegelii* individuals were observed or recorded during the survey September 2017 survery conducted within areas of suitable habitat within the CCE LSP study area.

Two *Caladenia* were observed during the survey; *Caladenia flava* and *Caladenia longicauda*. These two species are very common in the south-west of Western Australia and are of no conservation significance.

6 DISCUSSION AND CONCLUSION

A targeted survey of the study area was conducted by FVC on 27 September 2017. Results from previous surveys conducted by FVC in 2016 identified two vegetation types within the study area, BeEt and BaXp, which provided suitable habitat for *Caladenia huegelii* and therefore were included in the targeted search as shown in **Figure 2**.

The timing of the survey (September) was considered optimal to conduct a targeted flora survey for *Caladenia huegelii* as other orchids such as the Spider Orchid species, *Caladenia longicauda* were also observed in flower during the survey.

Although a detailed survey was carried out within suitable habitat within the site, no *Caladenia. huegelii* plants were observed or recorded.

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