SE Campbell Development Pty Ltd

Benger Solar Farm Connection Project

NVCP Supporting Document

May 2021

Table of contents

Table index

Appendices

Acronyms

Abbreviation	Description
AH Act	*Aboriginal Heritage Act 1972*
BC Act	*Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CD	Conservation Dependent
CCW	Conservation Category Wetland
DAWE	The Department of Agriculture, Water and the Environment
DBH	Diameter Breast Height
DBCA	The Department of Biodiversity, Conservation and Attractions
DE	Development Envelope
DoEE	The Department of Energy and the Environment
DP	Declared Pest
DPIRD	The Department of Primary Industries and Regional Development
DPLH	The Department of Planning, Lands and Heritage
DWER	The Department of Water and Environmental Regulation
EN	Endangered
ELA	Eco Logical Australia
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
FCT	Floristic Community Type
GHD	GHD Pty Ltd
GoWA	Government of Western Australia
IBRA	Interim Biogeographic Regionalisation for Australia
KSIA	Kemerton Strategic Industrial Area
NVCP	native vegetation clearing permit
P	Priority
PASS	Potential Acid Sulfate Soils
PEC	Priority Ecological Community
PDWSA	Public Drinking Water Source Area
PMST	Protected Matters Search Tool
R	Reserve
RIWI Act	*Rights in Water and Irrigation Act 1914*
South Energy	SE Campbell Development Pty Ltd
SWA	Swan Coastal Plain (*in other reports may be referred to as the SCP*)
TEC	Threatened Ecological Community
VA	Vegetation Associations
VU	Vulnerable
WA	Western Australia
WONS	Weeds of National Significance

1. Introduction

1.1 Project background

SE Campbell Development Pty Ltd (South Energy) (the Proponent) is proposing to construct a 3.71 kilometre (km) overhead transmission line ('the Proposal') connecting the proposed Benger Solar Farm to the Western Power network, to supply renewable electricity to industrial customers and approximately 35,000 homes (Figure 1, Appendix B). The Proposal comprises a dual circuit 132 kV overhead transmission line with associated infrastructure including pole pads, brake and winch sites, access tracks and laydown areas along the alignment.

The 3.71 km overhead transmission line will be supported by poles spaced approximately 100 – 250 m apart. Within the 78.29 ha Development Envelope (DE) a Development Footprint of 10.38 hectares (ha) is proposed and comprises 4.36 ha of native vegetation. A native vegetation clearing permit (NVCP) (purpose) is required for the clearing of native vegetation associated with the proposed works.

1.2 Scope and purpose

GHD Pty Ltd (GHD) has prepared this report on behalf of South Energy in support of an application for a NVCP under Section 51E of Part V of the *Environmental Protection Act 1986* (EP Act), to clear up to 4.36 ha of native vegetation within a DE of 78.29 ha.

This report includes:

- An overview of works required and description of clearing activities to be undertaken (Section 2)
- An overview of existing environment (Section 3)
- Potential impacts identified (Section 4)
- Environmental management measures to be implemented to minimise clearing impacts (Section 5)
- An assessment against the Ten Clearing Principles, as defined in Schedule 5 of the EP Act (Section 6). The Ten Clearing Principles aim to ensure that potential impacts resulting from removal of native vegetation can be assessed holistically.

The assessment was undertaken in accordance with the Department of Water and Environmental Regulation (DWER) clearing permit guidelines, using information obtain from the following sources:

- Eco Logical Australia (ELA) (2020) *Detailed and Targeted Flora and Vegetation Survey and Level 1 Fauna Survey*, which included field surveys of the DE in August and October of 2019 (Appendix A).
- Online databases:
    - *Data WA* (GoWA 2020a)
    - *LandMonitor* (GoWA 2020b)
    - *Clearing Permit Map Viewer* (DWER 2020a)
    - *Water Information Reporting* (DWER 2020)
    - *Map Viewer Plus* (Landgate 2020).

- Online technical reports:
    - *Banksia Woodlands of the Swan Coastal Plain: a nationally protected ecological community* (DoEE 2016)
    - *2019 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis* (GoWA 2019)
    - *Soil groups of Western Australia: a simple guide to the main soils of Western Australia (4th edition)* (Schoknecht and Pathan 2013).

The Proposal location, ecological constraints and environmental constraints are shown on Figures 1 through to Figure 6 of Appendix B.

1.3 Limitations and assumptions

This report has been prepared by GHD for SE Campbell Development Pty Ltd and may only be used and relied on by SE Campbell Development Pty Ltd for the purpose agreed between GHD and the SE Campbell Development Pty Ltd as set out in Section 1.2 of this report. GHD otherwise disclaims responsibility to any person other than SE Campbell Development Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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 online databases / publications and information provided by SE Campbell Development Pty Ltd, namely the ELA (2020) report 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 limitations and assumptions outlined in ELA (2020) also apply to this letter.

1.4 Location and land ownership

The Proposal is located 20 km north-east of Bunbury, within the Shire of Harvey in the south-west of Western Australia (WA) (Figure 1, Appendix B). A portion of the DE is situated within the 7,508 ha Kemerton Strategic Industrial Area (KSIA), which comprises a Strategic Industry Zone (industrial core), an Ancillary Industry Zone (support industry area) and a 5,200 ha Industry Buffer Zone (buffer) (Raymond 2015).

