V & V Walsh

V & V Walsh - Flora & Fauna Survey & Permitting
Biological Survey Report

February 2021

Executive summary

V &V Walsh is proposing to construct and operate a cold store facility as an expansion of their existing operation. The facility will represent a key piece of infrastructure for agricultural production in the region. The facility will require a development envelope of up to 3.9 hectares (ha).

The survey area comprised part of Lot 1050, Davenport located to the east of the South Western Highway and south of Rawling Road. The survey area is 5.29 ha in size.

A detailed flora and vegetation survey, basic fauna survey, Black Cockatoo and Western Ringtail Possum assessment was completed from 1 October to 6 November 2020 with a supplementary tree hollow inspection on 10 December. The purpose of the study was to identify and map key flora and fauna values as they occur in the survey area.

The results of the survey will inform the statutory environmental assessment and approvals process.

This report is subject to, and must be read in conjunction with, the limitations and assumptions contained throughout the report

Key findings (Flora)

- Four vegetation types were described and mapped within the survey area, excluding previously cleared areas. The vegetation types include *Corymbia calophylla* open forest, *Melaleuca rhaphiophylla* low woodland, *Eucalyptus rudis* tall woodland and an area of grassland of introduced species with clumps of *Juncus pallidus* sedges and scattered *Eucalyptus rudis* or *Melaleuca rhaphiophylla* trees.
- The vegetation condition of the survey area ranged from Good to Completely Degraded. Historical clearing, firebreaks, tracks, aggressive weed species and edge effects have influenced the structure and composition of the remaining native vegetation.
- Sixty seven flora taxa (including subspecies and varieties) representing 27 families were recorded from the survey area during the field survey. This total comprised 33 native taxa and 34 introduced flora taxa.
- No EPBC Act or BC Act listed flora were recorded from the survey area. One DBCA Priority 4 listed flora species *Eucalyptus rudis* subsp. *cratyantha* was recorded within the survey area. Based on previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and condition of the site, all other conservation significant flora identified within the desktop searches are considered highly unlikely/unlikely to occur within the survey area.
- Thirty four introduced flora species were recorded in the survey area. One of these, **Asparagus asparagoides* (Bridal Creeper), is listed as a Declared Pest under the *Biosecurity and Management Act 2007* and as a Weed of National Significance (WONS). Two species are listed as Declared Pest Plant, **Zantedeschia aethiopica* (Arum lily) and **Opuntia* sp. (Prickly Pear species).

Key findings (Fauna)

- Five fauna habitat types were mapped in the survey area based on the predominant landforms, soil and vegetation structure in the area

- The field survey recorded a total of 23 fauna species, consisting of 14 bird, five mammal, and three reptile and one amphibian species within the survey area. Of these, 20 are native and three are introduced
- Suitable habitat for Western Ringtail Possum (*Pseudocheirus occidentalis*) (Critically Endangered) was identified within the survey area. Two dreys in close proximity and one Western Ringtail Possum were observed. The habitat type Peppermint woodland is considered to be preferred habitat for the Western Ringtail Possum.
- Of the 33 conservation significant fauna (threatened and priority listed species) identified in the desktop searches one species was present, Western Ringtail Possum and nine are considered likely to occur.
- A total of sixty four potential Black Cockatoo breeding habitat trees with a diameter at breast height greater than 500 mm were recorded from the survey area. None were identified as having hollows suitable for Black Cockatoo breeding.

Assessment against the ten clearing principles

An assessment of the proposed native vegetation clearing within the survey area against the Ten Clearing Principles was undertaken see Table 5-1. This assessment concluded the proposed clearing associated with the project is likely to be at variance to principle (f) and potentially at variance with principle (b). The project is considered unlikely to be at variance to the remaining principles.

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1. Introduction

1.1 Project background

V &V Walsh is proposing to construct and operate a cold store facility as an expansion of their existing operation. The facility will represent a key piece of infrastructure for agricultural production in the region. The facility will require a development envelope of up to 3.9 ha.

1.2 Purpose of this report

The purpose of this study is to identify the flora and fauna values within the survey area in order to support environmental approvals.

The aim of the study was to:

- Identify, map and describe vegetation types
- Assess and map the condition of vegetation
- Identify and map the location of Threatened and Priority Ecological Communities
- Identify areas of high floristic value including those that provide habitat for conservation significant flora, wetland / riparian vegetation, vegetation types that are poorly represented and those with high diversity
- Map the location of conservation significant species
- Assess and map fauna habitats
- Undertake a targeted Western Ringtail Possum assessment
- Undertake a Black Cockatoo assessment.

1.3 Project location

1.3.1 Survey area

The survey area comprises part of Lot 1050 LPS6, Davenport located to the east of the South Western Highway and south of Rawling Road. The survey area is 5.29 ha in size. The survey area included sections of the lot zoned general industry and environmental conservation reserve. The lot immediately to the south of the survey area is zoned regional open space. The survey area is shown in Figure 1 (Appendix A).

1.3.2 Study Area

A study area was defined for the desktop based searches for the assessment and includes a 5 km buffer of the survey area.

1.4 Scope of works

The scope of works was to undertake an assessment of the fauna and flora values of the survey area. The following actions were completed to fulfil the scope:

A desktop review of publicly available information and relevant reports to determine the environmental values of the survey area.

A single season detailed and targeted flora and vegetation to identify:

- Vegetation community types present, including presence of any Threatened or Priority Ecological Communities (TECs or PECs) or other significant vegetation

- Vegetation condition, including the location of any Weeds of National Significance (WONS) or Declared Weeds
- Flora species present including introduced species
- The presence or potential presence of any Threatened or Priority Flora

A basic terrestrial fauna survey including a Black Cockatoo and targeted Western Ringtail Possum assessment to identify:

- Dominant fauna habitat types
- Fauna species present at the time of survey, including opportunistic searches for conservation listed fauna species
- Black Cockatoo assessment
- Western Ringtail Possum assessment

Preparation of a report (this document) that:

- Documents the results of the desktop assessment and field survey, including mapping
- Identifies and discusses potentially occurring significant flora and vegetation communities
- Identifies and discusses potentially occurring significant fauna and fauna habitat
- Provision of spatial files in GIS format.

In WA, some ecological communities, flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.5 Limitations and assumptions

This report has been prepared by GHD for V&V Walsh and may only be used and relied on by V&V Walsh for the purpose agreed between GHD and V&V Walsh as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than V&V Walsh arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by V&V Walsh and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of infrastructure, services and vegetation, and access. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and fauna values within the survey area, as shown in Figure 1, Appendix A. Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to both the survey area and study area and to assist in survey design. The desktop assessment involved a review of:

- Department of Agriculture, Water and the Environment (DAWE) (previously the Department of the Environment and Energy (DoEE)) Protected Matters Search Tool (PMST) to identify communities and species listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) potentially occurring within the study area (DAWE 2020a) (Appendix C)
- The Department of Biodiversity, Conservation and Attractions (DBCA) TEC and PEC database (DBCA 2020a) to determine the potential for significant ecological communities to be present within the study area
- The DBCA NatureMap database for flora and fauna species previously recorded within the study area (DBCA 2007-2020)
- The DBCA Threatened (Declared Rare) and Priority Flora database (TPFL) and the WA Herbarium database (WAHERB) for Threatened flora species listed under the Biodiversity Conservation Act 2016 (BC Act) (which replaced the Wildlife Conservation Act 1950) or listed as priority by DBCA, previously recorded within the study area (DBCA 2020b)
- The DBCA Threatened and Priority Fauna database for Threatened fauna species listed under the BC Act or listed as priority by DBCA previously recorded within the study area (DBCA 2020c)
- Existing datasets including previous vegetation mapping of the survey area, aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora species
- Previous studies undertaken within or in close proximity to the survey area

Marine listed bird species were excluded from the desktop assessment as the terrestrial habitats would not support these species.

2.2 Field survey

2.2.1 Flora and vegetation

Ecoedge botanists Russell Smith (SL flora permit FT61000473) and Colin Spencer (flora permit FB62000169) completed a single season reconnaissance and targeted vegetation and flora assessment of the survey area on 2 October 2020. The field survey was undertaken to identify and describe the dominant vegetation types, assess vegetation condition, and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant or other significant ecological communities and flora taxa were also undertaken during the field survey.

The survey methodology was undertaken with reference to the Environmental Protection Authority (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

Data collection

Field survey methods involved sampling quadrats and reléves located in identified vegetation types and traversing the survey area by foot. In total, nine survey sites were described throughout the survey area (Figure 5, Appendix A). Quadrat data is provided in Appendix D.

Quadrats (measuring 10 m x 10 m – area of 100 m2) were located within each identified vegetation type. A minimum of three quadrats were located within each identified vegetation unit, where possible

Field data at each quadrat were recorded on a pro-forma data sheet and included the parameters detailed in Table 2-1.

Table 2-1 Data collected during the field survey

Aspect	Measurement
Collection attributes	Site code, personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, slope, landform, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum using a hand-held GPS tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale adapted by EPA (2016a) for the South West Botanical Province.
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including average height and cover (using NVIS)

A flora inventory was compiled from taxa listed in described relevés and from opportunistic floristic records throughout the survey area.

Vegetation types

Vegetation types were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations. Vegetation types were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation type descriptions follow NVIS and are consistent with NVIS Level V (Association) (NVIS Technical Working Group 2017).

Statistical analysis

The floristic quadrat data from the survey area was subjected to MVA (multivariate analysis) using the software PATN (Belbin, 2003) to determine the relationship of the vegetation units described and mapped within the survey area to the floristic community types derived for the Swan Coastal Plain by Gibson et al. (1994).

A column fusion dendrogram for the quadrats is presented in Appendix D.

The MVA used two-way classification (Agglomerative Hierarchical Fusion) of the presence/absence data for each quadrat. The flexible UPGMA classification strategy was used (β = -0.1), together with the Bray-Curtis site similarity measure. The default settings for number of groups to be produced by the classification (i.e. the “cut-off level”) was accepted in each case. The primary output of the classification were dendrograms and a two-way table of taxa and quadrats. Two separate MVAs were carried out.

Firstly, an MVA using just the 9 quadrats installed in the survey area was conducted to examine floristic variation and relationships.

Secondly, data from all relevant quadrats from the Southern Swan Coastal Plain (SCP) survey dataset (Gibson et al., 1994) was used in the MVA after taxonomic updating was carried out. Taxonomic updating of the 25-year-old SCP data was required because many taxonomic changes have taken place since the original survey was carried out (e.g. *Dryandra* to *Banksia*, *Eucalyptus calophylla* to *Corymbia calophylla*, etc.). In addition, there is some uncertainty about the identification of such species as *Thysanotus manglesianus* and *T. patersonii*, where many Swan Coastal Plain specimens have intermediate characteristics between the two. In such cases terms such as '*Thysanotus manglesianus/patersonii* complex' were used. In addition, "singletons" (flora taxa recorded at only one site) were excluded. Due to the properties of the Bray-Curtis coefficient, singletons are seen as 'indicators' for grouping and therefore sway results. The matrix used in this MVA was 1,107 sites (quadrats) by 1,431 taxa.

For the quadrats from the Gibson et al. (1994) report, the assigned FCT code was affixed to the quadrat name to facilitate understanding the MVA outputs.

Vegetation condition

The vegetation condition was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces of Western Australia (IBRA) (devised by Keighery (1994) and adapted by EPA (2016a)). The scale recognises the intactness of vegetation and consists of six rating levels. The vegetation condition rating scale is located in Appendix B.

Conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. EPBC Act PMST, *NatureMap* and DBCA database search results) was reviewed to determine conservation significant flora taxa potentially present within the survey area. Targeted searches for conservation significant flora based on desktop assessments and habitat availability was undertaken throughout the survey area.

Flora identification and nomenclature

Species well known to the survey botanist were identified in the field. All other species were collected and assigned a unique collection number to facilitate tracking. Specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Species were identified by the use of taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–2020) and the EPBC Act Threatened species database provided by DAWE (2020b). Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 1998–2020).

Targeted surveys for Threatened and Priority Ecological Communities (TEC/PEC)

Targeted surveys for the presence of TECs and PECs were undertaken by identifying vegetation types and delineating boundaries using a combination of aerial photography, topographical features, field data/observations and statistical analyses (multivariate analyses). Vegetation units were described based on structure, dominant species and cover characteristics as defined by quadrat data and field observations.

2.2.2 Terrestrial fauna survey (including targeted Black Cockatoo and Western Ringtail Possum assessment)

GHD Senior ecologist (Andrew Fry) undertook the basic fauna survey and target significant species assessment on 2-3 October with a supplementary nocturnal survey on 4 November 2020. A drone assessment of potential Black Cockatoo nesting hollows was undertaken on 10 December. The survey area was traversed on foot over the course of the survey to identify, describe and map the dominant fauna habitat types, assess habitat connectivity, and identify habitat for conservation significant species. The habitat assessment had specific consideration for the locally occurring and conservation significant fauna, namely Black Cockatoos and Western Ringtail Possum habitat requirements. An assessment of the likelihood of conservation significant fauna and their habitats occurring within the survey area was also undertaken.

The survey methodology was undertaken in accordance with the EPA *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2016b) and *Technical Guidance – Terrestrial Fauna Surveys* (EPA 2020).

Opportunistic observations

Whilst conducting activities in the survey area, opportunistic observations were made of any other vertebrates (or signs of their presence). Fauna taxa observed or heard were noted, and indirect evidence (such as scats, tracks, diggings, nests, feathers, bones, pellets) indicating the current or recent presence of a species also noted. Searching was undertaken through microhabitats including turning over logs or rocks, turning over leaf litter and examining tree hollows and hollow logs.

Black Cockatoo assessment

The assessment involved ground-based visual and aural assessment of the survey area identifying breeding habitat (presence/absence of actual and potential trees with a suitable potential nest hollow), foraging habitat, roosting areas, current activity and any other signs of use by Black Cockatoos. Foraging habitat values were quantified based on the presence of known food plant species for Black Cockatoos.

Potential breeding habitat values were quantified based on the presence of potential breeding trees of known Black Cockatoo breeding tree species. Suitable DBH Trees were recorded based on tree trunk, or diameter at Breast Height (DBH) measured for all trees having DBH greater than 50 cm. A list of tree locations is included in Appendix E.

Black Cockatoo breeding habitat, as defined by in the Commonwealth referral guidelines (DoEE, 2017), includes:

- Relevant tree species with a suitable Diameter at Breast Height (DBH) to develop a nest hollow, where DBH is greater than or equal to 500 mm (herein referred to as 'Suitable DBH Trees')
- Trees with a hollow that meets the DoEE (2017) depth, width and angle criteria for nesting by Black Cockatoos, herein referred to as 'Potential Trees with a Suitable Nest Hollow', ground assessed only
- 'Known Nesting Trees' are those trees that have secondary evidence of nesting i.e. feathers, eggs/ shells etc.
- Potential hollows were assessed using pole camera/ drone photography.

Roosting habitat values were assessed based on presence of potentially suitable emergent tall trees, proximity of freshwater bodies, and local occurrence (if any) of any known roost sites

based on review of data gathered from the annual Great Cocky Count roost bird census (BirdLife Australia, unpublished spatial data).

Western Ringtail Possum

Searching was carried out for presence or recent signs of occurrence of Western Ringtail Possum and for suitable habitat. This involved searching potentially suitable habitat, specifically *Agonis* (Peppermint tree) woodland for scats and dreys (possum nests). A nocturnal survey of identified habitat was also undertaken through spotlighting traverses. Results of the survey and suitable habitat are presented in Figure 7, Appendix A.

Other conservation significant fauna

Habitat suitability and likelihood of occurrence of other locally relevant conservation significant fauna species was assessed based on the fauna habitat characteristics and the results of the database searches. All conservation significant fauna species recorded or likely to occur are presented in Appendix G.

2.3 Limitations

2.3.1 Desktop limitations

Desktop investigations use a variety of online resources such as the WA Museum and DBCA NatureMap database (DBCA 2007-2020), and the EPBC Act PMST (DAWE 2020a). The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DBCA searches of threatened fauna provide more accurate information for the general area. However, some records of collections, sightings or trappings cannot be dated and often misrepresent the current range of threatened species, therefore when undertaking desktop assessment flora and fauna database records need to be interrogated.

2.3.2 Field survey limitations

The EPA (2016a and 2020) Technical Guide states flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 2.

Table 2-2 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information	Nil	Adequate information is available for the survey area. This information includes: Broad scale (1:250,000) mapping by Beard (1979) and digitised by Shepherd et al. (2002) Vegetation mapping by Heddle et al. 1980 and Webb (DBCA) (2016) Regional biogeography (Mitchell et al. 2002).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not surveyed.
Proportion of flora collected and identified (based on sampling, timing and intensity)	Minor	The detailed vegetation and flora survey was undertaken on 2 October 2020. The flora recorded from the field survey is detailed in section 5.1 and a full flora species list is provided in Appendix F. The portion of flora collected and identified was considered moderate, based on largely degraded survey area, survey effort and

Aspect	Constraint	Comment
Proportion of fauna identified, recorded and/or collected		timing. The basic fauna survey aimed to map habitat and identify conservation significant species that may be present. An opportunistic species inventory was recorded however many cryptic species would not have been identified during a basic survey and seasonal variation within species often requires surveys at a particular time of the year. Due to the degraded nature of the survey area this is not considered a major constraint.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Nil	The survey area was entirely accessible and was accessed by foot.
Mapping reliability	Nil	The vegetation types were mapped using high-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard 1979) and field data. Data were recorded in the field using hand-held GPS tools (e.g. Samsung tablet and Garmin GPS).
Timing/weather/season/cycle	Nil	The field survey was undertaken in spring 2020. This timing of the flora and vegetation survey is considered the optimal season complete flora and vegetation surveys on the Swan Coastal Plain (optimal time is during spring). The weather for all fauna surveys was clear and warm.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	Parts of the survey area have been subject to historical disturbances such as clearing and weeds. These disturbances did not impact the survey.
Resources	Nil	Adequate resources were employed during the field surveys.
Access restrictions	Nil	There were no access problems along the alignment.
Experience levels	Nil	The ecologist and botanists who executed the survey are suitably qualified and experienced in the field with eight to 20 years experience undertaking flora and fauna surveys in the bioregion

3. Desktop Assessment

3.1 Climate

The Bunbury area experiences a Mediterranean climate and is characterised by warm, dry summers and cool, wet winters. Rainfall is largely received during the winter months as a result of cold fronts that regularly cross the South West coast. The closest BoM weather station is Bunbury (site number 009965) (BoM 2020). Climate statistics for the Bunbury weather station have been presented in Plate 1.

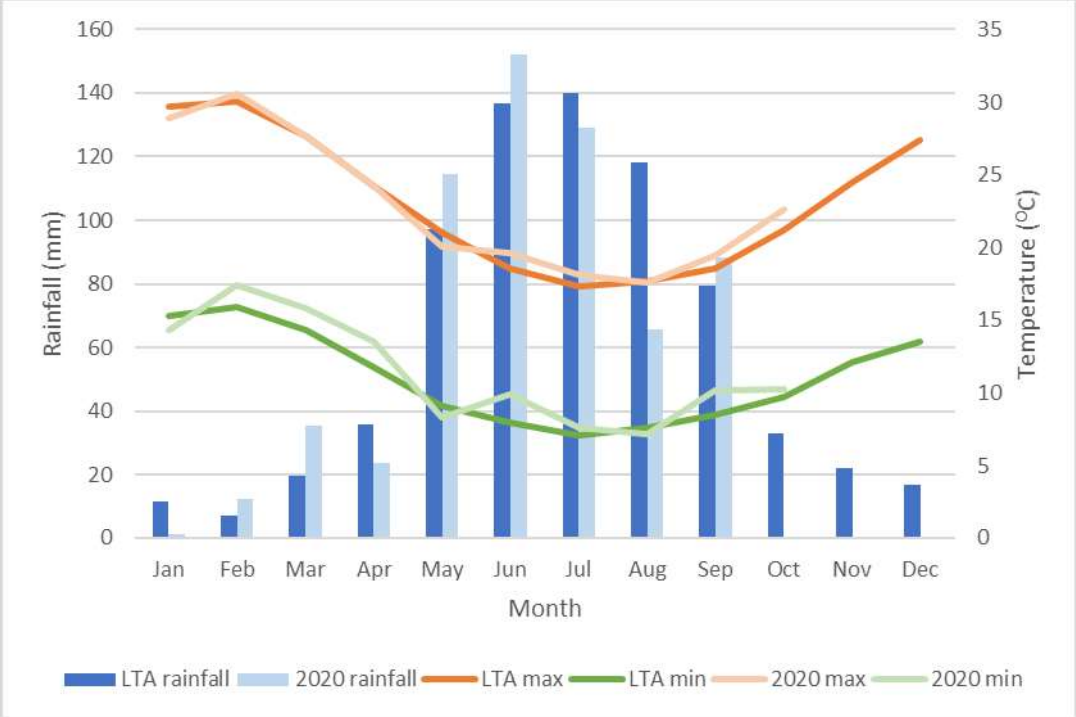


Plate 1 Climate statistics for Bunbury Weather Station (No. 9965) Annual and 2020

Note: Annual climate statistics are from November 1995 to current.

3.2 Province

The study area is located in the South West Botanical Province of WA (Beard 1990). The study area is located in the Swan Coastal Plain Bioregion and Perth (SWA2) subregion as described by the Interim Biogeographic Region of Australia (IBRA) (Department of the Environment 2012).

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart woodlands occur on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell *et al.* 2002).

3.3 Landforms and soils

The Swan Coastal Plain is comprised of five major geomorphological units, which lie more or less parallel to the coast, being the Quindalup, Spearwood and Bassendean Dunes, the Pinjarra Plain and the Ridge Hill Shelf (McArthur and Bettenay 1960, Churchwood and McArthur 1980). The survey area lies within the Bassendean Dune and Pinjarra Plain elements, which are broadly described as:

- Bassendean dune and sandplain system: Pleistocene sand dunes with very low relief, leached grey siliceous sand intervening sandy and clayey swamps and gently undulating plains. These occur immediately west of, and partly overlie, the Pinjarra Plain
- Pinjarra Plain: Broad low relief plain west of the foothills, comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Major soils are naturally poorly drained with many swamps.

The Department of Primary Industries and Regional Development soil-landscape mapping of the South West of WA (Government of Western Australia (GoWA) 2018a) provides soil and landform data compiled from various sources. This mapping identifies two different soil zones within the survey area.

Pinjarra Zone: Alluvial deposits (early Pleistocene to Recent) between the Bassendean Dunes Zone and the Darling Scarp, colluvial and shelf deposits adjacent to the Darling Scarp. Clayey to sandy alluvial soils with wet areas.

Bassendean Zone: Mid Pleistocene Bassendean sand. Fixed dunes inland from coastal dune zone. Non-calcareous sands, podsolised soils with low-lying wet areas.

3.4 Hydrology

3.4.1 Watercourses

There are no drainage lines intersecting the survey area. The Preston River is located 500m to the east. A small man-made dam exists at the central west boundary area of the survey area. Large parts of the survey area have been extensively modified for agricultural drainage and for construction of surrounding roads.

3.4.2 Wetlands

The survey area occurs extensively within a low-lying palusplain, which is seasonally inundated or has a high water table during winter. The EPBC Act PMST did not identify any wetlands of international importance (Ramsar wetland) or Nationally Important Wetlands within a 5 km buffer of the survey area.

The Geomorphic Wetlands Swan Coastal Plain dataset (Hill *et al.* 1996) identified the survey area intersects with a multiple use wetland (ID 14329). A conservation class wetland is mapped approximately 60 m south of the survey area (ID 14516). See Figure 3 in Appendix A.

3.5 Land use

3.5.1 Conservation reserves and estates

The survey area does not intersect with any DBCA legislated lands. The survey area intersects areas of Lot 1050 (City of Bunbury Local Planning Scheme No. 6) zoned environmental conservation reserve and general industry. The portion of Lot 1050 immediately to the south of the survey area is zoned regional open space.

3.5.2 Environmentally Sensitive Areas

The southern edge of the survey area intersects an Environmentally Sensitive Area (ESAs) which appears to be associated with the conservation class wetland (ID 14516).

3.5.3 Broad vegetation mapping and extents

Broad scale (1:250,000) pre-European vegetation mapping of the area has been completed by Beard (1979) at an association level. The survey area intersects the —Mosaic: Medium forest;

Jarrah-Marri/Low woodland; Banksia/Low forest; Teatree (Melaleuca spp.) (association 1000) vegetation association.

The pre-European mapping has been adapted and digitised by Shepherd *et al*. (2002). The extent of the vegetation associations have been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (latest update March 2019 – GoWA 2019b). As shown in Table 3-1, the current extents of vegetation association 1000 are less than 30 % of their pre-European extent at the IBRA Bioregion, IBRA subregion and within the Local Government Authority (LGA) levels.

Regional vegetation for the Swan Coastal Plain (at vegetation complex level) was mapped by Heddle *et al*. (1980) and updated and extended by Webb *et al*. (2016). The mapping indicates that one vegetation complexes is present within the survey area:

Southern River Complex – Open woodland of *Corymbia calophylla* (Marri) – *Eucalyptus marginata* (Jarrah) – *Banksia* species on elevated areas and a fringing woodland of *Eucalyptus rudis* (Flooded Gum) – *Melaleuca rhaphiophylla* (Swamp Paperbark) along streams. South of the Murray River *Agonis flexuosa* (Peppermint) occurs in association with the Flooded Gum and Swamp Paperbark.

GoWA (2018c) has assessed the vegetation complexes against presumed pre-European extents within the SWA IBRA Bioregion (Table 4) and LGA levels (Table 5). The current extents of the vegetation complex occurring within the survey area is less than 30 % of the pre-European distribution within the SWA IBRA Bioregion and LGAs.

Table 3-1 Extents of vegetation associations mapped within the survey area (GoWA 2019b)

VEGETATION ASSOCIATION	SCALE		PRE-EUROPEAN EXTENT (HA)	CURRENT EXTENT (HA)	REMAINING (%)	REMAINING WITHIN DBCA MANAGED LANDS (%)
Swan Coastal Plain IBRA Bioregion			1,501,221.93	578,997.37	38.57	38.47
1000	State: WA		99,835.86	27,705.61	27.75	18.67
	IBRA Bioregion: Swan Coastal Plain		94,175.31	24,805.96	26.34	19.21
	Sub-region: Perth		94,175.31	24,805.96	26.34	19.21
	LGA	City of Bunbury	2,171.67	621.00	28.60	2.12

Table 3-2 Extent of vegetation complexes on the Swan Coastal Plain mapped within the survey area (GoWA 2019c)

VEGETATION COMPLEX	PRE-EUROPEAN EXTENT (HA)	CURRENT EXTENT (HA)	REMAINING EXTENT (%)	CURRENT EXTENT REMAINING WITHIN ALL DBCA MANAGED LAND (%)
Southern River Complex	58,781.48	10,828.04	18.42	1.59

Table 3-3 Extent of vegetation complexes within Local Government Areas mapped within the survey area (GoWA 2019c)

VEGETATION COMPLEX	LGA	PRE-EUROPEAN EXTENT (HA)	CURRENT EXTENT (HA	REMAINING EXTENT (%)	PROPORTION OF THE VEGETATION COMPLEX WITHIN THE LGA (%)
Southern River Complex	City Bunbury	2,205.16	635.67	28.83	3.75

Note: red and orange indicate that less than 10 % and 30 %, respectively, of the pre-European extent is remains.

3.5.4 Conservation significant ecological communities

A search of the EPBC Act PMST identified three EPBC Act-listed TECs potentially occurring within the survey area (Table 6 and Figure 4, Appendix A). Seventeen TECs and PECs were identified in a search of the DBCA TEC/PEC database (DBCA 2020a). None intersect with the survey area.

Table 3-4 Threatened and Priority Ecological Communities

Community type	EPBC Act	BC Act/ DBCA	Description
Banksia woodlands of the Swan Coastal Plain (TEC) Banksia dominated woodlands of the Swan Coastal Plain IBRA region (PEC)	Endangered	Priority 3	The ecological community is a woodland associated with the Swan Coastal Plain. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range (TSSC 2016).
Coastal shrublands on shallow sands (SCP29a)		Priority 3	Mostly heaths on shallow sands over limestone close to the coast. No single dominant but important species include *Spyridium globulosum, Rhagodia baccata*, and *Olearia axillaris*.
Dense shrublands on clay flats (floristic community type 9 as originally described in Gibson et al. (1994))	Critically Endangered	Vulnerable	The shrublands or open woodlands of this community are inundated for longer periods and have lower species richness and numbers of weed taxa than the other clay pan types. Sedges including *Chorizandra enodis,Cyathochaeta avenacea, Lepidosperma longitudinale* and *Meeboldina coangustata* are more common in this community. Shrubs including *Hakea varia, Melaleuca viminea* and *Eutaxia virgata* are common.
Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson et al. (1994))	Critically Endangered	Vulnerable	The community can occur under a shrub layer comprising *Melaleuca viminea, M. osullivanii, M. cuticularis* or *Casuarina obesa* or other shrubs but can also occur as woodlands or herblands. Some areas such as where *Melaleuca cuticularis* or *Casuarina obesa* occur as an overstorey may be saline for part of the year due to evaporation resulting in increased salinity. A suite of herbs such as *Philydrella pygmaea, Brachyscome bellidioides, Centrolepis aristata, Centrolepis polygyna, Pogonolepis stricta* and *Cotula coronopifolia*; frequently occur in the community. Species such as *Angianthus drummondii, Eryngium pinnatifidum subsp. palustre* and *Blennospora drummondii* occur in low frequency
Herb Rich Shrublands in Clay Pans (SCP08)	Critically Endangered	Vulnerable	This vegetation community type occurs in low lying flats with a clay impeding layer allowing seasonal inundation. While aquatic annuals are common. This vegetation community type is dominated by one or more of the shrubs: *Viminaria juncea, Melaleuca viminea, M. lateritia, broom bush, Kunzea micrantha* or *K. recurva* with occasional emergents of *Eucalyptus wandoo*. Species such as *Hypocalymma angustifolium* (white myrtle), *Acacia lasiocarpa var. bracteolata* long peduncle variant (G. J. Keighery 5026) and *Verticordia huegelii* (variegated featherflower) occur at moderate frequencies. This vegetation community type has a high percentage of weeds and appears to be the clay pan vegetation community type that has the greatest disturbance.
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Priority 3	Consists of the assemblage of plants, animals and micro-organisms associated with saltmarsh in coastal regions of sub-tropical and temperate Australia (south of 23oS latitude).

Community type	EPBC Act	BC Act/ DBCA	Description
Tuart (Eucalyptus gomphocephala) woodlands and Forests of the Swan Coastal Plain (TEC) Tuart (Eucalyptus gomphocephala) woodlands of the Swan Coastal Plain (PEC)	Critically Endangered	Priority 3	Mostly confined to Quindalup Dunes and Spearwood Dunes from Jurien Bay to the Sabina River, with outliers along some rivers. Tuart is the key dominant canopy species however Tuart communities comprise a variety of flora and fauna assemblages. Flora commonly occurring with Tuart include *Agonis flexuosa, Banksia attenuata, B. grandis, Allocasuarina fraseriana, Xylomelum occidentale, Macrozamia riedlei, Xanthorrhoea preissii, Spyridium globulosum, Templetonia retusa* and *Diplolaena dampieri*
Southern Eucalyptus gomphocephala – Agonis flexuosa woodlands (SCP25) (Can form a component of the Endangered Banksia Woodlands of the Swan Coastal Plain EPBC listed TEC or the Tuart Woodlands of the Swan Coastal Plain PEC)	Endangered (Part)	Priority 3	Woodlands of *Eucalyptus gomphocephala - Agonis flexuosa* south of Woodman Point. Recorded from the Karrakatta, Cottesloe and Vasse units. Dominants other than tuart were occasionally recorded, including Corymbia calophylla at Paganoni block and *Eucalyptus decipiens* at Kemerton. Occasionally dominants other than tuarts were recorded (*Corymbia calophylla and Eucalyptus decipiens*) however tuarts are emergent nearby. Banksias found in this community include *Banksia attenuata, B. grandis* and *B. littoralis*. Tuart formed the overstorey nearby however.
Quindalup Eucalyptus gomphocephala and / or Agonis flexuosa woodlands (SCP30b) (Can form a component of the Tuart Woodlands of the Swan Coastal Plain PEC)		Priority 3	This community is dominated by either Tuart or *Agonis flexuosa*. The presence of *Hibbertia cuneiformis, Geranium retrorsum* and *Dichondra repens* differentiate this group from other Quindalup community types. The type is found from the Leschenault Peninsular south to Busselton
Herb Rich Shrublands in Clay Pans (SCP08)	Critically Endangered	Vulnerable	This vegetation community type occurs in low lying flats with a clay impeding layer allowing seasonal inundation. While aquatic annuals are common. This vegetation community type is dominated by one or more of the shrubs: *Viminaria juncea, Melaleuca viminea, M. lateritia*, broom bush, *Kunzea micrantha* or *K. recurva* with occasional emergents of *Eucalyptus wandoo*. Species such as *Hypocalymma angustifolium* (white myrtle), *Acacia lasiocarpa var. bracteolata* long peduncle variant (G. J. Keighery 5026) and *Verticordia huegelii* (variegated featherflower) occur at moderate frequencies. This vegetation community type has a high percentage of weeds and appears to be the clay pan vegetation community type that has the greatest disturbance.

Community type	EPBC Act	BC Act/ DBCA	Description
Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. (1994))	Critically Endangered	Endangered	The community occurs on skeletal soils that have shallow microtopography and the habitat is the most rapidly drying of the four clay pans identified in Gibson et al. (1994). Shrubs in the community include *Hakea sulcata, Hakea varia, Pericalymma ellipticum* and *Verticordia densiflora*. Herbs and sedges that are also common include *Schoenus rigens, Aphelia cyperoides, Centrolepis aristata, Schoenolaena juncea, Drosera gigantea* subsp. *gigantea*, 11 and *Drosera menziesii* subsp. *menziesii*
Southern Banksia attenuata woodlands	Endangered	Priority 3	Southern Banksia attenuata woodlands ('community type 21b') (a component of the Endangered Banksia Woodlands of the Swan Coastal Plain EPBC listed TEC) Priority 3(i) Endangered TEC (part) This community is restricted to sand sheets at the base of the Whicher Scarp, the sand sheets on elevated ridges or the sand plain south of Bunbury. Structurally, this community type is normally *Banksia attenuata* or *Eucalyptus marginata – B. attenuata* woodlands. Common taxa include *Acacia extensa, Jacksonia* sp. Busselton, *Laxmannia sessiliflora*, *Lysinema ciliatum* and *Johnsonia acaulis*.
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (floristic community type 19 as originally described in in Gibson et al. (1994))	Endangered	Critically Endangered	The community occurs in linear damplands and occasionally sumplands, between Holocene dunes. Typical and common native species are the shrubs *Acacia rostellifera, Acacia saligna, Xanthorrhoea preissii*, the sedges *Baumea juncea, Ficinia nodosa, Lepidosperma gladiatum,* and the grass *Poa porphyroclados*. Several exotic weeds are found in this community but generally at low cover values.
Shrublands on calcareous silts of the Swan Coastal Plain (floristic community type 18 as originally described in in Gibson et al. (1994))		Vulnerable	A suckering form of *Acacia saligna* (orange wattle), *Melaleuca viminea* (mohan), *Melaleuca teretifolia* (banbar), *Hakea varia* (variable-leaved hakea), *Xanthorrhoea preissii* (balga) and *Leptomeria ellytes* are common in the shrub layer, with sedges including *Lepidosperma longitudinale* (pithy sword-sedge) and *Gahnia trifida* (coast sawsedge), and a suite of herbs including *Meionectes tenuifolia* a priority 3 flora taxon also common

3.5.5 Conservation significant flora

Desktop searches of the EPBC Act PMST (DAWE 2020a), NatureMap (DBCA 2007-2020), DBCA TPFL, WAHERB databases (DBCA 2020b) identified the presence/potential presence of 55 conservation significant flora species within the study area. The desktop searches recorded:

- 18 taxa under the EPBC Act and/or Threatened under the BC Act
- Four Priority 1
- Seven Priority 2
- 13 Priority 3
- 13 Priority 4

The locations of conservation significant flora registered on the DBCA databases are mapped in Figure 5 Appendix A and listed with likelihood of occurrence in Appendix C. There are no previous records of conservation listed flora species mapped within the survey area (DBCA 2020b).