Table 1-1 Land tenure and ownership

Lot No.	Address	Certificate of Title (CoT)	Land use zone / reserve	Land holder/manager
Lot 0 on Diagram 685	n/a	2075/513	Rural	Adam Shine (private landholder)

Lot No.	Address	Certificate of Title (CoT)	Land use zone / reserve	Land holder/manager
Lot 94 on Plan 21621	Bernbrooke Place, Wellesley	2093/508	Industrial SCA No. 2 - Kemerton Industrial Zone Buffer	Development WA
P Road	Wellesley Road North	n/a	Regional Open Space Industrial SCA No. 2 - Kemerton Industrial Zone Buffer	Shire of Harvey
P Road	Bernbrooke Place Wellesley	n/a	Industrial	Shire of Harvey
Lot 255 on Plan 416516	868 Wellesley Road	2983/131	Rural SCA No. 2 - Kemerton Industrial Zone Buffer	Development WA
Lot 254 on Plan 416516	67 Devlin Road	2983/130	Rural Industrial SCA No. 2 - Kemerton Industrial Zone Buffer	Development WA
Lot 41 on Plan 17392	Marriott Road	1903/49	Rural Industrial SCA No. 2 - Kemerton Industrial Zone Buffer	Shire of Harvey
P Road	Devlin Road	n/a	Industrial	Shire of Harvey
Lot 2 on Diagram 73742	n/a	1802/345	Industrial Public Purposes - Public Utilities	Western Power
Lot 5409 on Plan 13831	n/a	3080/533	Reserve 38137 for the purpose of public recreation	Shire of Harvey
Lot 5531 on Plan 216969	n/a	3143/649	Reserve 22762 for the purpose of drainage	Water Corporation

South Energy has obtained Certificates of Title (CoT) for all of lots intersecting the DE. All CoTs are attached in Appendix C.

As identified in Table 1-1 there are four key land holders/managers: Development WA, Shire of Harvey, Western Power and private landholder Adam Wayne Shine. South Energy has sought

authorisation from all land holders/managers to use the land for the purpose of this Proposal. Third party authorisation documentation is attached in Appendix D.

1.5 Associated approvals

Other approvals associated with development of the Proposal include:

- Planning application submitted to the Shire of Harvey and approved on the 11th May 2021 (Application no. P215/20)

Referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Assessment No. 2020/8763) and request for project to be assessed under the bilateral agreement if the Department of Agriculture, Water and the Environment (DAWE) determined the Proposal to be a 'Not controlled action'.

2. Description of clearing activities

Vegetation will be cleared to establish permanent infrastructure, temporary construction areas (e.g., pole / tower pads, laydown areas), and access/maintenance tracks. The area within which vegetation is proposed to be cleared is referred to hereafter as the 'Development Footprint'.

Table 2-1 identifies the approximate dimension for each activity identified. A sufficient buffer has been provided for the powerline corridor and laydown areas to accommodate break and winch pads (required to string transmission cable), or helicopter landing pads (if cable is alternatively strung via helicopter).

Table 2-1 Proposed clearing activities

Activity	Number	Est. Dimensions
Powerline corridor	n/a	25 m x 3690 m
Tower pads (~50 m tall)	20	35 m x 40 m *(pads located within the powerline corridor)*
Power pads (<50 m tall)		25 m x 40 m *(pads located within the powerline corridor)*
Laydown area (small)	2	30 m x 30 m
Laydown area (large)	1	80 m x 80 m
Access/maintenance track	20 (one track per pole/tower)	6 m (wide)

It is anticipated the clearing of native vegetation will be undertaken using traditional earth moving machinery such as bulldozers. Where possible, topsoil will be stripped and stockpiled for later reuse in rehabilitation.

3. Existing environment

3.1 Climate

The Proposal is located in the south-west of WA which experiences a warm Mediterranean climate with hot dry summers and mild wet winters. As recorded at the nearby Bureau of Meteorology (BoM) Brunswick Junction weather station (station number 9513) located approximately 5.5 km east of the DE, the average annual rainfall is 989.9 millimetres (mm) with most rainfall occurring during the winter months of June, July and August (ELA 2020).

Temperature data obtained from the nearby Wokalup weather station (station number 9642) located approximately 13.5 km north-east of the DE, indicates that the average minimum temperature ranges from 8.0°C in July to 15.5°C in January, while average maximum temperature ranges from 16.7°C in July to 31.0°C in January (ELA 2020).

3.2 Land use

The DE traverses areas of native vegetation and significantly altered / intensive agricultural areas. Where practical, the Development Footprint occurs along existing tracks, areas that have previously been cleared and areas with naturally sparse vegetation cover. The Development Footprint is limited to areas surrounding and underneath transmission poles, laydown areas and access / maintenance tracks.

Table 3-1 outlines the composition of existing land types in the DE and Development Footprint. The proposed Development Footprint requires clearing of 10.38 ha, of which only 4.36 ha is considered native vegetation and is the subject of this clearing permit.

Table 3-1 Land types within the Development Envelope and Development Footprint

Land type	Development Envelope Area (ha)	Development Footprint Area (ha)
Pine plantation	21.89	3.33
Cleared access tracks	18.9	2.69
Native vegetation	37.5	4.36
Total	**78.29**	**10.38**

3.3 Landforms and soil

The DE is located in the Swan Coastal Plain (SWA) bioregion and the Perth (SWA02) subregion as described by the Interim Biogeographic Regionalisation for Australia (IBRA). This subregion is dominated by Banksia and Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark in swampy areas. In the east, the plain rises to duri-crusted Mesozoic sediments dominated by Jarrah woodland (ELA 2020).