3.6 Fauna

3.6.1 Fauna diversity

The NatureMap database (DBCA 2007-2020) identified 242 terrestrial vertebrate fauna species previously recorded within the study area. Of the 242 fauna species previously recorded, 233 are native species and 9 are naturalised (introduced) species.

3.6.2 Conservation significant fauna

Searches of the EPBC Act PMST (DAWE 2020a), NatureMap (DBCA 2007-2020) and DBCA database (DBCA 2020c) identified the presence/potential presence of 33 conservation significance fauna within the study area. This total does not include those species that are exclusively marine as no marine habitat is present within the study area or indirectly impacted by the project. A likelihood of occurrence assessment for conservation significant fauna identified by the desktop is provided in Appendix C.

4. Field Survey Results

4.1 Flora and vegetation

4.1.1 Vegetation types

Four vegetation type were identified intersecting with the survey area, not including cleared areas. The majority of the vegetation includes highly degraded areas where clearing or other activities have fundamentally altered the natural composition of native vegetation.

The vegetation types are described in further detail in Table 7 and mapped in Figure 5, Appendix A.

Table 4-1 Vegetation types recorded in the survey area

VEGETATION TYPE DESCRIPTION	PHOTOGRAPH	SAMPLE SITES (QUADRATS), CONDITION AND EXTENT WITHIN SURVEY AREA
Vegetation Unit A: *Corymbia calophylla* open forest over *Agonis flexuosa* low woodland over *Kunzea glabrescens* tall open shrubland over *Macrozamia riedlei* open shrubland over **Cenchrus clandestinus*, **Ehrharta calycina* grassland and **Oxalis pes-caprae, *Watsonia meriana* and **Zantedeschia aethiopicum* herbland on grey loamy sand		WAL01, WAL02, WAL03 Good-Completely Degraded condition 1.12 ha

VEGETATION TYPE DESCRIPTION	PHOTOGRAPH	SAMPLE SITES (QUADRATS), CONDITION AND EXTENT WITHIN SURVEY AREA
Vegetation Unit B: *Melaleuca rhaphiophylla* low woodland over **Cynodon dactylon, *Ehrharta longifolia* grassland over *Caladenia latifolia, *Lotus subbiflorus, *Rumex crispus, *Zantedeschia aethiopica* open herbland with **Lepidosperma longitudinale* open sedgeland on grey sandy clay loam.		WAL04, WAL05, WAL06 Degraded-Completely Degraded condition 1.70 ha

VEGETATION TYPE DESCRIPTION	PHOTOGRAPH	SAMPLE SITES (QUADRATS), CONDITION AND EXTENT WITHIN SURVEY AREA
Vegetation Unit C: *Eucalyptus rudis* subsp. *cratyantha* (P4) tall woodland over *Agonis flexuosa, Melaleuca rhaphiophylla* low woodland over **Asparagus asparagoides* very open shrubland over **Cenchrus clandestinus, *Ehrharta longifolia* grassland over *Caladenia latifolia, *Lotus subbiflorus, *Rumex crispus, *Sonchus oleraceus, *Zantedeschia aethiopica* open herbland on grey loamy sand		WAL07, WAL08, WAL09 Degraded condition 1.3 ha

VEGETATION TYPE DESCRIPTION	PHOTOGRAPH	SAMPLE SITES (QUADRATS), CONDITION AND EXTENT WITHIN SURVEY AREA
Vegetation Unit D: Grassland and herbland of introduced species with clumps of *Juncus pallidus* sedges and scattered *Eucalyptus rudis* or *Melaleuca rhaphiophylla* trees.		Completely Degraded condition 0.76 ha
Cleared		Completely Degraded condition 0.40 ha
Total		**5.28 ha**

4.1.2 Vegetation condition

The vegetation condition of the survey area ranged from Good to Completely Degraded. The majority of the survey area is degraded or completely degraded (5.16 ha or 97.46 %). Historical clearing, firebreaks, tracks, aggressive weed species and edge effects have influenced the structure and composition of the remaining native vegetation.

A summary of the vegetation condition is provided in Table 8 and vegetation condition mapping is shown in Figure 6, Appendix A.

Table 4-2 Extent of vegetation condition ratings mapped within the survey area

VEGETATION CONDITION	EXTENT IN SURVEY AREA (HA)	EXTENT IN SURVEY AREA (%)
Good	0.13	2.55
Degraded	3.78	71.31
Completely Degraded	1.38	26.15
Total	**5.28**	**100**

4.1.3 Conservation significant ecological communities

Based on the results of the desktop searches, dominant species, landform features and field observations no conservation significant ecological communities were identified within the survey area.

4.1.4 Flora diversity

Sixty seven flora taxa (including subspecies and varieties) representing 27 families were recorded from the survey area during the field survey. This total comprised 33 native taxa and 34 introduced flora taxa

Dominant families recorded from the survey area included:

- Poaceae (eight taxa)
- Asteraceae (eight taxa)
- Fabaceae (nine taxa).

The combined species list is provided in Appendix D.

4.1.5 Conservation significant flora

No EPBC Act or BC Act listed flora were recorded from the survey area. One species taxonomically consistent with the description for DBCA Priority 4 listed flora species *Eucalyptus rudis* subsp*. cratyantha* was recorded within the survey area. This species was characteristic of vegetation unit C. *Eucalyptus rudis* subsp*. cratyantha* is a rough barked box-type tree growing to 20 meters. The species grows in winter-wet areas and is locally abundant (WAH 1998-2020). Recent taxonomic re assessment of the species, indicates that plants in the Bunbury region are an intergrade between *Eucalyptus rudis* subsp*. cratyantha* and the common species *Eucalyptus rudis* subsp*. rudis*, with subsp*. cratyantha* confined to a near-coastal distribution in the Cape Naturaliste area (Mike Hislop, WA Herbarium, pers comm. 2020). As a result it is likely that the species collected from the survey area does not represent the priority 4 listed flora species *Eucalyptus rudis* subsp. *cratyantha*, however this cannot be resolved at this time. As such the species recorded from the survey area has been reported as *Eucalyptus rudis* subsp*. cratyantha.*

The location of *Eucalyptus rudis* subsp*. cratyantha* recorded within the survey area is shown in Figure 5 Appendix A. Based on previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and condition of the site, all other conservation significant flora identified within the desktop searches are considered highly unlikely/unlikely to occur within the survey area.

4.2 Fauna

4.2.1 Fauna habitat types

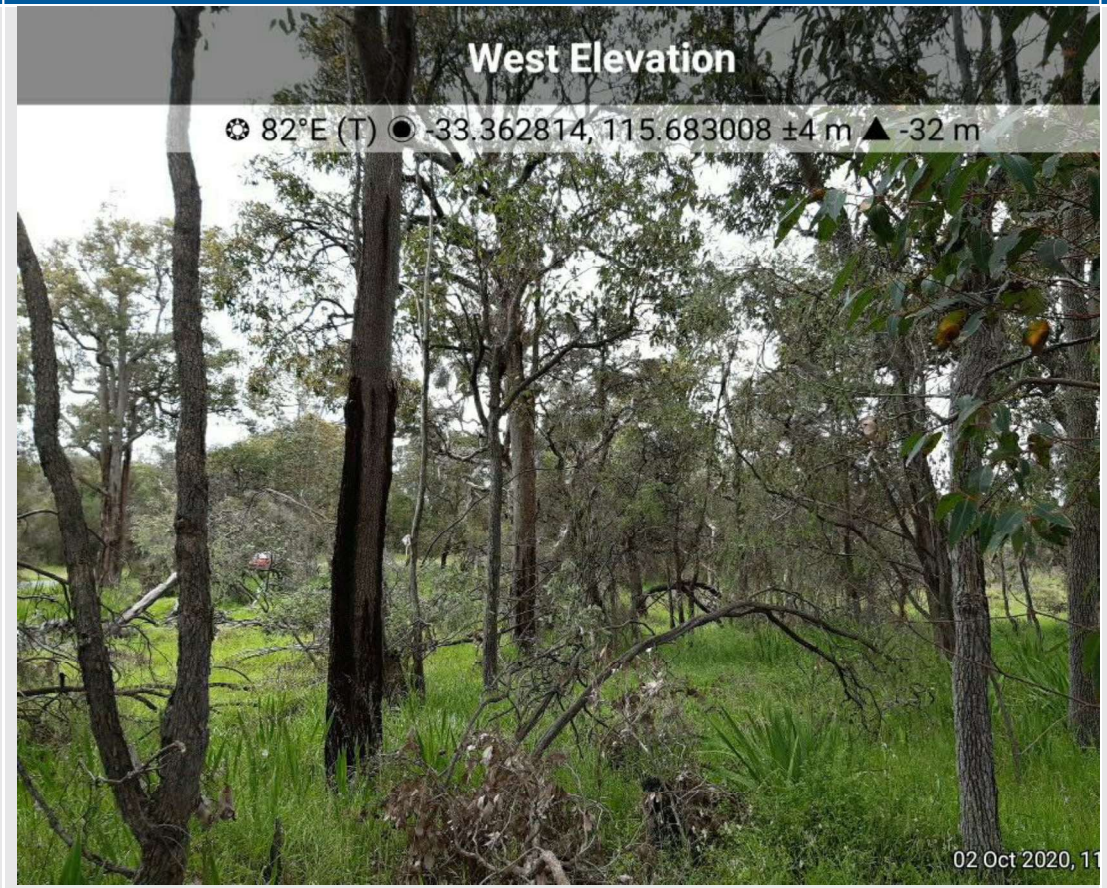
Five broad habitat types were identified in the survey area based on the predominant landforms, soil and vegetation structure in the area, shown in Figure 7, Appendix A. These habitat types generally correspond to the vegetation types outlined in Section 4.1 and include:

- Marri and Melaleuca Woodland
- Melaleuca Woodland
- Flooded Gum Woodland
- Peppermint Woodland
- Completely Degraded Grassland

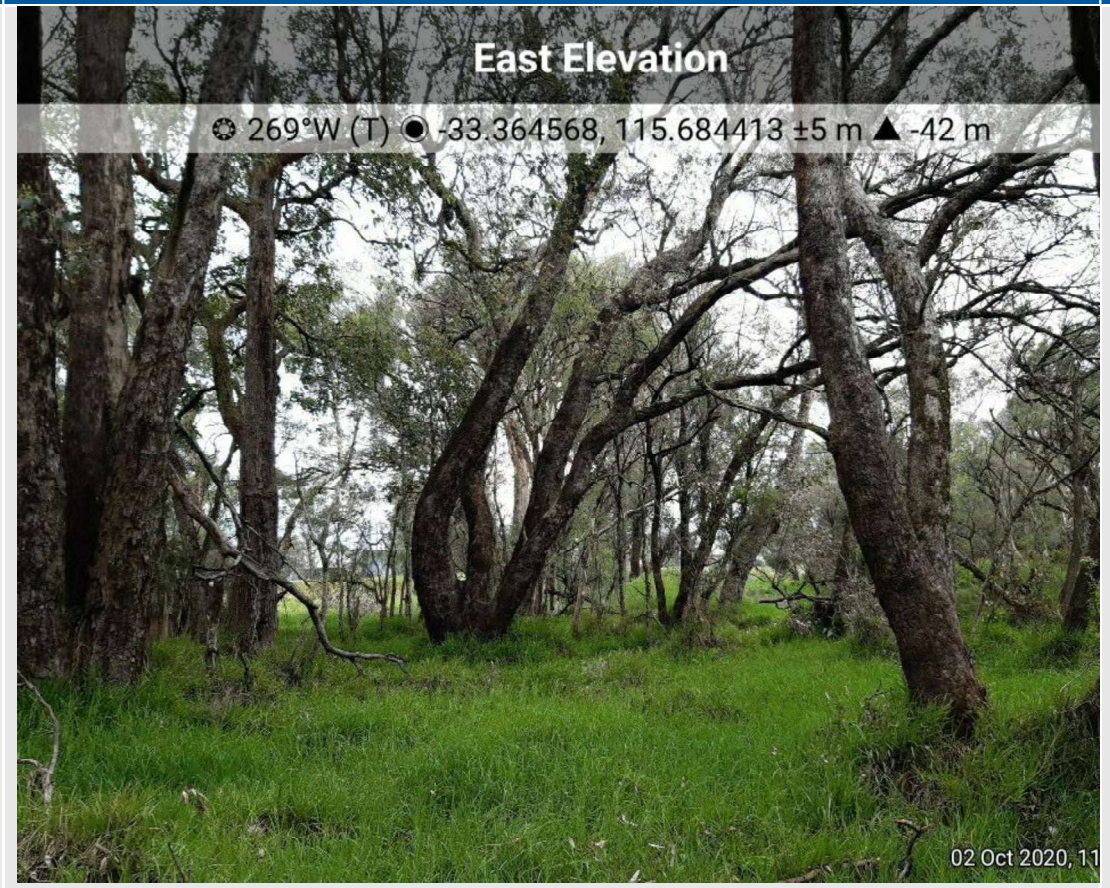
These fauna habitat types are outlined in Table 9, including their suitability for conservation significant fauna.

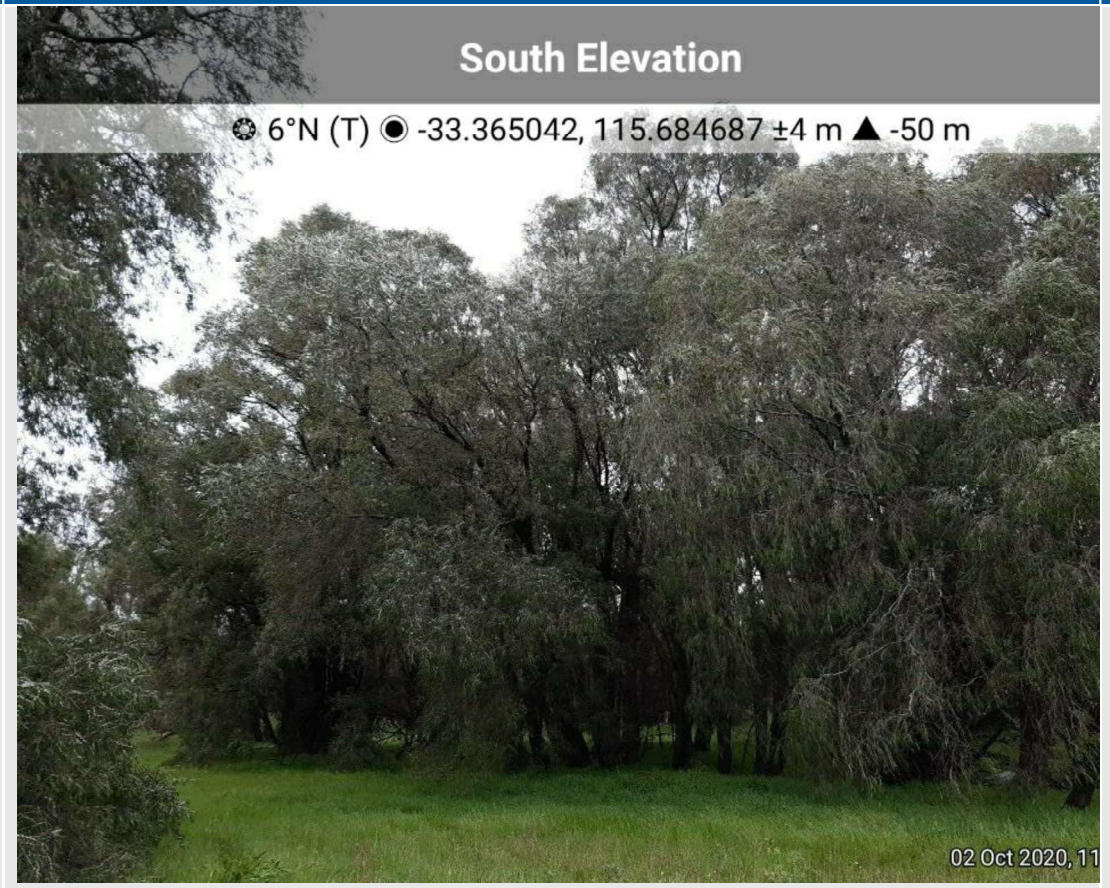
All of the habitat types within the survey area provide some habitat value for a range of common birds, lizards, snakes, frogs, macropods, possums, and small ground dwelling mammals. Habitat values for specific conservation significant fauna are outlined in Table 9.