The Proposal is located on the Bassendean (Bassendean 1000) and Pinjarra (Pinjarra 968) dune systems in the southwest of WA.

The Bassendean system consists of sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Vegetation associated with the Bassendean system includes *Banksia*-paperbark

woodlands and mixed heaths (ELA 2020). The current extent of this vegetation in the Perth (SWA02) sub-region is 24,869.20 ha, which is 26.41% of the pre-European extent (ELA 2020).

The Pinjarra system is characterised by poorly drained coastal plains with variable alluvial and Aeolian soils (ELA 2020). Vegetation associated with the Pinjarra system includes jarrah, marri, wandoo, paperbark, sheoaks and *Eucalyptus rudis* (ELA 2020).

The Department of Primary Industries and Regional Development (DPIRD) (DPIRD-076) soil mapping indicates the DE is situated within the following WA Soil Groups:

- SG 444 "pale deep sand" is the dominate soil type within the DE. Characterised by neutral to acidic sandy soils to depths greater than 80 cm (sometimes intermingled with ironstone gravel).
- SG 103 "semi-wet soil" associated with intensive farmland within the eastern portion of the DE, and intersecting Conservation and Resource Enhancement wetlands. Characterised by non-saline soils (sands; loams; clays) with moderate to neutral pH, waterlogged to 30-80 cm for a major part of the year.
- SG 441 "brown deep sand" associated with the bed and banks of the Wellesley River. Characterised by brown sands to depths greater than 80 cm, neutral to acid pH.
- SG 105 "wet soil" associated with intersecting Multiple Use wetlands. Characterised by non-saline soils (sands; loams; clays) with acidic pH, waterlogged to <30 cm for a major part of the year.

3.4 Hydrology

3.4.1 Groundwater

The DE is located within the South West Coastal and Bunbury Proclaimed groundwater resources protected under the *Rights in Water and Irrigation Act 1914* (RiWI Act). There are no Public Drinking Water Source Areas (PDWSAs) within a 10 km radius of the DE.

Depth to groundwater is unknown; however, given the presence of wetlands and seasonally inundated areas within the DE, it is anticipated that groundwater would occur within 5-10 m of the surface following winter recharge, and may occur within 1 - 5 m of the surface if shallow aquifers are present in lower-lying areas adjacent to the Wellesley River.

3.4.2 Surface water

There are no Wetlands of International (Ramsar) or National Importance (i.e., significant wetlands of the South Coast Region; or wetlands in the Directory of Important Wetlands in Australia) that occur within or adjacent to the DE. The closest Nationally Important wetland is Benger Swamp located approximately 4 km north-east (and up-gradient) of the Proposal.

No wild rivers protected under the RiWI Act occur within or adjacent to the DE.

The DE runs perpendicular to the Wellesley River, a classified 'Other Heritage Place' (ID 33865 "Wellesley River Waugal") (DPLH 2020). The Development Footprint crosses over the river at the east end of the DE (Figure 6, Appendix B).

The DE intersects 10 geomorphic wetlands of the Swan Coastal Plain (SCP) along the transmission line (ELA 2020) (Table 3-2, Figure 6, Appendix B).

Table 3-2 Geomorphic wetlands intersecting the Development Envelope

Land use	Wetland name	ID	Landform	Category
Conservation	Kemerton Wetlands	ID 14551	Basin	Sumpland
Resource Enhancement	Kemerton Wetlands	ID 14481	Basin	Sumpland
	Kemerton Wetlands	ID 14482		
	Kemerton Wetlands	ID 14483		
	Unknown	ID 1837		
	Unknown	ID 1530		Dampland
	Unknown	ID 1675		
Multiple Use	Unknown	ID 1502	Basin	Sumpland
	Unknown	ID 1699		Dampland
	Unknown	ID 15225	Flat	Palusplain

3.5 Flora and vegetation

3.5.1 Broad vegetation mapping and extents

The Proposal is situated in the South West Botanical Province of WA within the SWA bioregion and the Perth (SWA02) subregion as described by the IBRA (ELA 2020). Beard (1979) pre-European vegetation mapping (1:1,000,000 scale) indicates that two Vegetation Associations (VAs) occur within the DE:

- VA 1000 – described as '*Banksia*-paperbark woodlands and mixed heaths'
- VA 968 – described as 'Variable vegetation includes jarrah, marri, wandoo, paperbark, sheoks and *Eucalyptus rudis*'.

The pre-European mapping has been adapted and digitised by Shepherd et al. (2002, as cited in ELA 2020). Table 3-3 presents the extent of the VAs remaining at all scales (State, IBRA bioregion, IBRA subregion and Local Government Area) as determined by the state-wide vegetation remaining extent calculations maintained by the Department of Biodiversity, Conservation and Attractions (DBCA) (latest update March 2019 – GoWA 2020).

Table 3-3 Extent of vegetation associations 1000 and 986

Vegetation Association (VA)	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)
1000	State: WA	99,835.86	27,768.84	27.81
	IBRA bioregion: Swan Coastal Plain (SWA)	94175.31	24,869.20	26.41
	IBRA sub-region: Perth (SWA02)	94,175.31	24,869.20	26.41
	LGA: Shire of Harvey	20121.61	8209.83	40.80
968	State: WA	296,877.84	95,048.82	32.02
	IBRA bioregion: SWA	136188.20	9017.32	6.62
	IBRA sub-region: Perth (SWA02)	136,188.20	9,017.32	6.62

	LGA: Shire of Harvey	23465.19	1260.92	5.37

The DBCA calculations indicate that:

- 26.41% of VA 1000 remains in the SWA IBRA bioregion and Perth (SWA02) sub-region, with only 27.81% remaining within the State
- 6.62% of VA 968 remains in the SWA IBRA bioregion and Perth (SWA02) sub-region, with only 32.02% remaining within the State.

3.5.2 Vegetation types and condition

Six (6) vegetation types are present within the DE (ELA 2020). The extent of each vegetation type within the DE and Development Footprint is summarised in Table 3-4 and shown in Figure 2 of Appendix B.

Table 3-4 Vegetation types within the Development Envelope and Development Footprint

ID	Description	Development Envelope Area (ha)	Development Footprint Area (ha)
BaEmW	*Banksia attenuata* and *Eucalyptus marginata* woodland over tall and low sparse shrubland	16.41	1.93
CcOW	*Corymbia calophylla* open woodland over a low grassland	4.84	0.26
EmAfW	*Eucalyptus marginata* and *Agonis flexuosa* woodland over tall sparse shrubland, over a mid sparse grassland	9.71	1.45
ErMrW	*Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low sparse forbland	4.45	0.42
MpW	*Melaleuca preissiana* woodland over a tall sparse shrubland, over a tall open sedgeland	2.09	0.29
Plantation	*Pinus* spp. and *Eucalyptus* spp.	21.89	3.33
Cleared	n/a	18.90	2.69
	Total	**78.29**	**10.38**

Vegetation condition within the DE ranges from Excellent to Completely Degraded (Figure 4, Appendix B). Native vegetation in Good or better condition accounts for 28.02 ha (36% of the DE). The remaining 50.27 ha (64% of the DE) comprises plantations, degraded / completely degraded farmland, and areas cleared for roads, tracks, utilities and industrial facilities.

Table 3-5 provides a breakdown of vegetation condition within the DE and the proposed Development Footprint.

Table 3-5 Vegetation condition within the Development Envelope and Development Footprint

Vegetation condition	Development Envelope Area (ha)	Development Footprint Area (ha)
Excellent	4.69	0.62

Very Good	8.14	1.08
Good	15.19	1.53
Degraded	9.48	1.13
Completely Degraded	18.9	2.69
Plantation	21.89	3.33
Total	**78.29**	**10.38**

3.5.3 Conservation significant ecological communities

One (1) vegetation community, BaEmW, was found to represent the '*Banksia* Woodlands of the Swan Coastal Plain' ecological community, which is both a listed Threatened Ecological Community (TEC) (Endangered) under the EPBC Act and Priority Ecological Community (PEC) (Priority 3) as listed by DBCA (Figure 2, Appendix B, ELA 2020).

Areas of BaEmW representing this PEC / TEC were found to have a strong affiliation with Floristic Community Type (FCT) 21a 'Central *Banksia attenuata – Eucalyptus marginata* woodlands' and to a lesser extent FCT 21b 'Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands' and FCT 21c 'Low lying *Banksia attenuata* woodlands or shrublands' (ELA 2020). FCT 21a, 21b, 21c and 20b are all recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community (ELA 2020).

Vegetation community BaEmW is mapped across 16.41 ha of the DE, vegetation representing the PEC and TEC overlap. Some areas of BaEmW did not show a clear affiliation to FCT's defined by Gibson et al. (1994), in part due to a high proportion of weed species to the exclusion of natives (ELA 2020). Consequently, the total area of BaEmW within the DE representing:

- *Banksia* Woodlands of the Swan Coastal Plain PEC (Priority 3 - DBCA) is 15.26 ha (excludes Completely Degraded and includes Degraded).
- *Banksia* Woodlands of the Swan Coastal Plain TEC (Endangered - EPBC Act) is 14.26 ha (excludes Completely Degraded and Degraded).

Table 3-6 presents the condition of BaEmW representing *Banksia* Woodlands of the Swan Coastal Plain PEC/TEC within the DE and the Development Footprint.

Table 3-6 Extent of PEC/TEC within the Development Envelope and Development Footprint

Vegetation condition	Extent of PEC within the Development Envelope (ha)	Extent of TEC within the Development Envelope (ha)	Extent of PEC within the Development Footprint (ha)	Extent of TEC within the Development Footprint (ha)
Excellent	4.69	4.69	0.62	0.62
Very Good	4.32	4.32	0.53	0.53
Good	5.25	5.25	0.57	0.57
Degraded	1.00	-	-	-
Total	**15.26**	**14.26**	1.72	1.72

3.5.4 Flora diversity

ELA (2020) recorded 130 flora species within the DE representing 37 families and 96 genera. This total includes 94 native and 36 introduced species. Species richness per quadrat ranged from seven (7) to 37 species (ELA 2020). These recordings were taken across 13 quadrats

established within the DE and from opportunistic collections. Dominant families within the DE included *Fabaceae* (13 species), *Asteraceae* (10 species), *Poaceae* (10 species) and *Myrtaceae* (8 species). The floristic diversity recorded during the survey was considered representative of the floristic diversity in the area (ELA 2020).