Table 4-3 Habitat types present within the survey area

BROAD FAUNA HABITAT TYPES	PHOTOGRAPH	EXTENT WITHIN SURVEY AREA (HA)
Marri and Melaleuca Woodland: *Corymbia calophylla* and *Melaleuca preissii* open woodland to woodland over *Kunzea glabrescens* shrubland over **Cenchrus clandestinus, *Ehrharta calycina* grassland and **Oxalis pes-caprae, *Watsonia meriana* and **Zantedeschia aethiopicum* herbland on grey loamy sand near dampland and including previously cleared areas (regrowth) This habitat type contains lower structural diversity and reduced micro-habitat types including low patches of thick leaf litter, fallen logs and branches, with some open sandy areas. Disturbances included previous clearing, weeds and vehicle track. Corresponds with vegetation types: VT-A. This habitat is an extensively utilised foraging habitat for Carnaby's and Forest Red-tailed Black Cockatoos. This habitat is also suitable for South-western Brush-tailed Phascogale, Quenda, Western False Pipistrelle, Coastal Plains Skink and potentially the Western Brush Wallaby. The Peregrine Falcon would opportunistically utilise this habitat for foraging only. Habitat Significance- High. High foraging value for Forest Red-tailed and Carnaby's Cockatoo, and Baudin's Cockatoo (Groom 2011).		0.62

BROAD FAUNA HABITAT TYPES	PHOTOGRAPH	EXTENT WITHIN SURVEY AREA (HA)
Melaleuca Woodland: *Melaleuca rhaphiophylla* open woodland with over **Cynodon dactylon, *Ehrharta longifolia* grassland over **Lotus subbiflorus, *Rumex crispus, *Zantedeschia aethiopica* open herbland with **Lepidosperma longitudinale* open sedgeland on grey sandy clay loam, sometimes in cleared areas. Occasionally *Eucalyptus rudis* is present. Suitable habitat for a range of terrestrial vertebrates associated with seasonal dampland areas. Corresponds with vegetation type: VT-B. Habitat Significance – Moderate. Foraging and breeding habitat for Quenda. The Peregrine Falcon would opportunistically utilise this habitat for foraging only. Low foraging value for Forest Red-tailed, Carnaby's and Baudin's Cockatoo, (Groom 2011).		2.08

BROAD FAUNA HABITAT TYPES	PHOTOGRAPH	EXTENT WITHIN SURVEY AREA (HA)
Flooded Gum Woodland: *Eucalyptus rudis* tall woodland with occasional scattered *Agonis flexuosa* and *Melaleuca rhaphiophylla* over **Cenchrus clandestinus*, **Ehrharta longifolia* grassland on grey loamy sand. This habitat type contains lower structural diversity and reduced micro-habitat types including low patches of thick leaf litter, some fallen logs and branches. Disturbances included previous clearing, weeds and vehicle tracks. Corresponds with vegetation type: VT-C Habitat Significance- Moderate. This habitat may be occasionally utilised foraging habitat for Carnaby's and Forest Red-tailed Black Cockatoos. This habitat is also suitable for Brush-tailed Phascogale, Quenda and Western False Pipistrelle. The Western Ringtail Possum and the Western Brush Wallaby may potentially utilise this habitat occasionally. The Peregrine Falcon would opportunistically utilise this habitat for foraging only. Low foraging value for Forest Red-tailed, Carnaby's and Baudin's Cockatoo, (Groom 2011).		0.92

BROAD FAUNA HABITAT TYPES	PHOTOGRAPH	EXTENT WITHIN SURVEY AREA (HA)
Peppermint Woodland: *Agonis flexuosa* woodland with occasional *Corymbia calophylla* over **Cenchrus clandestinus*, **Ehrharta longifolia* grassland on grey loamy sand. This habitat type contains lower structural diversity and reduced micro-habitat types including low patches of thick leaf litter, some fallen logs and branches. Disturbances included previous clearing, weeds and vehicle tracks. Dense groves of Agonis flexuosa with connecting canopy are present. Corresponds with sections of vegetation types: VT-A and VT-C Habitat Significance- High This habitat is suitable for Western Ring-tail Possum, South-western Brush-tailed Phascogale, Quenda, Western False Pipistrelle and Coastal Plains Skink. The Western Brush Wallaby may potentially utilise this habitat occasionally. Low foraging value for Forest Red-tailed, Carnaby's and Baudin's Cockatoo, (Groom 2011).		0.76

BROAD FAUNA HABITAT TYPES	PHOTOGRAPH	EXTENT WITHIN SURVEY AREA (HA)
Completely Degraded Grassland: Grassland and herbland of introduced species with scattered clumps of *Juncus pallidus* sedges and scattered *Eucalyptus rudis* or *Melaleuca rhaphiophylla* trees. Low value habitat for a range of terrestrial vertebrates associated with seasonal dampland areas Habitat Significance- Low. Corresponds with vegetation type: VT-D		0.92

4.2.2 Fauna diversity

The field survey recorded a total of 23 fauna species, consisting of 14 bird, five mammal, and three reptile and one amphibian species within the survey area. Of these, 20 are native and three are introduced.

A list of the fauna species recorded during the survey is provided in Appendix E.

4.2.3 Conservation significant fauna

A likelihood of occurrence assessment was conducted for all conservation significant fauna species identified in the desktop assessment. This assessment was based on species biology, habitat requirements, the likely quality and availability of suitable habitat (based on vegetation associations present within the survey area) and records of the species in the vicinity of the survey area. No assumptions were made on the transient potential of these species. The likelihood assessment is provided in Appendix C.

Of the 33 conservation significant fauna (threatened and priority listed species) identified in the desktop searches one species was present, Western Ringtail Possum (*Pseudocheirus occidentalis*) and nine are considered likely to occur, including:

- Baudin's Cockatoo (*Calyptorhynchus baudinii*)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*)
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)
- Peregrine Falcon (*Falco peregrinus*)
- Quenda (*Isoodon fusciventer*)
- Western False Pipistrelle (*Falsistrellus mackenziei*)
- Western Brush Wallaby (*Macropus irma*)
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*)
- Coastal Plains Skink (*Ctenotus ora*)

Table 10 provides the conservation listed species present and considered likely for each of the fauna habitats within the survey area.

Western Ringtail Possum

The Western Ringtail Possum (*Pseudocheirus occidentalis*) is listed as Critically Endangered under the EPBC Act and BC Act. One Western Ringtail Possum and two dreys were recorded. The possum observation location and suitable habitat for Western Ringtail Possum, where Peppermint was recorded, is presented in Figure 7 (Appendix A). The fauna habitat Peppermint woodland is considered to be the preferred habitat for the Western Ringtail Possum.

Black Cockatoos

A total of 64 potential Black Cockatoo breeding habitat trees with a diameter at breast height greater than 500 mm were recorded from the survey area, of these two were identified as having hollows that were potentially suitable for Black Cockatoo breeding. A detailed inspection of the hollows was undertaken by Greg Harewood using a drone. These were deemed to be unsuitable dure to size or insufficient depth (see Appendix F) . No breeding activity or foraging evidence of Black Cockatoo species was observed within the survey area. Black cockatoo foraging habitat value for each fauna habitat type is presented in Figure 7 (Appendix A) with foraging habitat significance presented in Table 9.

Table 4-4 Conservation significant fauna recorded and likely to occur within each fauna habitat

TAXON	COMMON NAME	STATUS		FLOODED GUM WOODLAND	MARRI AND MELALEUCA WOODLAND	MELALEUCA WOODLAND	PEPPERMINT WOODLAND	COMPLETELY DEGRADED WOODLAND	LIKELIHOOD OF OCCURRENCE
		BC Act	EPBC Act						
BIRDS									
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	VU	VU	**F**	**F,B**			**F,B**	**Likely**
Calyptorhynchus baudinii	Baudin's Cockatoo,	EN	EN	**F**	**F,B**			**F,B**	**Likely**
Calyptorhynchus latirostris	Carnaby's Cockatoo,	EN	EN	**F**	**F,B**			**F,B**	**Likely**
Falco peregrinus	Peregrine Falcon	OS		**F**	**F**	**F**	**F**	**F**	**Likely**
MAMMALS									
Falsistrellus mackenziei	Western False Pipistrelle	P4		**F,B**	**F,B**		**F,B**		**Likely**
Isoodon fusciventer	Quenda	P4		**F,B**	**F,B**	**F,B**	**F,B**	**F,B**	**Likely**
Macropus irma	Western Brush Wallaby	P4		**F**	**F**		**F**	**F**	**Likely**

TAXON	COMMON NAME	STATUS		FLOODED GUM WOODLAND	MARRI AND MELALEUCA WOODLAND	MELALEUCA WOODLAND	PEPPERMINT WOODLAND	COMPLETELY DEGRADED WOODLAND	LIKELIHOOD OF OCCURRENCE
		BC Act	EPBC Act						
Phascogale tapoatafa wambenger	South-western Brush-tailed phascogale	CD		**F,B**	**F,B**		**F,B**		**Likely**
Pseudocheirus occidentalis	Western Ringtail Possum	CR	VU	**F**	**F**		**F,B**		**Present**
REPTILES									
Ctenotus ora	Coastal Plains Skink	P3		**F,B**	**F,B**		**F,B**		**Likely**

F - Foraging, B - Breeding

5. Assessment Against the Ten Clearing Principles

An assessment of the proposed native vegetation clearing within the survey area against the Ten Clearing Principles was undertaken see Table 5-1. This assessment concluded the proposed clearing associated with the project is likely to be at variance to principle (f) and potentially at variance with principle (b). The project is considered unlikely to be at variance to the remaining principles.

Principle (b) states “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”. There is no habitat within the survey area that would be considered specific to or solely relied upon by any of the conservation significant species known or likely to occur within the area; however, it may form part of a significant habitat for Black Cockatoos and Western Ringtail Possums. None of the Black cockatoo habitat trees recorded in the survey area had evidence of use for breeding or roosting. A single observation of a Western Ringtail Possum was recorded during the field survey. Given the relatively small area to be cleared and the extent of suitable habitat within the immediate vicinity and existing disturbances within the survey area, it is unlikely that the proposed clearing would have a significant impact upon conservation significant fauna known to occur in the area.

Principle (f) states “Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland”. The survey area supports vegetation growing in association with a wetland, including Eucalyptus rudis and Melaleuca rhaphiophylla, and the removal of this vegetation is likely to be at variance to this principle. However, given the highly degraded nature of the survey area, the relatively small amount of clearing required of this vegetation and the highly modified and isolated nature of the wetland , it is considered the impact of its loss is unlikely to be significant.

The Project is being referred to the Department of Agriculture, Water and Environment (DAWE), as the clearing associated within the project envelope impacts upon habitat for Black Cockatoos and Western Ringtail Possums.

Table 5-1 Assessment Against the Ten Clearing Principles

Principle	Assessment	Outcome
(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	The survey area is located in the South West Botanical Province of WA (Beard 1990)and the Swan Coastal Plain Bioregion and Perth (SWA2) subregion as described by the Interim Biogeographic Region of Australia (IBRA) (Department of the Environment 2012). Four vegetation type were identified intersecting with the survey area, not including cleared areas. The majority of the vegetation includes highly degraded areas where clearing or other activities have fundamentally altered the natural composition of native vegetation. • *Corymbia calophylla* open forest over *Agonis flexuosa* low woodland over open shrubland over grassland and herbland on grey loamy sand • *Melaleuca rhaphiophylla* low woodland over grassland over open herbland with open sedgeland on grey sandy clay loam. • *Eucalyptus rudis* tall woodland over low woodland over very open shrubland over grassland open herbland on grey loamy sand • Grassland and herbland of introduced species with clumps of *Juncus pallidus* sedges and scattered *Eucalyptus rudis* or *Melaleuca rhaphiophylla trees*. The vegetation condition of the survey area ranged from Good to Completely Degraded. The majority of the survey area is degraded or completely degraded (5.16 ha or 97.46 %). Historical clearing, firebreaks, tracks, aggressive weed species and edge effects have influenced the structure and composition of the remaining native vegetation. No significant, threatened or restricted vegetation types were identified within the survey area. The survey area does not contain areas of native vegetation that are in better condition, or of a higher floristic value, than the surrounding vegetation. Sixty seven flora taxa (including subspecies and varieties) representing 27 families were recorded from the survey area during the field survey. This total comprised 33 native taxa and 34 introduced flora taxa The field survey recorded a total of 23 fauna species, consisting of 14 bird, five mammal, and three reptile and one amphibian species within the survey area. Of these, 20 are native and three are introduced	The proposed clearing is unlikely to be at variance to this principle.

Principle	Assessment	Outcome
	Given the history of disturbances within the survey area due to clearing and edge effects (both within and adjacent to the survey area), the development envelope is not likely to comprise a greater diversity than similar areas either locally or at a bioregional scale. Clearing for the project is not likely to be at variance to this Principle.	
(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 broad habitat types were identified in the survey area based on the predominant landforms, soil and vegetation structure in the area. These habitat types include: • Marri and Melaleuca Woodland • Melaleuca Woodland • Flooded Gum Woodland • Peppermint Woodland • Completely Degraded Grassland One conservation significant fauna species (threatened and priority listed species) was present, Western Ringtail Possum (*Pseudocheirus occidentalis*), and a further nine were considered likely to occur, including: • Baudin's Cockatoo (*Calyptorhynchus baudinii*) • Carnaby's Cockatoo (*Calyptorhynchus latirostris*) • Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) • Peregrine Falcon (*Falco peregrinus*) • Quenda (*Isoodon fusciventer*) • Western False Pipistrelle (*Falsistrellus mackenziei*) • Western Brush Wallaby (*Macropus irma*) • South-western Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) • Coastal Plains Skink (*Ctenotus ora*)	The proposed clearing is potentially at variance to this principle.

Principle	Assessment	Outcome
	A portion of the survey area was identified as having high foraging value for Carnaby's and Forest Red-tailed Black Cockatoos. This habitat was also suitable for Western Ringtail Possum, South-western Brush-tailed Phascogale, Quenda, Western False Pipistrelle, Coastal Plains Skink and potentially the Western Brush Wallaby. The Peregrine Falcon would opportunistically utilise this habitat for foraging only. A total of 64 potential Black Cockatoo breeding habitat trees with a diameter at breast height greater than 500 mm were recorded from the survey area, of these two were identified as having hollows that were potentially suitable for Black Cockatoo breeding. A detailed inspection of the hollows deemed them to be unsuitable due to size or insufficient depth. No breeding activity or foraging evidence of Black Cockatoo species was observed within the survey area. Habitats with characteristics consistent with those recorded in the survey area are well represented in the immediate vicinity of the survey area, and would likely be utilised by all the conservation significant species known or likely to occur in the area. Furthermore, there is no habitat within the survey area that would be considered specific to or solely relied upon by any of the conservation significant species known or likely to occur within the area. Given the relatively small area to be cleared, the degraded nature of the survey area, the extent of suitable habitat within the immediate vicinity and the existing disturbances within the survey area, it is unlikely the proposed clearing represents a core habitat for any of the conservation significant fauna identified as present or likely to occur. The proposed clearing is not expected to have a significant impact upon these fauna species of conservation significance. The Project is being referred to the Department of Agriculture, Water and Environment (DAWE) out of abundance of caution, as the clearing associated within the project envelope impacts upon significant habitat for black cockatoos and Western Ringtail Possums.	
(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	Desktop searches of the EPBC Act PMST (DAWE 2020a), NatureMap (DBCA 2007-2020), DBCA TPFL, WAHERB databases (DBCA 2020b) identified the potential presence of 55 conservation significant flora species within the desktop study area. The desktop searches recorded: • 18 taxa under the EPBC Act and/or Threatened under the BC Act • Four Priority 1 • Seven Priority 2 • 13 Priority 3 • 13 Priority 4	The proposed clearing is unlikely to be at variance to this principle.

Principle	Assessment	Outcome
	. There are no previous records of conservation listed flora species mapped within the survey area (DBCA 2020b). No EPBC Act or BC Act listed flora were recorded from the survey area. One species taxonomically consistent with the description for DBCA Priority 4 listed flora species *Eucalyptus rudis* subsp. *cratyantha* was recorded within the survey area. This species was characteristic of vegetation unit C. *Eucalyptus rudis* subsp. *cratyantha* is a rough barked box-type tree growing to 20 meters. The species grows in winter-wet areas and is locally abundant (WAH 1998-2020). Recent taxonomic re assessment of the species, indicates that plants in the Bunbury region are an intergrade between *Eucalyptus rudis* subsp. *cratyantha* and the common species *Eucalyptus rudis* subsp. *rudis*, with subsp. *cratyantha* confined to a near-coastal distribution in the Cape Naturaliste area (Mike Hislop, WA Herbarium, pers comm. 2020). As a result it is likely that the species collected from the survey area does not represent the priority 4 listed flora species *Eucalyptus rudis* subsp. *cratyantha*, however this cannot be resolved at this time. Given the survey effort and season coverage (spring and autumn survey), if populations of Threatened flora taxa were present it is expected they would have been identified in the field. Clearing for the project is not likely to be at variance to this Principle.	
(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	Seventeen TECs and PECs were identified in a search of the DBCA TEC/PEC database (DBCA 2020a). A search of the EPBC Act PMST identified three EPBC Act-listed TECs potentially occurring within 5 km of the survey area. None intersect with the survey area. No PEC/TEC communities were identified within the survey area during the field survey. Clearing for the project is not likely to be at variance to this Principle.	The proposed clearing is not at variance to this principle.
(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The project will require clearing of a project envelope of a maximum of 3.9 ha. The vegetation condition of the survey area ranged from Good to Completely Degraded. The majority of the survey area is degraded or completely degraded (5.16 ha or 97.46 %). The study area is located in the South West Botanical Province of WA (Beard 1990). The study area is located in the City of Bunbury Local Government Authority area, which falls within the Swan Coastal Plain Bioregion and	The proposed clearing is unlikely to be at variance to this principle.