3.5.5 Conservation significant flora

A desktop survey of flora databases identified the potential presence of 24 conservation significant flora taxa within or nearby the DE (ELA 2020). Eleven (11) of these conservation significant flora taxa were considered likely to occur within the DE based on a desktop assessment of potential habitat and proximity of historical records.

Two DBCA-listed Priority 4 flora species, *Pultenaea skinneri* and *Acacia semitrullata,* were recorded within the DE during the targeted Spring survey (Figure 2, Appendix B, ELA 2020).

Based on the presence of suitable habitat and proximity of previous records, ELA (2020) identified six additional Priority flora as possibly occurring within the DE, however none were recorded within the DE:

- *Pterostylis frenchii (*P2)
- *Stylidium acuminatum* subsp. *acuminatum* (P2)
- *Carex tereticaulis* (P3)
- *Dillwynia dillwynioides* (P3)
- *Lasiopetalum membranaceum* (P3)
- *Verticordia attenuata* (P3).

No threatened flora species listed under the EPBC Act or the *Biodiversity Conservation Act 2016* (BC Act) were recorded within the DE during any of the targeted flora surveys undertaken by ELA (2020) in winter and spring. The surveys included targeted searches for two threatened flora species *Drakaea micrantha* and *Drakaea elastica*. Neither species was recorded within the DE or in the broader Kemerton area (ELA 2020).

3.5.6 Weeds

A total of 36 introduced (weed) species were recorded within the DE, representing 27.7% of the total species recorded by ELA (2020). One opportunistic collection, **Gomphocarpus fruticosus*, was also recorded approximately 7 m outside the DE boundary (ELA 2020).

Two recorded species, **Gomphocarpus fruticosus* and **Zantedeschia aethiopica* are listed as Declared Pests (DP) under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) (ELA 2020). **Gomphocarpus fruticosus* is categorised as s.22(2) (C3) and **Zantedeschia aethiopica* (Arum Lily) as s.22(2) (exempt).

None of the 36 introduced taxa are Weeds of National Significance (WoNS).

3.5.7 Phytophthora (dieback)

Phytophthora cinnamomi (dieback) is an introduced plant pathogen targeting the roots of susceptible plants, common in the south west of WA where the mean annual rainfall exceeds 400 mm (Department of the Environment, 2014). It is considered that Dieback may pose a risk to the native vegetation within the DE, which experiences a mean annual rainfall of 733.2 mm. Furthermore, ELA (2020) recorded vegetation health decline (dead or dying species) within the DE, which may be attributed to dieback.

3.6 Fauna

3.6.1 Fauna diversity

The Level 1 fauna survey by ELA (2020) recorded a total of 31 native fauna species in the DE, including 25 birds, four (4) mammals and two (2) reptiles. Three (3) introduced (pest) fauna species (rabbit, cat and fox) were also recorded (ELA 2020).

The ELA (2020) desktop assessment identified the potential presence of 21 conservation significant fauna species (ELA 2020). The field survey recorded one EPBC Act listed species (Forest Red-tailed Black Cockatoo [*Calyptohynchus banksia* subsp. *naso*]) and evidence of one EPBC Act listed species (Carnaby's Black Cockatoo [*Calyptohynchus latirostris*]). No other conservation significant fauna were recorded.

The desktop survey identified six (6) EPBC Act-listed Migratory Species that are likely to occur within the area, however, the field survey did not record the presence of any migratory species (ELA 2020).

3.6.2 Fauna habitat

ELA (2020) identified six (6) fauna habitat types as described in Table 3-7 and shown in Figure 3 of Appendix B). Completely Degraded (cleared) areas representing 18.9 ha (24.14% of the DE) provide lower value habitat for fauna.

Table 3-7 Fauna habitats within the Development Envelope and Development Footprint

Fauna habitat type	Development Envelope Area (ha)	Development Footprint Area (ha)
(1) Mid *Corymbia calophylla* open woodland over a low grassland	4.84	0.26
(2) Mid *Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low sparse forbland	4.45	0.42
(3) Mid *Melaleuca preissiana* woodland over a tall sparse shrubland over a tall open sedgeland	2.09	0.29
(4) Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall sparse shrubland over a low sparse shrubland	16.41	1.92
(5) Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall sparse shrubland over a mid sparse grassland	9.71	1.45
(6) Plantation of *Pinus* spp. and *Eucalyptus* spp.	21.89	3.33

Fauna habitat type	Development Envelope Area (ha)	Development Footprint Area (ha)
Cleared	18.9	2.69
Total area (comprising vegetation)	**59.39**	**7.68**
Total area (comprising native vegetation)	**37.50**	**4.36**

3.6.3 Conservation significant fauna

The ELA (2020) desktop assessment identified 21 significant fauna species as possibly occurring within the DE. The only significant fauna species recorded during the ELA 2019 surveys was the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*). This species is listed as Vulnerable (VU) under the EPBC Act and BC Act [VU species are published under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018].

Following the field surveys, an additional five (5) significant fauna species were identified by ELA (2020) as likely to occur in the DE based on the presence of suitable habitat and proximity of previous records:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (listed EN under the EPBC Act; EN [Schedule 2] under the BC Act)
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) (listed EN under the EPBC Act; EN [Schedule 2] under the BC Act)
- Carter's freshwater mussel (*Westralunio carteri*) (listed VU under the EPBC Act; VU [Schedule 3] under the BC Act)
- Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) (listed Conservation Dependent (CD) [Schedule 6] under the BC Act)
- Quenda (*Isoodon obesulus* subsp. *fusciventer*) (P4 as listed by DBCA).