Principle	Assessment	Outcome
	Perth (SWA2) subregion as described by the Interim Biogeographic Region of Australia (IBRA)(Department of the Environment 2012). Broad scale (1:250,000) pre-European vegetation mapping of the area has been completed by Beard (1979) at an association level. The survey area intersects the —Mosaic: Medium forest; Jarrah-Marri/Low woodland; Banksia/Low forest; Teatree (Melaleuca spp.) (association 1000) vegetation association. The extent of the vegetation associations has been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (latest update March 2019 – GoWA 2019b). The current extents of vegetation association 1000 are less than 30 % of their pre-European extent at the State (27.75%), IBRA Bioregion (26.34%), IBRA subregion (26.34%) and within the Local Government Authority (LGA) (28.60%) levels. In the immediate vicinity of the survey area there exists significant areas of remnant vegetation associated with the Preston River corridor, Manea Park and City of Bunbury land zoned as regional open space immediately to the south of the survey area. Many of these areas of adjacent remnant vegetation fall within the recently proclaimed Kalgalup Regional Park. Although the broad scale vegetation associated with the survey area is remaining at less than 30% of the pre-European extent, at a local scale the survey area is not considered to represent a significant remnant of native vegetation. Significant areas of similar vegetation are present in conservation reserves in close proximity to the survey area	
(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 survey area occurs within a low-lying palusplain, which is seasonally inundated or has a high water table during winter. The EPBC Act PMST did not identify any wetlands of international importance (Ramsar wetland) or Nationally Important Wetlands within a 5 km buffer of the survey area. The Geomorphic Wetlands Swan Coastal Plain dataset (Hill *et al.* 1996) identified the survey area intersects with a multiple use wetland (ID 14329). A conservation class wetland is mapped approximately 60 m south of the survey area (ID 14516) There are no drainage lines intersecting the survey area. The Preston River is located 500m to the east. A small man-made dam exists at the central west boundary area of the survey area. Large parts of the survey area have been extensively modified for agricultural drainage and for construction of surrounding roads.	The proposed clearing is likely to be at variance to this principle.

Principle	Assessment	Outcome
	Vegetation type units, C and D, were associated with the multiple use wetland (ID 14329). These units were described as being in Degraded to Completely Degraded condition. These units were also listed as having Moderate to Low habitat significance to faunal species. Given the highly degraded nature of the survey area, the relatively small amount of clearing required of this vegetation and the highly modified and isolated nature of the wetland, it is considered the impact of its loss is unlikely to be significant.	
(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Given the small area of the required clearing (3.9 ha) and flat topography of the site, the proposed clearing for the project is not likely to cause appreciable land degradation either from wind erosion, changes to soil properties or chemistry, nor likely to have an impact on adjacent vegetation.	The proposed clearing is unlikely to be at variance to this principle.
(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 survey area does not intersect with any DBCA legislated lands. The survey area intersects areas of Lot 1050 (City of Bunbury Local Planning Scheme No. 6) zoned environmental conservation reserve and general industry. The conservation reserve will not be cleared. The portion of Lot 1050 immediately to the south of the survey area is zoned regional open space. Given the small area of the required clearing (3.9 ha) and flat topography of the site, the proposed clearing for the project is not likely to cause appreciable land degradation either from wind erosion, changes to soil properties or chemistry, nor likely to have an impact on adjacent vegetation.	The proposed clearing is unlikely to be at variance to this principle.
(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.	There are no regionally significant wetlands or watercourses with permanent water within the survey area. The survey area intersects the Preston Surface Water Management Area. The survey area does not intersect any major watercourses or drainage lines. The Preston River is located 500m to the east. The project will not change the hydrology of the area. As no surface water will be taken for this project and due to the minor nature of the works, it is unlikely there will be a significant impact to the surface water quality of this area. Given the small scale of clearing and that no water extraction, dewatering or drainage modifications are required, it is considered there will be very little to no deterioration of underground water quality.	The proposed clearing is unlikely to be at variance to this principle.

Principle	Assessment	Outcome
(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.	There are some low-lying areas present within the survey area but the minimal amount of clearing required for the project would have no significant impact on the natural surface and groundwater processes. The survey area also does not intersect any major watercourses or drainage lines The proposal is not likely to cause, or exacerbate, the incidence or intensity of flooding.	The proposed clearing is unlikely to be at variance to this principle.

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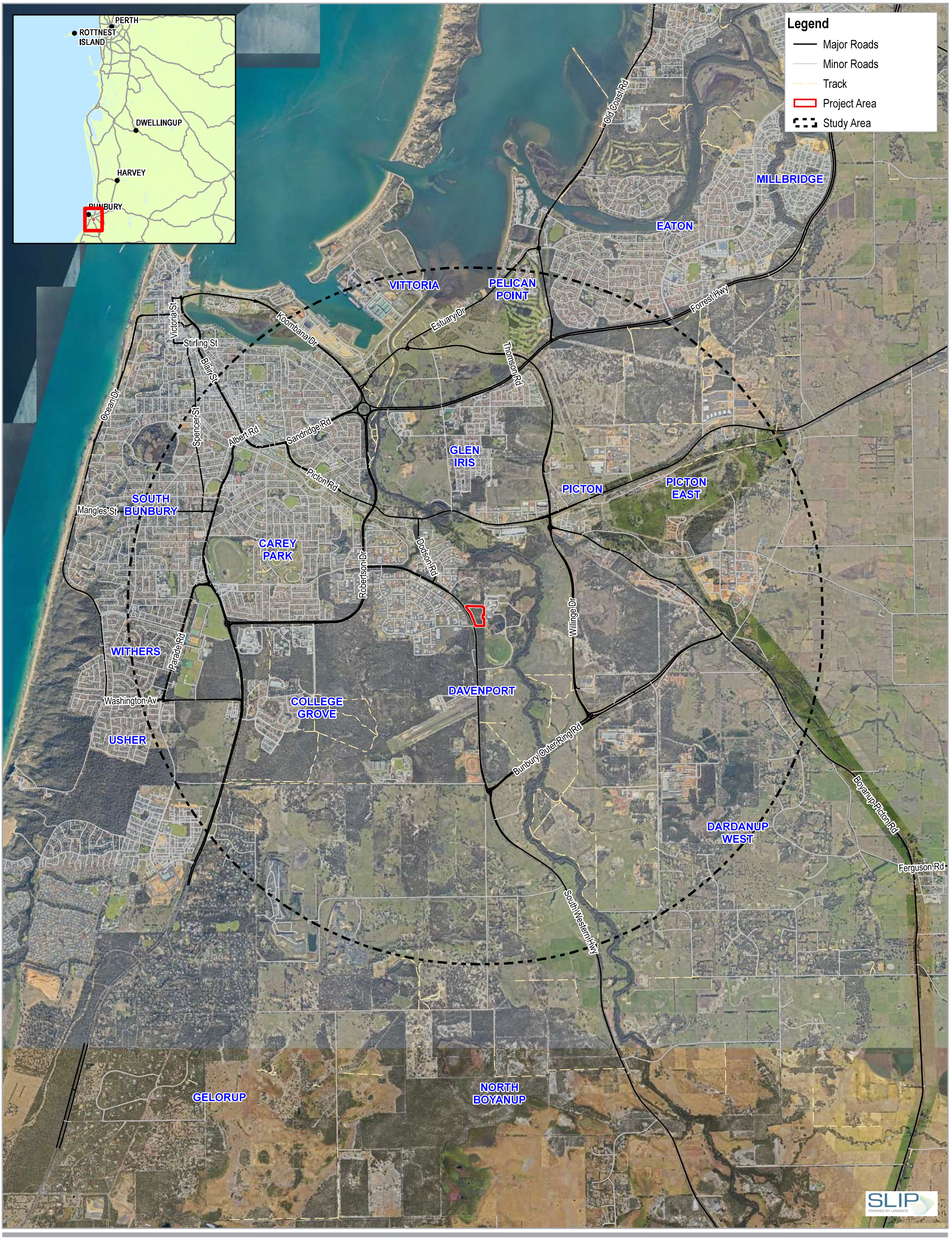
Appendices

Appendix A – Figures

Figure 1 Project Locality



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Grid: GDA 1994 MGA Zone 50

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Project Location

Project No. **12539969**
Revision No. **A**
Date **25/11/2020**

FIGURE 1

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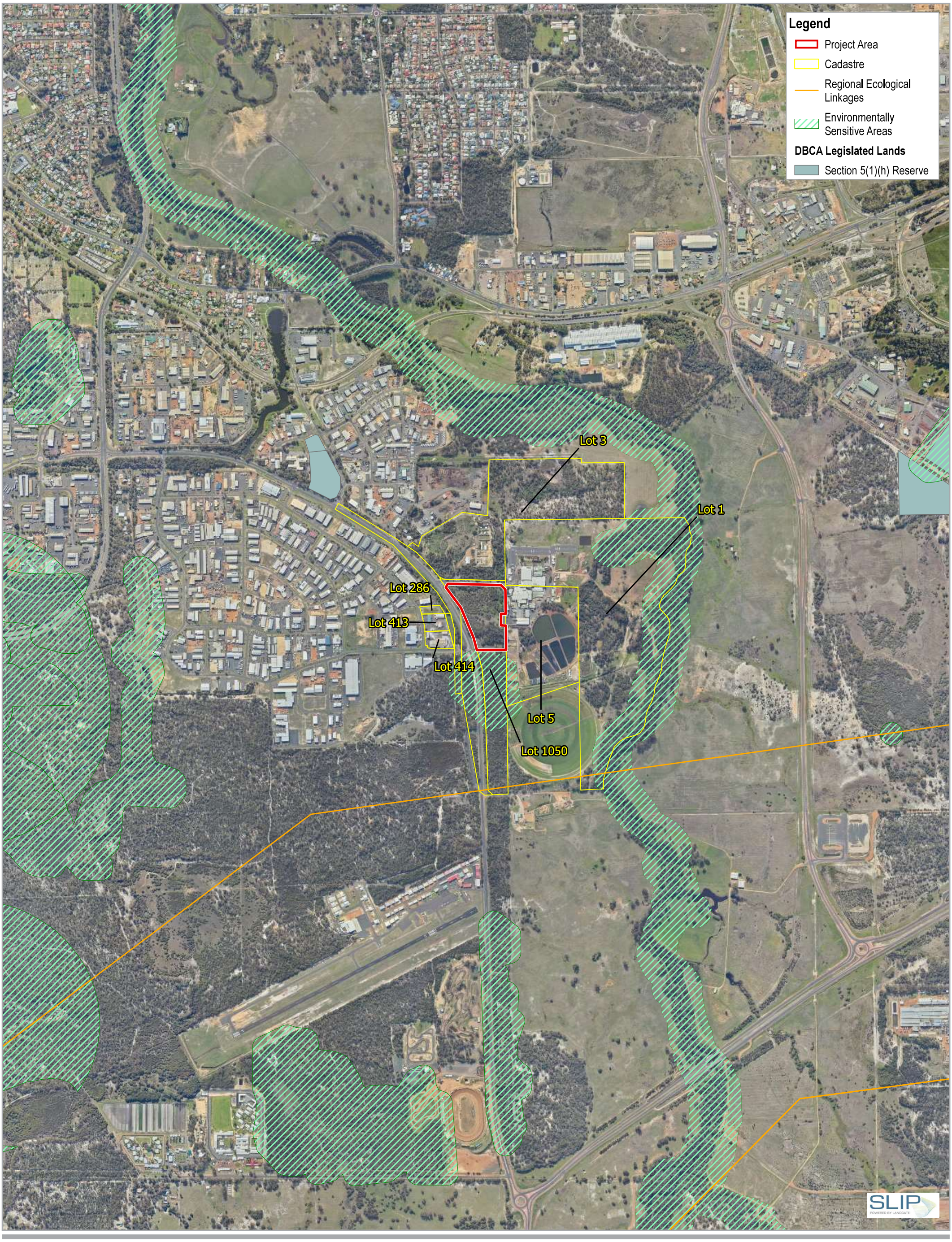

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

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Land Use Constraints

Project No. **12539969**
Revision No. **A**
Date **25/11/2020**

FIGURE 2

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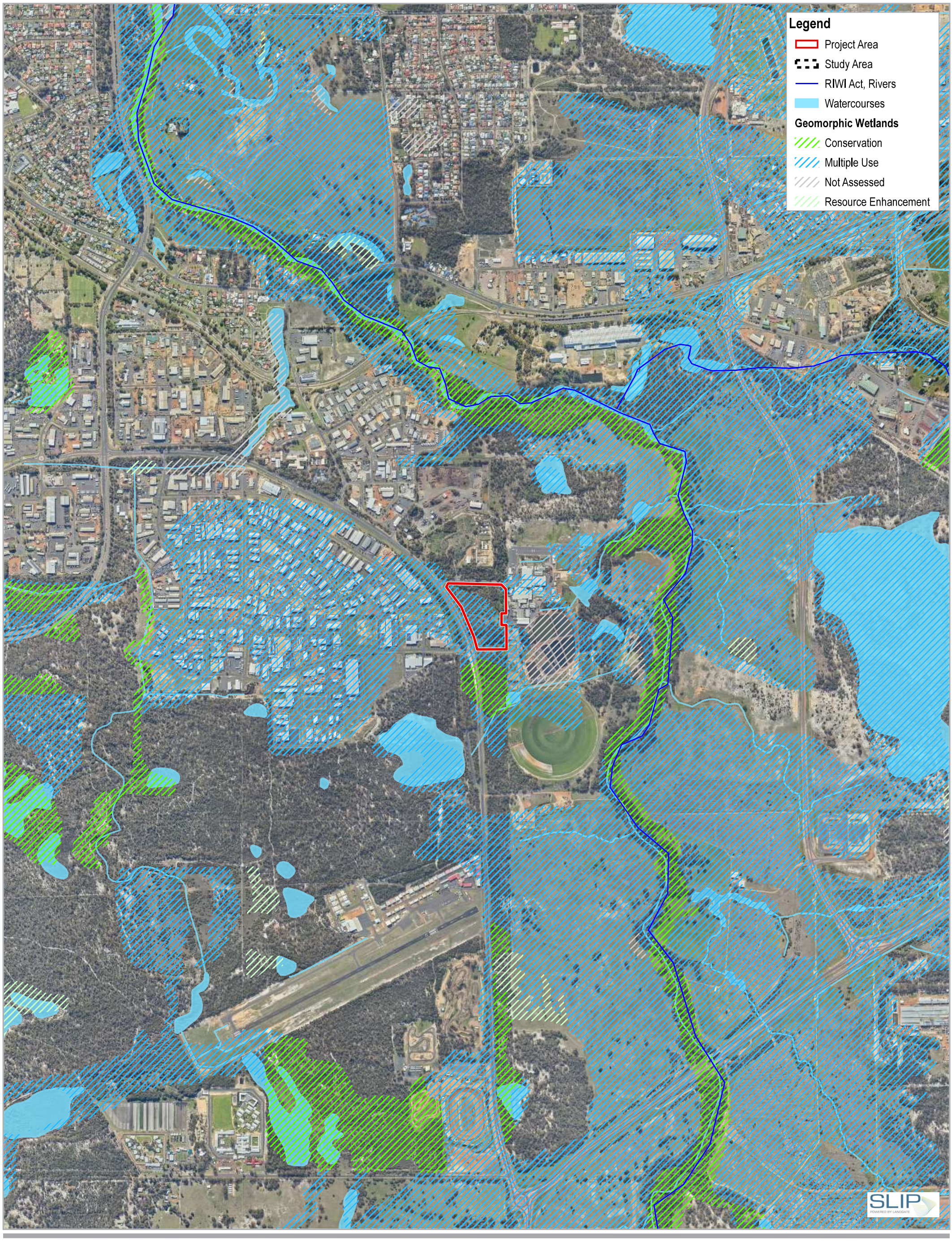

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Grid: GDA 1994 MGA Zone 50

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GHD

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Hydrology Constraints

Project No. **12539969**
Revision No. **A**
Date **25/11/2020**

FIGURE 3

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Legend

- Study Area
- Project Area

DBCA flora Database search

- Threatened Species (T)
- Priority 1
- Priority 2
- Priority 3
- Priority 4

Fauna Conservation Categories

- Critically Endangered Species (CR)
- Endangered Species (EN)
- Vulnerable Species (VU)
- Species of Special Conservation Interest (CD)
- Migratory Species Protected under International Agreement (MI)
- Other Specially Protected Species (OS)
- Priority 2 (P2)
- Priority 3 (P3)
- Priority 4 (P4)