Of the 15 remaining species identified from the desktop assessment ELA (2020) considers that four (4) species have the potential to occur, seven (7) have potential to be vagrant visitors, and four (4) are unlikely to occur within the DE based on the habitat requirements of these species and proximity of previous records.

Vegetation within the DE was identified as suitable foraging habitat for all three black cockatoo species (Figure 5, Appendix B). Table 3-8 identifies foraging potential of fauna habitats within the DE for each black cockatoo species as determined by ELA (2020). Field surveys recorded evidence of foraging by Forest Red-tailed Black Cockatoos and Carnaby's Black Cockatoos within the DE (ELA 2020).

Table 3-8 Black cockatoo foraging habitat within the Development Envelope and Development Footprint

Fauna habitat (see Table 3-7 for descriptions)	Carnaby's Black Cockatoos foraging habitat (ha)	Baudin's Black Cockatoo foraging habitat (ha)	Red-tailed Black Cockatoos foraging habitat (ha)
1		4.84	4.84
2		4.45	4.45

Fauna habitat (see Table 3-7 for descriptions)	Carnaby's Black Cockatoos foraging habitat (ha)	Baudin's Black Cockatoo foraging habitat (ha)	Red-tailed Black Cockatoos foraging habitat (ha)
3		2.09	2.09
4	16.41		
5		9.71	9.71
6 (plantation)	21.89	21.89	
Total area of suitable foraging (within the DE)	**38.30**	**42.98**	**21.08**
Total area of suitable foraging (within Development Footprint)	**5.25**	**5.76**	**2.43**

Potential breeding and roosting habitat for all species of black cockatoo comprised 142 potentially significant trees with a diameter breast height (DBH) greater than 500 mm (Marri, Jarrah, Flooded Gums) (Figure 5, Appendix B). Nine (9) trees had hollows of greater than 100 mm (trunk and/or spout hollows) observed from the ground-based assessment (ELA 2020).

3.7 Conservation area

No DBCA managed lands or regional parks occur within or adjacent to the DE. The closest DBCA conservation area is Benger Swamp Nature Reserve (Reserve (R) 34811) located approximately 4 km north-east of the DE. The 577.62 ha reserve is vested with the Conservation Commission of WA for the purpose of conserving flora and fauna.

The southern reaches of the Wellesley River fall within EPA Redbook Recommended Conservation Reserve 'The Darling System' (No. C66) (DBCA-029). The northern most portion of this recommended reserve extends approximately 400 m north of the DE, with the southern reaches connecting to the Leschenault Estuary. The eastern end of the DE therefore intersects the proposed reserve.

3.8 Regional ecological linkages

Vegetation within the DE connects to larger areas of remnant vegetation which extend north. These areas are not held or managed for conservation and appear from aerial imagery to be largely dissected by access tracks. It is likely that given the extent of disturbance (i.e., access tracks), vegetation health would be declining due to edge impacts (e.g., weed and dieback spread).

Vegetation growing in association with the Wellesley River (to the east of the DE) provides a valuable ecological linkage within a landscape that is largely cleared and assists with maintaining water quality within the Wellesley River.

A review of aerial imagery shows that land between the DE and Benger Swamp Nature Reserve (R 34811) has been almost entirely cleared for intensive agriculture, and there are no vegetation corridors connecting this nature reserve with nearby remnant vegetation.

3.9 Environmentally Sensitive Areas

The DE intersects one (1) Conservation Category wetland “Kemerton Wetlands” which is also a declared Environmentally Sensitive Area (ESA). The boundary of this ESA falls outside of the proposed Development Footprint.

3.10 Cultural heritage

A search of the Aboriginal Heritage Inquiry System (AHIS) did not identify any ‘Registered’ sites of Aboriginal heritage significance under the *Aboriginal Heritage Act 1972* (AH Act). However, the Wellesley River Waugal was identified as an ‘Other Heritage Place’ located within the Proposal area (Figure 6, Appendix B, DPLH 2020), indicating that the site is lodged with the Department of Aboriginal Affairs’ (DAA) however, an assessment has not been completed to determine if it meets Section 5 of the AH Act. The Wellesley River Waugal (ID 33865) is identified as a ‘Other Heritage Place’ on the basis of the mythical importance of the river and the importance of the river as a natural feature and water source (DPLH 2020).

South Energy has consulted with the Traditional Owners /Elders regarding clearing within the Wellesley River. The Traditional Owners showed support for the transmission line going over the Wellesely River Waugal and advised that the works will not require a Section 18 under the AH Act. Following this consultation, South Energy advised the Traditional Owners that no poles would be placed within 30 m on either side of the river and agreed to the presence of two Aboriginal heritage monitors during works near and on the river at all times.

The letter of support from the Traditional Owners to South Energy is provided in Appendix E.

4. Potential impacts

4.1 Impact avoidance through design

The Proposal design has taken into account environmental and heritage values present in the DE and has minimised potential clearing impacts to these where possible. The proposed Development Footprint avoids:

- All significant trees with hollows >100 mm that may provide breeding and roosting habitat for all three Black Cockatoo species. Significant trees have a DBH greater than 500 mm.
- No poles to be located within 30 m either side of the Wellesley River to minimise ground disturbance and impacts to the watercourse, in addition to minimising impacts to the following values:
  - Other Heritage Place 'Wellesley River Waugal' (ID 33865)
  - EPA Redbook Recommended Conservation Reserve (DBCA-029).
- Clearing within the mapped extent of Conservation Category wetland "Kemerton Wetlands" which is also a declared ESA (includes avoiding clearing of buffer vegetation up to 100 m from the wetland waterbody).
- Recorded populations of DBCA-listed Priority 4 flora species, *Pultenaea skinneri* and *Acacia semitrullata*.