TEC/PEC

- Threatened Ecological Community
- Priority Ecological Community

Paper Size ISO A3

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Kilometres

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

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Biological Constraints

Project No. **12539969**
Revision No. **A**
Date **25/11/2020**

FIGURE 4

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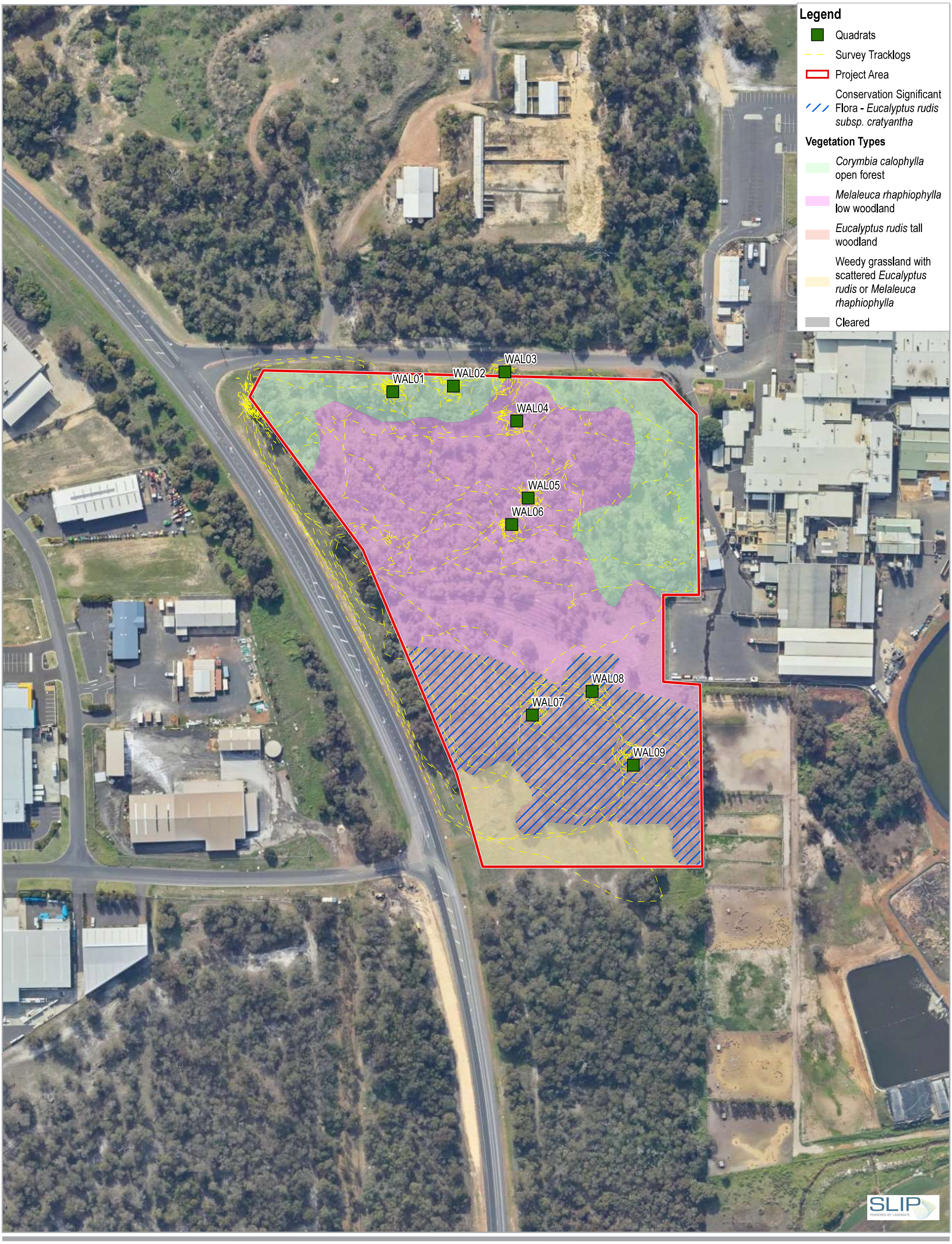

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GHD

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Flora and Vegetation Survey Results

Project No. **12539969**
Revision No. **A**
Date **30/11/2020**

FIGURE 5

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Metres

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GHD

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Vegetation Condition Survey Results

Project No. **12539969**
Revision No. **A**
Date **30/11/2020**

FIGURE 6

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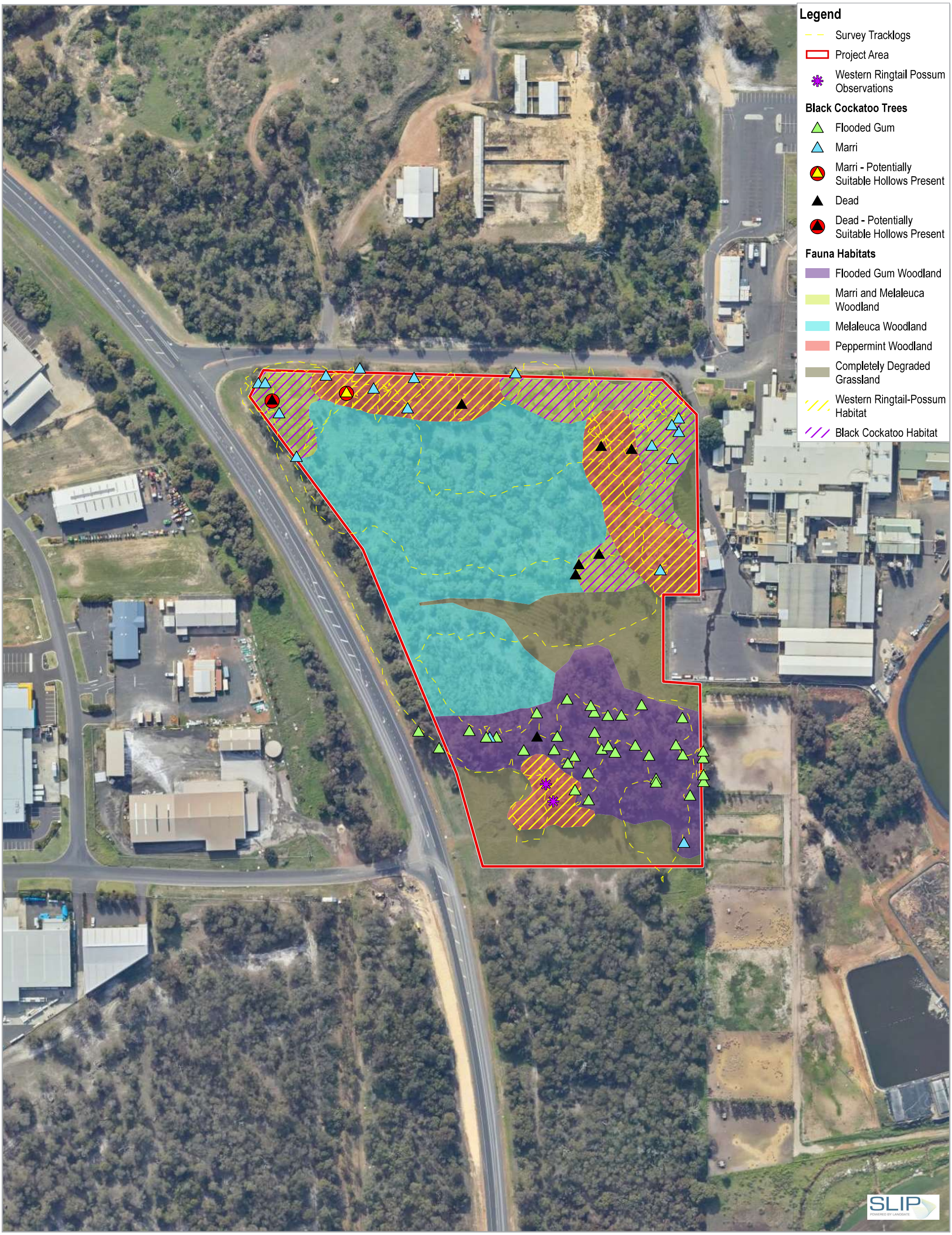

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GHD

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Fauna Survey Results

Project No. **12539969**
Revision No. **A**
Date **26/11/2020**

FIGURE 7

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Appendix B – Relevant legislation, background information and conservation codes

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of Agriculture, Water and the Environment (DAWE).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.

c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

g) 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.

h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

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.

j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biodiversity and ecological integrity should be a fundamental consideration indecision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976.* The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the *Australian Heritage Commission Act 1975* of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in "Bush Forever" Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*.
The areas covered by the *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002*.
The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) applies.
Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.

Reserves and conservation areas

Department of Biodiversity, Conservation and Attractions managed lands and waters

DBCA manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DBCA managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. Access to, or through, some areas of DBCA managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DBCA managed lands will generally be referred to DBCA throughout the assessment process.

Wetlands

Wetlands include not only lakes with open water, but areas of seasonally, intermittently or permanently waterlogged soil.

Ramsar Wetlands (Wetlands of International Importance)

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are "sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance" (DAWE 2020b). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as "maintaining the ecological character of a wetland" (DAWE 2020b).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DAWE 2020a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance.

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia's Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2019), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated every 2-3 years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA 2016a). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale for the South West and Interzone Botanical Provinces

Condition	South West and Interzone Botanical Provinces description
Pristine	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Excellent	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.
Very Good	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.
Good	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.
Degraded	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.
Completely Degraded	The structure of vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State BC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The BC Act provides for the Minister to list an ecological community as a TEC (section 27), or as a collapsed ecological community (section 31) statutory listing of State TECs by the Minister. The legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

Possible TECs that do not meet survey criteria are added to the DBCA Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Codes and definitions for TECs listed under the EPBC Act and/ or BC Act

Categories	Definition
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Endangered (EN)	An ecological community if, at that time: A) is not critically endangered; and B) is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Vulnerable (VU)	An ecological community if, at that time: A) is not critically endangered or endangered; and B) is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Western Australia Conservation Categories (BC Act)	
Threatened Ecological Communities	
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

Categories	Definition
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.
Collapsed ecological communities	
An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time – (a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed); or (b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover – (i) its species composition or structure; or (ii) its species composition and structure. Section 33 of the BC Act provides for a collapsed ecological community to be regarded as a threatened ecological community if it is discovered in a state that no longer makes it eligible for listing as a collapsed ecological community.	

Categories and definitions for PECS as listed by the DBCA

Category	Description
Priority 1	Poorly known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Poorly known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Category	Description
Priority 3	Poorly known ecological communities. (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	Conservation Dependent ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016a, b) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- A role as a refuge
- Providing an important function required to maintain ecological integrity of a significant ecosystem
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in ‘pristine’ condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range.

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Flora and fauna

Significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the BC Act can warrant referral to the DEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for flora and fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of flora and fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act flora and fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered significant.

Categories and definitions for EPBC Act and BC Act listed flora and fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	
Migratory (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species

Conservation category	Definition
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Codes for DBCA listed Priority flora and fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring A. Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. B. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. C. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016a, b) states that significant flora may include taxa that have/are:

- A keystone role in a particular habitat for Threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
- Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
- New species or anomalous features that indicate a potential new species
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- Unusual species, including restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems)

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007.*

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values.

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

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Appendix C – Desktop searches

Flora and Vegetation Desktop

Definitions

Term	Description
Desktop area	A 10 km buffer around the project area
Project area	The potential project footprint of the alignment options
Cr	Critically endangered
En	Endangered
T	Threatened
Vu	Vulnerable
P1 – P4	Priority 1 – Priority 4
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
DBCA	Department of Biodiversity and Conservation Attractions 2018. WA Government, Department of Parks and Wildlife Threatened (Declared Rare) and Priority Flora List
BC Act	Biodiversity Conservation Act 2016

Conservation significant flora desktop assessment and likelihood of occurrence

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence
Brachyscias verecundus	T (CR)	Nov	Annual (or ephemeral), herb, 0.012-0.022 m high, entirely glabrous. Fl. white/cream. In a moss sward. On a granite outcrop.	Unlikely
*Synaphe*a sp. *Fairbridge Farm* (D. Papenfus 696)	T (CR)	Oct	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. Yellow. Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	Unlikely
Synaphea sp. Serpentine	T (CR)	Sep-Oct	Shrublands and woodlands on loamy soils	Unlikely
Andersonia gracilis	T (EN)	Sep-Nov	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Possible
Austrostipa bronwenae	T (EN)	Sep-Oct	Perennial grass, 0.6 m high x 0.3 m wide. Flowers green. Calcareous, winter-wet grey-brown sandy-loam or dark brown loam over clay.	Unlikely
Banksia nivea subsp. uliginosa	T (EN)	July-Sep	Dense, erect, non-lignotuberous shrub, 0.2–1.5 m high. Fl. yellow, brown. Sandy clay, gravel.	Unlikely
Caladenia huegelii	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green, cream, red. Grey or brown sand, clay loam.	Unlikely
Darwinia whicherensis	T (EN)	Oct-Nov	Erect low shrub to 30 cm, flowers green, outer red. Winter-wet area of shrubland over shallow red clay over ironstone	Unlikely
Diuris purdiei	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.15-0.35 m high. Fl. yellow. Grey-black sand, moist. Winter-wet swamps. Found between Perth and Yarloop.	Possible
Drakaea elastica	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Possible
Lambertia echinata subsp. occidentalis	T (EN)	Feb/May-Jun/Oct	Prickly, much-branched, non-lignotuberous shrub, to 3 m high. Fl. yellow. White sandy soils over laterite, orange/brown-red clay over ironstone.	Unlikely
Synaphea sp. *Pinjarra Plain* (A.S. George 17182)	T (EN)	Sep to Nov	Erect, clumped shrub (sub-shrub), to 0.8 m high. Fl. yellow. Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains.	Unlikely

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence
Synaphea stenoloba	T (EN)	Aug-Oct	Caespitose shrub, 0.3–0.45 m high. Fl. Yellow. Sandy or sandy clay soils. Winter-wet flats, granite. Shrublands and woodlands on loamy soils.	Unlikely
Banksia squarrosa subsp. *argillacea*	T (VU)	Jun-Nov	Erect, open, non-lignotuberous shrub, 1.2–4 m high. Fl. yellow, Jun–Nov. White/grey sand, gravelly clay or loam. Winter-wet flats, clay flats.	Unlikely
Chamelaucium sp. S Coastal Plain (R.D. Royce 4872)	T (VU)	Oct-Dec	Winter-wet areas, loams and ironstone.	Unlikely
Diuris drummondii	T (VU)	Nov-Jan	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow. Low-lying depressions, swamps.	Possible
Drakaea micrantha	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.15–0.3 m high. Fl. red, yellow. White-grey sand.	Unlikely
Eleocharis keigheryi	T (VU)	Aug-Nov	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green. Clay, sandy loam. Emergent in freshwater: creeks, claypans	Unlikely
Austrostipa jacobsiana	T	Aug-Sep	Tufted rhizomatous herb, to 1.2 m, leaf sheaths hairy. Marri woodland, Melaleuca tall shrubland.	Possible
Carex tereticaulis	P1	Sep-Oct	Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.7 m high. Fl. brown. Black peaty sand.	Possible
Puccinellia vassica	P1	Sep-Nov	Caespitose annual or perennial, grass-like or herb, 0.41–0.55 m high. Saline soils. On the outer margins of coastal saltmarshes	Unlikely
Stylidium perplexum	P1	Dec	Cushion like plant to 20 cm tall with scapes extending higher, flowers white. Whicher Scarp in Lateritic soils, upper ridge slope.	Unlikely
Synaphea odocoileops	P1	Aug-Oct	Tufted, compact shrub, 0.2–0.5 m high. Fl. yellow. Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas.	Unlikely
Craspedia sp. Waterloo (G.J. Keighery 13724)	P2	Aug-Sep or Oct	Completely glabrous. Fl. Bright yellow. Growing in water on seasonally inundated heavy soils of the Pinjarra plain near Waterloo.	Unlikely
Gastrolobium whicherense	P2	Oct	Slender, open shrub, to 1.6 m high. Fl. orange/yellow/red. Red-grey sandy clay over quartzite. Steep westerly slopes.	Unlikely

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence
Grevillea rosieri	P2	Jul-Sep	Shrubs, 0.5 m high. Flowers red or brown. Gravelly soil, or sand; sandplains; gravel pits.	Unlikely
Leptomeria furtiva	P2	Jan, Aug-Oct	Lax, sprawling shrub, 0.2–0.45 m high. Fl. orange, brown. Grey or black peaty sand. Winter-wet flats.	Possible
Leucopogon sp. Busselton (D. Cooper 243)	P2	Aug-Sep	Slender, erect shrub to 70 cm; flowers white. Pericalymma ellipticum wet shrubland, Marri-Jarrah woodland.	Unlikely
Schoenus loliaceus	P2	Aug-Nov	Annual, grass-like or herb (sedge), 0.03–0.06 m high. Sandy soils. Winter-wet depressions.	Possible
Thelymitra variegata	P2	Jun-Sep	Tuberous, perennial, herb, 0.1–0.35 m high. Fl. orange, red, purple, pink. Sandy clay, sand, laterite.	Unlikely
Adelphacme minima	P3	Nov	Sandy soils. Annual 10-20 cm tall. Fl. white.	Unlikely
Angianthus drummondii	P3	Oct-Dec	Erect annual, herb, to 0.1 m high. Fl. yellow. Grey or brown clay soils, ironstone. Seasonally wet flats.	Unlikely
Boronia tetragona	P3	Oct-Dec	Perennial, herb, 0.3–0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Fl. pink, red. Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland.	Unlikely
Caustis sp. Boyanup (G.S. McCutcheon 1706)	P3	Dec-Jan	Rhizomatous, clumped perennial, grass-like or herb (sedge), 0.7–1 m high. White or grey sand.	Unlikely
Chamaescilla gibsonii	P3	Sep	Clumped tuberous, herb. Fl. blue. Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Unlikely
Lasiopetalum membranaceum	P3	Sep-Dec	Multi-stemmed shrub, 0.2-1 m high. Fl. pink, blue, purple. Sand over limestone.	Unlikely
Platysace ramosissima	P3	Oct-Nov	Perennial, herb, to 0.3 m high. Fl. white, cream. Sandy soils.	Possible
Schoenus benthamii	P3	Oct-Nov	Tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high. Fl. brown. White, grey sand, sandy clay. Winter-wet flats, swamps.	Possible
Schoenus capillifolius	P3	Oct-Nov	Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Fl. green. Brown mud. Claypans.	Unlikely

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence
Stylidium paludicola	P3	Oct-Dec	Reed-like perennial, herb, 0.35-1 m high, Leaves tufted, linear or subulate or narrowly oblanceolate, 0.5-4 cm long, 0.5-1.5 mm wide, apex acute, margin entire, glabrous. Scape mostly glabrous, inflorescence axis glandular. Inflorescence racemose. Fl. pink. Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	Possible
Synaphea hians	P3	Jul-Nov	Prostrate or decumbent shrub, 0.15-0.6 m high, to 1 m wide. Fl. Yellow. Sandy soils. Rises.	Unlikely
Synaphea polypodioides	P3	Sep-Oct	Clumped shrub (sunshrub), 0.35-0.4 m high. Light brown loam, red-brown sandy loam, gravelly, brown sandy clay over laterite. In undulating areas.	Unlikely
Verticordia attenuata	P3	Dec-May	Shrub, 0.4–1 m high. Fl. pink. White or grey sand. Winter-wet depressions	Possible
Acacia flagelliformis	P4	May-Sep	Rush-like, erect or sprawling shrub, 0.3-0.75(-1.6) m high. Fl. yellow. Sandy soils. Winter-wet areas.	Possible
Acacia semitrullata	P4	May-Oct	Slender, erect, pungent shrub, (0.1-)0.2-0.7(-1.5) m high. Fl. cream, white. White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	Possible
Aponogeton hexatepalus	P4	Jul-Oct	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white. Mud. Freshwater: ponds, rivers, claypans.	Likely
Caladenia speciosa	P4	Sep-Oct	Tuberous, perennial, herb, 0.35-0.6 m high. Fl. white, pink. White, grey or black sand.	Possible
Chamelaucium erythrochlorum - formerly sp. yoongarillup	P4	Jul-Oct	Non-lignotuberous shrub, to 2.5 m high. Fl. cream, yellow. Jarrah-marri forest. Loams, sandy clays. Riverbanks, lower slopes, below laterite breakaways.	Unlikely
Eucalyptus rudis subsp. cratyantha	P4	Jul-Sep	Tree, 5-20 m high, bark rough, box-type. Fl. white. Loam. Flats, hillsides.	Present
Franklandia triaristata	P4	Aug-Oct	Erect, lignotuberous shrub, 0.2-1 m high. Fl. white, cream, yellow , brown, purple. White or grey sand.	Possible
Microtis quadrata	P4	Dec-Jan	Slender erect annual herb, 0.3 - 0.8 m high, up to 100 yellowish-green flowers 2.5 - 3mm across. Clay based coastal flats.	Unlikely

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence
Ornduffia submersa	P4	Sep-Oct	Tuberous emergent aquatic perennial dwarf shrub, height to 35 cm; flowers white; leaves floating on surface of water. Clay-based ponds and swamps (semi-aquatic)	Possible
Pultenaea skinneri	P4	Jul-Sep	Slender shrub, 1-2 m high. Fl. yellow, orange, red. Sandy or clayey soils. Winter-wet depressions.	Possible
Rumex drummondii	P4		Erect perennial, herb, 0.6-0.9 m high. Winter-wet disturbed areas.	Possible
Stylidium longitubum	P4	Oct-Dec	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. Pink. Sandy clay, clay. Seasonal wetlands.	Possible
Trithuria australis	P4		Small aquatic herb. Ponds, pools	Possible

Note: The BC Act Conservation Status is shown, EPBC Act status, where relevant, is in brackets.