Where possible, proposal disturbances have been located to optimise use of existing cleared areas (e.g., access tracks; farmland) or Degraded / Completely Degraded vegetation.

4.2 Potential impacts to vegetation and flora

The Proposal will involve clearing of up to 4.36 ha of native vegetation within a 78.29 ha DE. Of the native vegetation to be cleared, 1.72 ha is representative of TEC/PEC 'Banksia dominated woodlands of the SWA IBRA region' listed as Endangered under the EPBC Act and as Priority 3 by DBCA (Figure 2, Appendix B, ELA 2020). The condition of vegetation within the proposed Development Footprint ranges from Completely Degraded to Excellent (Figure 4, Appendix B). Approximately 3.23 ha (31.1% of the Development Footprint) comprises native vegetation in Good or better condition.

The Proposal is located in a *Phytophthora cinnamomi* dieback susceptible bioregion. South Energy acknowledges that the spread of this pathogen has the potential to impact susceptible species present in the TEC/PEC 'Banksia dominated woodlands of the SWA IBRA region'. However, given the extent of existing disturbance within the DE and the proposed Development Footprint it is possible that Dieback is already present. This is further evidenced through the observation of dead or dying trees within the DE which could be attributable to Dieback (ELA 2020). South Energy will include strict hygiene controls for dieback within the Environmental Management Plan (EMP).

The Proposal may also result in indirect impacts on adjacent vegetation, primarily associated with the introduction and spread of weeds. While approximately 12.83 ha (16.39% of the DE) comprises vegetation in Very Good to Excellent condition, much of the DE and adjacent areas have been previously cleared for agriculture, access tracks and utility corridors. It is likely that vegetation adjacent to these disturbances would have been impacted to some extent by weeds. Nevertheless, South Energy is committed to preventing further weed spread and will implement strict hygiene controls (for weeds) during construction and operations/maintenance, with all controls included in the EMP.

4.3 Potential impacts to fauna and fauna habitat

The DE contains habitat suitable for six (6) conservation significant fauna species:

- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) (listed VU under the EPBC Act and BC Act)
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (listed EN under the EPBC Act; EN [Schedule 2] under the BC Act)
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) (listed EN under the EPBC Act; EN [Schedule 2] under the BC Act)
- Carter's freshwater mussel (*Westralunio carteri*) (listed VU under the EPBC Act; VU [Schedule 3] under the BC Act)
- Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) (listed CD [Schedule 6] under the BC Act)
- Quenda (*Isoodon obesulus* subsp. *fusciventer*) (P4 as listed by DBCA).

The only conservation significant fauna species recorded within the DE by ELA (2020) was the Forest Red-tailed Black Cockatoo and foraging evidence of the Carnaby's Black Cockatoos was also observed.

The Proposal will require clearing of habitat identified as suitable for all three species of Black Cockatoo (Figure 5, Appendix B). Within the Development Footprint:

- Approximately 5.25 ha is considered suitable foraging habitat for Carnaby's Black Cockatoos (1.92 ha of this habitat comprises native vegetation, the remainder is plantation)
- Approximately 5.76 ha is considered suitable foraging habitat for Baudin's Black Cockatoo (2.43 ha of this habitat comprises native vegetation, the remainder is plantation)
- Approximately 2.43 ha is considered suitable foraging habitat for Forest Red-tailed Black Cockatoo (all habitat comprises native vegetation).

Given suitable habitat overlaps between the three Black Cockatoo species, the total area of native vegetation to be cleared that represents suitable foraging habitat for one or more species of Black Cockatoo is 4.36 ha (Figure 5, Appendix B).

Within the DE, 142 potential roosting/breeding trees (DBH > 500 mm) were identified, of which nine (9) had hollows of greater than 100 mm. The Development Footprint avoids clearing of all significant trees with hollows and will require clearing of nine (9) significant trees with the potential to develop hollows in the future (Figure 5, Appendix B).

The proposed Development Footprint avoids placing poles within 30 m either side of the Wellesley River. In addition, the Development Footprint avoids the intersecting Conservation Category wetland by approximately 100 m and is therefore unlikely to cause impact to aquatic fauna habitats.

The eastern section of the DE intersects EPA Redbook Recommended Conservation Reserve 'The Darling System' (No. C66) (DBCA-029), which includes land within and adjacent to the Wellesley River. Vegetation growing in association with the Wellesley River provides a valuable ecological linkage within a landscape that is largely cleared and assists with maintaining water quality within the Wellesley River (e.g., stabilising embankments; nutrient uptake). Up to 0.17 ha of native vegetation clearing within this ecological linkage will be required to allow the transmission line to cross the Wellesley River. No poles will be placed within 30 m either side of the Wellesley River to minimise further impacts to this ecological linkage.

The Proposal has the potential to cause direct impacts to fauna including injury and death through vehicle strikes, as well as secondary impacts caused by noise/light during construction. All potential impacts to fauna will be managed under the Proposal EMP.