Likely – Known to occur within one kilometres of the Survey Area with suitable habitat within the Survey Area.

Possible – Suitable habitat within the Survey Area.

Unlikely – No suitable habitat present within the Survey Area.

Unknown – Data deficient.

Fauna Desktop

A likelihood of occurrence assessment was conducted for all conservation significant fauna species identified in the desktop assessment. This assessment was based on species biology, habitat requirements and observed habitat. No assumptions were made on the transient potential of these species

Parameters of fauna likelihood of occurrence assessment

Assessment outcome	Description
Present	Recorded during the current survey either as direct observation or indirect evidence (scats, possum drey, Black cockatoo foraging residue)
Likely	Species are **likely** to occur in the project area where there is suitable habitat within the project area and there are recent records of occurrence of the species in close proximity to the project area. OR Species known distribution overlaps with the project area and there is suitable habitat within the project area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 5 km of the project area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the project area. • The suitable habitat within the project area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the project area. OR Those species that have a known distribution overlapping with the project area however: • There is limited habitat in the project area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). • The suitable habitat within the project area is isolated from other areas of suitable habitat and species has no capacity to migrate into the project area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the project area include: • Those species that have no suitable habitat within the project area. • Those species that have become locally extinct, or are not known to have ever been present in the region of the project area.

Definitions

Term	Description
Desktop area	A 10 km buffer around the project area
Project area	The potential project footprint of the alignment options
Cr	Critically endangered
En	Endangered
Vu	Vulnerable
IA	International agreement
OS	Other specially protected fauna
P1 – P4	Priority 1 – Priority 4. Threatened and Priority fauna rankings
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
DBCA	Department of Biodiversity and Conservation Attractions
BC Act	Biodiversity Conservation Act 2016

Fauna likelihood of occurrence assessment of conservation significant fauna identified in the desktop assessment as potentially occurring within the project area.

Fauna desktop and likelihood of occurrence

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
Birds						
Anous tenuirostris melanops	Australian Lesser Noddy	EN	VU	The Australian Lesser Noddy is usually found only around its breeding islands in the Houtman Abrolhos Islands. It usually occupies coral-limestone islands that are densely fringed with White Mangrove *Avicennia marina*. It occasionally occurs on shingle or sandy beaches. The bird roosts mainly in mangroves, especially at night, but may sometimes rest on a beach. They can commonly be found dead after winter storms	**Highly unlikely** The survey area does not contain suitable habitat to support this species.	TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				along the southwest coast between Yanchep and Dunsborough (DotE 2016d).		
Botaurus poiciloptilus	Australasian Bittern	EN	EN	The Australasian Bittern's preferred habitat is wetlands with tall dense vegetation. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over a muddy or peaty substrate. In the south west, the Bittern is largely confined to coastal areas, especially along the south coast. It also occurs around swamps, lakes, pools, rivers and channels fringed with lignum Muehlenbeckia, canegrass Eragrostis or other dense vegetation (Marchant 1990). They can be found in reed beds near Two Peoples Bay, in lakes near Mt Manypeaks, and the Lake Muir area (Nevill 2013).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	PMST TPFL
Calidris canutus	Red Knot			In Australasia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (DotE 2016f). They are found near mudflats and estuaries from Murchison to Bunbury but are then uncommon from Wilson Inlet to Esperance. In the Perth region they are mainly found in Alfred Cove and Peel Inlet (Nevill 2013).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	NatureMap PMST TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
Calidris ferruginea	Curlew Sandpiper	CR, IA	CR,MI	Curlew Sandpipers mainly occur in areas with soft mud conditions, including intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are found inland less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. In WA, they are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley Division, but are more sparsely distributed between Carnarvon and Dampier Archipelago (DotE 2016g). They are common on the Swan Coastal Plain, particularly near large drying lakes like Thompson and Forrestdale, and Peel Inlet. They are less common along the southern coast to Esperance (Nevill 2013).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	NatureMap TPFL
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	VU	VU	The Forest Red-tailed Black Cockatoo inhabits the dense jarrah, karri, and marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala)*, Albany Blackbutt (*E. staeri*), Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DotE 2017). Habitats tend to have an understorey of balga (*Xanthorrhoea* spp.), kingia (*Kingia australis*), snottygobble (*Persoonia* spp.), parrot bush (*Banksia sessillis*), holly-leaved mirbelia (*Mirbelia dilatata*), bull banksia (*B. grandis*), bullich (*Taxandria* spp.) and sheoak (*Allocasuraina fraseriana*). They are most common in the jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the	**Likley** Suitable foraging and potential roosting habitat is available within the survey area to support this species	NatureMap PMST TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				Swan Coastal Plain, mainly in search of food the exotic white cedar (*Melia azedarach*). There are also several small isolated populations in the eastern parts of its range (DEE 2016j).		
Calyptorhynchus baudinii	Baudin's Cockatoo,	EN	EN	Baudin's Black Cockatoo mainly occurs in eucalypt forests, especially jarrah, marri and karri forest that receives 750 mm of annual rainfall. The species is less frequently in woodlands of wandoo (*E. wandoo*), blackbutt (*E. patens*), flooded gum (*E. rudis*), yate (*E. cornuta*), partly cleared farmlands and urban areas. The range of the species extends from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup. Preferred roosts are in areas with a dense canopy close to permanent sources of water (DotE 2016k).	**Likely** Suitable foraging and potential roosting habitat is available within the survey area to support this species	Naturemap PMST TPFL
Calyptorhynchus latirostris	Carnaby's Cockatoo,	EN	EN	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum, wandoo, marri, jarrah and karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the jarrah-marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. It nests in trees older than 120-150 years (DotE 2016l).	**Likely** Suitable foraging and potential roosting habitat is available within the survey area to support this species	Naturemap PMST TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
Falco peregrinus	Peregrine Falcon	OS		The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004; Pizzey and Knight 2012). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	**Likely** This species may use the survey area for opportunistic foraging. It is also known to breed in tall eucalyptus trees such as Jarrah (RBC pers.ops)	Naturemap
Falco hypoleucos	Grey Falcon	VU	VU	Found on and near cliffs, gorges, plains, open woodlands, and pylons and spires of buildings. They are not common but can be found almost anywhere throughout WA and in the southwest.	**Unlikely** The survey area does not contain suitable habitat to support this species	PMST
Ixobrychus falvicollis	Black bittern	P2		The Black Bittern tends to be found on smaller bodies of water, particularly along creek lines with shadowy, leafy waterside trees (callistemons, casuarinas, paperbarks, eucalypts, mangroves, and willows), in sheltered mudflats, and oyster-slats. In the south west they are found on the quieter river systems, often where there are large paperbarks. They can be found in the coastal south west from Perth, through Margaret River, to Northcliffe (Nevill 2013; Pizzey and Knight 2012).	**Unlikely** The survey area does not contain suitable habitat to support this species	TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
Limosa lapponica baueri	Bar-tailed Godwit	MI (& VU or CR at subsp. level)	MI (& VU or CR at subsp. level)	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (DotE 2016t). They are uncommon in the south west, but can be sighted from Geraldton to Bunbury, at Alfred Cove, and then at a few estuaries on the south coast including Kalgan River Mouth and Oyster Harbour (Nevill 2013).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	PMST TPFL
Limosa lapponica menzbieri	Black-tailed Godwit	MI	MI	In Australia the Black-tailed Godwit has a primarily coastal habitat environment. The species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets. It is also found in shallow and sparsely vegetated, near-coastal, wetlands; such as saltmarsh, saltflats, river pools, swamps, lagoons and floodplains. There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows. They also use lagoons in sewage farms and saltworks. In the south-west, there is some evidence that small flocks move along the coast during April (DotE 2016u).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	NatureMap TPFL
Numenius madagascariensis	Eastern Curlew	CR	CR & MI	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock	**Highly unlikely** The survey area does not contain suitable habitat to	NatureMap PMST TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, sometimes within the mangroves, and in coastal saltworks and sewage farms. In the south west, Eastern Curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet (Marchant & Higgins 1993). They are uncommon further south of Geraldton, but can be spotted in Alfred Cove, Peel Inlet and the Albany region (Nevill 2013).	support this species	
Numenius phaeopus	Whimbrel	MI	MI	The Whimbrel is often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes near coastal areas. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields. There are a small number of inland records from saline lakes and canegrass swamps. The Whimbrel is common and widespread from Carnarvon to the north-east Kimberley Division. It is occasionally seen on the south coast of WA and has occasionally been recorded in the south-west and further north to Shark Bay (DotE 2016v).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	NatureMap TPFL
Oxyura australis	Blue-billed Duck	P4		The blue-billed duck is a small Australian almost entirely aquatic duck (Morcombe 2004). The blue-billed duck is endemic to Australia's temperate regions, ranging from the south west of WA, extending to southern Queensland, through New South Wales and Victoria, to Tasmania. The species is	**Unlikely** No deep fresh water habitat is present.	NatureMap TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				readily seen on freshwater lakes and billabongs where deep fresh water is present (Morcombe 2004).		
Pluvialis squatarola	Grey Plover	MI	MI	Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (DotE 2016z).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	NatureMap TPFL
Rostratula australis	Australian Painted Snipe	EN	EN	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia, canegrass, or sometimes tea-tree (Melaleuca). It sometimes uses areas that are lined with trees, or that have some scattered fallen or washed-up timber (DotE 2016b). In the south west it can be found around Carnarvon and wetlands north of Perth, particularly those west of Moora and Gin Gin (Nevill 2013).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	PMST
Sternula nereis nereis	Australian Fairy Tern	VU	VU	The Fairy Tern occurs along the coast of WA as far north as the Dampier Archipelago near Karratha, but mostly in the southern part of Australia including most of the coastline in the south west. It nests on sheltered sandy beaches, coastal inlets, spits and banks above the high tide line and below vegetation. It has been	**Highly unlikely** The survey area does not contain suitable	PMST

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands, and mainland coastline (DotE 2016cc; Nevill 2013). They can also be seen in saltfields, saline or brackish lakes, and sewage ponds near the coast (Pizzey & Knight 2012).	habitat to support this species	
Thalasseus bergii	Crested Tern	MI	MI	The crested tern inhabit coastal offshore waters, beaches, bays, inlets, tidal rivers, salt swamps, lakes and large rivers. The sustralian range is primarily coastal on the mainland and around Tasmania. This is a sedentary, dispersive species (Prizzey & Knight 2012).	**Highly unlikely** The survey area does not contain suitable habitat to support this species	Naturemap
Tringa nebularia	Common Greenshank	MI	MI	The Common Greenshank is found in a wide variety of inland wetlands and coastal habitats of varying salinity. It occurs in sheltered coastal areas typically with large mudflats and saltmarsh, mangroves or seagrass, including embayments, harbours, river estuaries, deltas and lagoons, but less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats, and artificial wetlands. They occur around most of the coast from Cape Arid in the south to Carnarvon in the north-west (DotE 2020c), and are moderately common here given suitable habitat. They can be found in areas including Wannamal Lake, many Perth lakes, Alfred Cove, Peel Inlet, Vasse and Harvey Estuaries, and the Albany and Esperance regions (Nevill 2013).	**Unlikely** The species may be an infrequent vagrant to the riverine section of the survey area.	Naturemap TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
Mammals						
Dasyurus geoffroii	Chuditch, Western Quoll	VU	VU	The Chuditch inhabits eucalypt forest (especially Jarrah, *E. marginata*), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2012a). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck and Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented.	**Unlikely** While the species is known from the wider region, the habitat is relatively isolated and the species may only infrequently visit	Naturemap PMST TPFL
Falsistrellus mackenziei	Western False Pipistrelle	P4		The Western False Pipistrelle occurs in wet sclerophyll forest dominated by Karri (*Eucalyptus diversicolor*), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) dry sclerophyll forests. The species is restricted to areas in or adjacent to stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*E. calophylla*), Sheoak (*Casuarina huegeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (Churchill 2008; McKenzie and Start 1999).	**Likely** Suitable habitat may be present within the survey area to support this species.	Naturemap TPFL
Isoodon fusciventer	Quenda	P4		The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat	**Likely** Suitable habitat may be	NatureMap TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent Jarrah and Wandoo forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (DEC 2012e; Van Dyck & Strahan 2008).	available within the survey area to support this species.	
Notaacropus irma	Western Brush Wallaby	P4		The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally-wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DEC 2012c; Van Dyck and Strahan 2008).	**Likely** Suitable habitat may be available within the survey area to support this species.	TPFL
Phascogale tapoatafa wambenger	South-western Brush-tailed phascogale	CD		The South-western Brush-tailed Phascogale is found in dry, open sclerophyll forests and woodlands with a generally sparse ground-storey, which contain suitable nesting resources such as tree hollows, rotted stumps and tree cavities. In northern Australia all sightings are in drier habitats with recent records occurring in tall open forest of *Eucalyptus miniata* and *E. tetrodonta*. Records are less common in high rainfall areas in both the north and south of WA (DEC 2012d). Foraging success is greatest on mature trees, large logs and dead standing trees with rough bark. An individual can use more than 40 nests in a single year, including hollow trees, rotted stumps, house ceilings and bird nests (Van Dyck & Strahan 2008).	**Likely** Suitable habitat may be available within the survey area to support this species.	TPFL

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
Pseudocheirus occidentalis	Western Ringtail Possum	CR	VU	Ideal habitat for the Western Ringtail Possum comprises long unburnt mature remnants of peppermint (*Agonis flexuosa*) woodlands with high canopy continuity; others comprise of jarrah (*Eucalyptus marginata*)/marri (*Corymbia calophylla*) forests and woodlands with adequate hollows, coastal heath, myrtaceous heaths and shrublands, Bullich (*E. megacarpa*) dominated riparian zones and karri forests. Populations are associated with swamps, water courses or floodplains, and at topographic low points which provide cooler, often more fertile conditions. Their current distribution is patchy and largely restricted to the moister south-western corner of WA, especially in the Australind/Eaton area to Waychinicup National Park. The Upper Warren area east of Manjimup is the only place the possum survives in the absence of coastal peppermint. Persistence in translocation sites has only been at Karakamia Sanctuary, Perup Sanctuary and Yalgorup National Park (DPaW 2014; TSSC 2013; Van Dyck & Strahan 2008).	**Present** Suitable habitat is available within the survey area to support this species. One individual was recorded	NatureMap PMST TPFL
Setonix brachyurus	Quokka	VU	VU	The current distribution of the Quokka includes Rottnest and Bald Islands, and at least 25 sites on the mainland, including Two Peoples Bay Nature Reserve and Torndirrup, Mt Manypeaks and Walpole-Nornalup National Parks, and swamp areas through the south-west forests from Jarrahdale to Walpole. The last known population on the Swan Coastal Plain occurs in Muddy Lakes near Bunbury. Quokkas have also been reintroduced to Karakamia Sanctuary (DEC 2012e). They occupy dense forests and thickets, streamside vegetation, heaths, shrublands, *Agonis linearifolia*-dominated swamps in the Jarrah (*Eucalyptus marginata*) forest, and sometimes tea-	**Highly unlikely** The survey area does not contain suitable habitat to support this species	PMST

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				tree thickets on sandy soils along creek systems. The northern extent on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, from where it extends southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 mm or more (DEC 2012e; Van Dyck & Strahan 2008).		
Reptiles						
Ctenotus ora	Coastal Plains Skink	P3		The Coastal Plains Skink is locally restricted the sandy regions of the Swan Coastal Plain south of Perth. It inhabits open eucalypt woodland over Banksia, as well as sandy coastal plain and coastal dunes between Pinjarra and Yallingup Brook (Wilson & Swan 2013).	**Likely** The survey area may contain suitable habitat to support this species.	NatureMap TPFL
Aquatic						
Galaxiella nigrostriata	Black-stripe minnow	EN	EN	They are restricted to shallow, tannin stained, ephemeral pools and are most common in waterbodies of peat flats (Morgan and Gill 2000).	**Unlikely** Wetland section appears shallow and short lived. Wetland is highly modified and degraded	TPFL NatureMap
Westralunio carteri	Carter's Freshwater Mussel	VU	VU	Carter's Freshwater Mussel is usually found in freshwater river pools. They are most common in areas with muddy, silty and sandy bottoms and flowing permanent water. Environmental	**Unlikely**	NatureMap PMST

TAXON	COMMON NAME	STATUS		DESCRIPTION AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE WITHIN THE SURVEY AREA	SOURCE
		BC Act	EPBC Act			
				tolerances of *W. carteri* are not precisely known but they can be found where water temperatures range from 4°C to over 30°C.	No permanent water present	TPFL

Parameters of fauna likelihood of occurrence assessment

Likelihood of occurrence	Guideline
Present	Recorded during the current survey either as direct observation or indirect evidence (scats, possum drey, Black cockatoo foraging residue)
Likely	Species are **likely** to occur in the project area where there is suitable habitat within the project area and there are recent records of occurrence of the species in close proximity to the project area. OR Species known distribution overlaps with the project area and there is suitable habitat within the project area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 5 km of the project area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the project area. • The suitable habitat within the project area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the project area. OR Those species that have a known distribution overlapping with the project area however: • There is limited habitat in the project area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). The suitable habitat within the project area is isolated from other areas of suitable habitat and species has no capacity to migrate into the project area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the project area include: • Those species that have no suitable habitat within the project area.

Likelihood of occurrence	Guideline
	Those species that have become locally extinct, or are not known to have ever been present in the region of the project area.

Definitions

Term	Description
Study area	A 5 km buffer around the survey area
Survey area	The potential project footprint of the alignment options
Cr	Critically endangered
En	Endangered
Vu	Vulnerable
IA	International agreement
Mi, Ma	Migratory, Marine
CD	Conservation dependent
OS	Other specially protected fauna
P1 – P4	Priority 1 – Priority 4. Threatened and Priority fauna rankings
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
DBCA	Department of Biodiversity and Conservation Attractions
BC Act	*Biodiversity Conservation Act 2016*

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Appendix D – Flora survey results

Flora recorded within the project area

Family	Species	Naturalised	Conservation status
Araceae	*Lemna disperma*		
Araceae	*Zantedeschia aethiopica*	* DP	
Asparagaceae	*Asparagus asparagoides*	* DP WONS	
Asparagaceae	*Lomandra micrantha*		
Asparagaceae	*Sowerbaea laxiflora*		
Asteraceae	*Arctotheca calendula*	*	
Asteraceae	*Conyza bonariensis*	*	
Asteraceae	*Cotula coronopifolia*	*	
Asteraceae	*Cotula turbinata*	*	
Asteraceae	*Hypochaeris glabra*	*	
Asteraceae	*Senecio pinnatifolius*		
Asteraceae	*Sonchus oleraceus*	*	
Asteraceae	*Ursinia anthemoides*	*	
Boraginaceae	*Echium plantagineum*	*	
Cactaceae	*Opuntia* sp.	* DP	
Caryophyllaceae	*Silene gallica*	*	
Colchicaceae	*Burchardia congesta*		
Crassulaceae	*Crassula colorata*		
Crassulaceae	*Crassula natans*	*	
Cyperaceae	*Ficinia nodosa*		
Cyperaceae	*Lepidosperma longitudinale*		
Cyperaceae	*Mesomelaena tetragona*		
Dasypogonaceae	*Dasypogon bromeliifolius*		
Euphorbiaceae	*Ricinus communis*	*	
Fabaceae	*Acacia pulchella*		
Fabaceae	*Acacia saligna*		
Fabaceae	*Jacksonia furcellata*		
Fabaceae	*Kennedia prostrata*		
Fabaceae	*Lotus subbiflorus*	*	
Fabaceae	*Lupinus angustifolius*	*	
Fabaceae	*Trifolium arvense*	*	
Fabaceae	*Trifolium repens*	*	
Fabaceae	*Vicia sativa*	*	
Geraniaceae	*Erodium cicutarium*	*	
Iridaceae	*Romulea rosea*	*	
Iridaceae	*Sparaxis bulbifera*	*	
Iridaceae	*Watsonia meriana*	*	
Juncaceae	*Juncus pallidus*		
Juncaginaceae	*Cycnogeton lineare*		

Family	Species	Naturalised	Conservation status
Lauraceae	*Cassytha racemosa*		
Myrtaceae	*Agonis flexuosa*		
Myrtaceae	*Corymbia calophylla*		
Myrtaceae	*Eucalyptus rudis* subsp. *cratyantha*		P4
Myrtaceae	*Hypocalymma angustifolium*		
Myrtaceae	*Kunzea glabrescens*		
Myrtaceae	*Melaleuca preissiana*		
Myrtaceae	*Melaleuca rhaphiophylla*		
Orchidaceae	*Caladenia latifolia*		
Orchidaceae	*Microtis media*		
Oxalidaceae	*Oxalis pes-caprae*	*	
Poaceae	*Briza maxima*	*	
Poaceae	*Cenchrus clandestinus*	*	
Poaceae	*Cynodon dactylon*	*	
Poaceae	*Ehrharta calycina*	*	
Poaceae	*Ehrharta longiflora*	*	
Poaceae	*Eragrostis curvula*	*	
Poaceae	*Lolium perenne*	*	
Poaceae	*Poa annua*	*	
Polygonaceae	*Rumex crispus*	*	
Proteaceae	*Banskia grandis*		
Proteaceae	*Banksia littoralis*		
Proteaceae	*Hakea varia*		
Proteaceae	*Persoonia longifolia*		
Ranunculaceae	*Ranunculus muricatus*	*	
Rubiaceae	*Opercularia hispidula*		
Xanthorrhoeaceae	*Xanthorrhoea brunonis*		
Zamiaceae	*Macrozamia riedlei*		

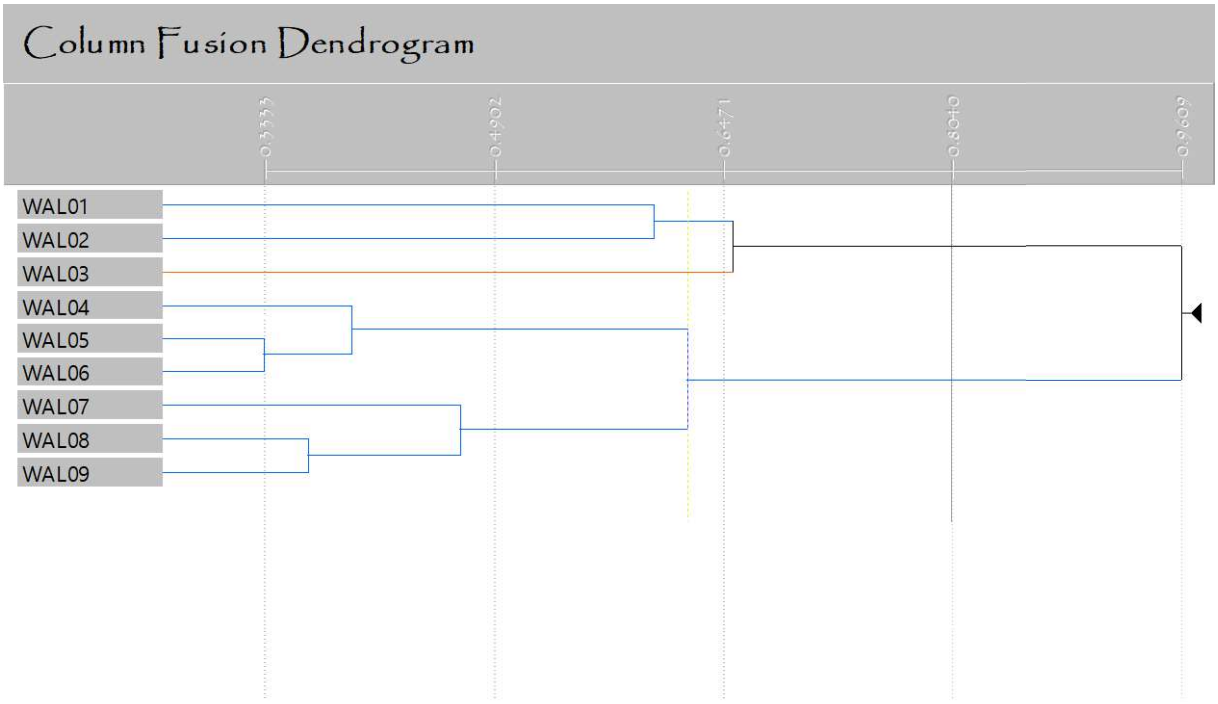
* Introduced (weed) species

DP Declared Pest

WONS Weed of National Significance

P4 Priority 4

Quadrat floristic analysis



Appendix E – Fauna survey results

Family	Taxon	Common name	Status (EPBC Act)
Birds			
Alcedinidae	*Dacelo novaeguineae*	Laughing kookaburra	Int
Anatidae	*Chenonetta jubata*	Australian wood duck	
Anatidae	*Anas superciliosa*	Pacific black duck	
Artamidae	*Gymnorhina tibicen*	Australian magpie	
Artamidae	*Cracticus nigrogularis*	Pied butcherbird	
Corvidae	*Corvus coronoides*	Australian raven	
Hirundinidae	*Hirundo neoxena*	Welcome swallow	
Meliphagidae	*Anthochaera carunculata*	Red wattlebird	
Monoarchidae	*Grallina cyanoleuca*	Magpie-lark	
Phalacrocoracidae	*Phalacrocorax varius*	Pied cormorant	
Psittaculidae	*Barnardius zonarius*	Australian ringneck	
Psittaculidae	*Purpureicephalus spurius*	Red-capped parrot	
Rhipiduridae	*Rhipidura leucophrys*	Willie wagtail	
Threskiornithidae	*Threskiornis moluccus*	Australian white ibis	
Mammals			
Felidae	*Felis catus*	House cat	Int
Leporidae	*Oryctolagus cuniculus*	Rabbit	Int
Macropodidae	*Macropus fuliginosus*	Western grey kangaroo	
Phalangeridae	*Trichosurus vulpecula*	Common brushtail possum	
Pseudocheiridae	*Pseudocheirus occidentalis*	Western ringtail possum	Cr
Reptiles			
Gekkonidae	*Christinus marmoratus*	Marbled Gecko	
Scincidae	*Hemiergis quadrilineata*	Two-toed earless skink	
Scincidae	*Menetia greyii*	Common dwarf skink	
Amphibians			
Pelodryadidae	*Ranoidea moorei*	Motorbike frog	

Cr = Critically endangered under the *WA Biodiversity Conservation Act 2016*

En = Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*

Vu = Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*

Int = Introduced species

Black Cockatoo Suitable DBH Tree locations

Number	Tree species	DBH (trunk diameter) m	*Visible hollows	Latitude	Longitude
1	Flooded Gum	1.2	2	-33.364531	115.683889
2	Flooded Gum	0.95	2	-33.364621	115.684018
3	Flooded Gum	0.73	1	-33.364639	115.684748
4	Flooded Gum	0.51	1	-33.364675	115.684876
5	Flooded Gum	0.65	2	-33.364711	115.684834
6	Flooded Gum	0.75	1	-33.364854	115.684876
7	Flooded Gum	0.52	1	-33.364908	115.684962
8	Flooded Gum	0.66	1	-33.364764	115.684962
9	Flooded Gum	0.78	1	-33.364639	115.685048
10	Flooded Gum	0.55	1	-33.364549	115.685005
11	Flooded Gum	0.61	1	-33.364621	115.685091
12	Flooded Gum	0.53	1	-33.364657	115.685134
13	Flooded Gum	0.8	2	-33.364621	115.685263
14	Flooded Gum	0.6	1	-33.364675	115.685349
15	Flooded Gum	0.9	1	-33.3648	115.685391
16	Flooded Gum	1	1	-33.364818	115.685391
17	Marri	0.95	1	-33.365141	115.685563
18	Flooded Gum	0.6	1	-33.36489	115.685606
19	Flooded Gum	0.6	1	-33.364818	115.685692
20	Flooded Gum	0.58	1	-33.364782	115.685692
21	Flooded Gum	0.75	1	-33.364693	115.685692
22	Flooded Gum	0.55	1	-33.364657	115.685692
23	Flooded Gum	0.51	1	-33.364675	115.685563
24	Flooded Gum	0.67	1	-33.364621	115.68552
25	Flooded Gum	0.73	2	-33.364478	115.685563
26	Flooded Gum	0.65	1	-33.364406	115.685306
27	Flooded Gum	0.6	1	-33.36446	115.685177
28	Flooded Gum	0.6	1	-33.36446	115.685091
29	Flooded Gum	0.9	1	-33.364442	115.685005
30	Flooded Gum	0.55	1	-33.364406	115.684984
31	Flooded Gum	0.85	1	-33.36437	115.684834
32	Flooded Gum	0.75	1	-33.364567	115.684769
33	Dead	0.65	2	-33.364567	115.68464
34	Flooded Gum	0.7	1	-33.364442	115.68464
35	Flooded Gum	0.7	2	-33.364639	115.684555
36	Flooded Gum	0.73	1	-33.364567	115.684383
37	Flooded Gum	0.52	1	-33.364567	115.684383
38	Marri	0.51	1	-33.364567	115.68434
39	Flooded Gum	0.95	1	-33.364567	115.684319
40	Flooded Gum	0.6	1	-33.364531	115.684211
41	Marri	0.53	1	-33.363689	115.685434
42	Dead	0.63	2	-33.363599	115.685048
43	Dead	0.71	1	-33.363653	115.684919
44	Marri	0.8	1	-33.363098	115.68552
45	Dead	0.55	1	-33.363707	115.684898
46	Marri	0.57	1	-33.363026	115.685391

Number	Tree species	DBH (trunk diameter) m	*Visible hollows	Latitude	Longitude
47	Marri	0.56	1	-33.362954	115.685563
48	Marri	0.65	1	-33.362883	115.685563
49	Marri	0.63	1	-33.362918	115.68552
50	Dead	0.74	2	-33.363044	115.685263
51	Marri	0.57	1	-33.362632	115.684533
52	Dead	0.58	1	-33.362793	115.68419
53	Marri	0.53	1	-33.36265	115.683889
54	Marri	0.77	2	-33.362811	115.683846
55	Marri	0.63	1	-33.362703	115.683632
56	Marri	0.52	1	-33.363062	115.683138
57	Marri	0.55	3	-33.362721	115.68346
58	Marri	0.52	1	-33.362596	115.683546
59	Marri	1	1	-33.362632	115.683331
60	Marri	0.52	1	-33.362668	115.682902
61	Marri	0.7	1	-33.362668	115.682945
62	Marri	0.55	1	-33.362829	115.683031
63	Dead	0.9	3	-33.362757	115.682988
64	Dead	0.88	2	-33.363026	115.68507

*1-No hollows, 2- Small hollows, 3-Large hollows

Appendix F – Black Cockatoo Hollow Inspection

[redacted]

[redacted]

RE: Black Cockatoo Habitat Tree Assessment - 1 Rawlings Road, Davenport,

1. BACKGROUND

This report details the results of a black cockatoo habitat tree assessment of two trees with land associated with V&V Walsh's property at Rawlings Road, Davenport.

It is understood that V&V Walsh are proposing to widen the road to improve access into their property and the removal of vegetation bordering the existing road will be required.

An environmental assessment identified the presence of two "habitat trees" (diameter at breast height of ≥50cm) within the proposed clearing area.

Ecoedge have requested that the trees be further assessed for the presence of hollows suitable, or potentially suitable for black cockatoos to use for nesting purposes. The results of this assessment are provided in the following report.

2. SCOPE

The scope of works was to carry out the following:

- Identification hollows within the two previously identified habitat trees that are suitable or potentially suitable for black cockatoos to use for nesting purposes.

  Tree 1: -33.362721°S, 115.68346°E - Marri

  Tree 2: -33.362757°S, 115.682988°E – Dead (unidentifiable species)

3. METHODS

Field work was carried out by Greg Harewood (Zoologist) on the 6 December 2020.

The two habitat trees (i.e. DBH >50cm) previously identified were re-examined for hollows and relevant details recorded. For the purposes of this assessment a tree containing a potential cockatoo nest hollow has been 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 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 nest hollow".

Where considered necessary and if possible a drone (DJI Mavic Air) was used to examine and photograph each potential hollow in detail to assist in determining if they actually represented suitable hollows or if they showed any signs of current or previous use by black cockatoos (e.g. significant chew marks around hollow entrances).

4. RESULTS

Neither tree was found to contain hollows of a size suitable for black cockatoos to use for nesting purposes.

Tree 1 (a marri) has a number of dead branches which contain small hollows (or possible hollows), however the hollow entrances and branches themselves are too small (<10cm diameter) to accommodate a black cockatoo. Example images are provided below.

Tree 2 (a dead unidentifiable species) also has a number of branches which contain small hollows (or possible hollows), however the hollow entrances and branches themselves are generally too small (<10cm diameter) to accommodate a black cockatoo. One larger upward facing branch was examined with a drone and found to have no depth which confirmed its lack of suitability. Example images are provided below.

5. CONCLUSION

The assessment reported on here was carried out to provided additional information on the two black cockatoo habitat trees identified within the proposed clearing area.

Neither tree was found to contain hollows of a size suitable for black cockatoos to use for nesting purposes.

If you have any questions or queries relating the information provided here please contact the undersigned on 0402 141 197 / gharewood@iinet.net.au

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