4.4 Land degradation, water quality and flooding

Surface water resources intersecting the DE include a number of geomorphic wetlands and the Wellesley River (Figure 6, Appendix B). To minimise impacts to these resources, only 0.17 ha of native vegetation will be required to be cleared within the Wellesley River, and the Proposal avoids placing poles within 30 m either side of the River to minimise ground disturbance. In addition, the Development Footprint avoids the Conservation Category Wetland to the north of the DE by approximately 100 m. However, clearing will occur within the mapped extent of some intersecting Resource Enhancement and Multiple Use wetlands (total clearing within mapped wetlands is up to 3.88 ha, Figure 5, Appendix B).

The DE comprises sandy soils in a gently undulating landscape, which have a low susceptibility for erosion and dispersion (which has the potential to cause turbidity impacts in surface water resources). According to GoWA (2020a; 2020b) datasets, the DE is mapped within an area having low risk of salinization.

The DE intersects a 12.02 ha flood risk zone adjacent to Wellesley River that is approximately 250 m wide (DWER-031), of which 10 - 30% has the potential to become inundated during the winter months. A large extent of this flood zone, particularly towards the east, has been previously cleared for intensive agriculture and is largely stabilised with grasses. The Proposal requires limited clearing (1.57 ha) within this area and is unlikely to exacerbate soil erosion or alter hydrological processes (e.g., flooding; waterlogging), to the extent that present or future land uses (primarily livestock grazing) would be affected. Only one power pole is located within this flood zone and is located approximately 115 m west of Wellesley River.

ASS risk mapping identifies High to Moderate risk areas of potential acid sulfate soils (PASS) within the DE associated with intersecting geomorphic wetlands and the Wellesley River. Ground disturbance in High to Moderate risk areas, presents greater risk of PASS exposure and possible acidification of surface and groundwater resources if ASS were exposed. South Energy has considered ASS risk in the design, limiting placement of power poles within higher risk PASS areas. Two (2) poles/towers (of the 20 proposed) are located in High to Moderate risk areas.

The DE is located within the South West Coastal and Bunbury Proclaimed groundwater resources protected under the RiWI Act. Given the small amount of clearing proposed (10.38 ha), construction of the Proposal is unlikely to cause deterioration in the quality of underground water unless ASS are exposed and not appropriately managed. The EMP will include appropriate controls for the management of PASS.

5. Environmental Management Framework

GHD has prepared a preliminary EMP for the Proposal on behalf of South Energy, which is to be submitted with this NVCP application. The sections below outline key management controls that will be included in the EMP.

5.1 Vegetation clearing management

- Vegetation to be retained will be clearly demarcated on maps and marked with flagging tape on site prior to commencement of clearing (this will include clearly marking areas to avoid such as the Wellesley River Waugal)
- Significant trees (with hollows >100 mm) will be clearly demarcated on maps and marked with flagging tape / spray paint on site prior to commencement of clearing
- Existing cleared areas such as roads and tracks will be used to access and construct each power pole/tower where available
- Laydown areas will be located within Completely Degraded (cleared) areas of the DE
- Vehicle turn around will occur in areas cleared for permanent works
- Where possible, shorter vegetation underneath the power transmission corridor will not be cleared, and taller vegetation will be cut (in preference to clearing) to maintain a clearance of at least 2.5 m between vegetation and the transmission cable.

5.2 Hygiene management

- Establish a hygiene check point (and clean down station).
- All plant, machinery and vehicles will be inspected at entry and exit of the construction site and be confirmed to be clean and free of vegetation and soil material.
- Implement protocols for disposal of contaminated clean down water and mud/soil.

5.3 Fauna management

- Speed limits between 40-60 km p/hr will be applied throughout the construction site, which will consequently reduce the risk of fauna strikes during construction.
- Transfer of any injured fauna found within the construction site to an appropriate fauna rescue organisation or individual. A list of local fauna rescue organisations and individuals will be maintained on site.

5.4 Acid Sulfate Soil management

- All PASS will be treated and management in accordance with DWER's (2015) Guidance 'Treatment and management of soils and water in acid sulfate soil landscape'.
- Where exposure of ASS is identified as a Moderate to High risk, potentially acidic soils/water will be isolated and either treated on-site or disposed off-site to an appropriately licenced waste facility.

5.5 General construction management

- Water carts and/or surface stabilization measures (e.g., hydro mulch) will be used to minimise dust generated from cleared areas.
- Temporary drainage controls will be installed to capture and infiltrate surface runoff from construction areas and prevent runoff from entering adjacent native vegetation.

5.6 Revegetation management

- Topsoil will be harvested, stockpiled and reused in rehabilitation of laydown areas.
- Revegetation (using locally representative native species) of cleared areas not required for ongoing operational use will be undertaken within 3 months following completion of construction to prevent soil erosion by water / wind.

6. Assessment against the Ten Clearing Principles

Schedule 5 of the EP Act defines 10 Clearing Principles for native vegetation. These principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way. The clearing required for the construction of project has been assessed against the Ten Clearing Principles, with each principle being assessed in accordance with the DWER's 'A Guide to the Assessment of Applications to Clear Native Vegetation' (Department of Environment Regulation 2014) to determine whether the application is at variance to the principles.

The assessment indicates that the Proposal is at variance with principles (d), (e) and (f).

- Principle (d) due to clearing of up to 1.72 ha of Endangered TEC '*Banksia* dominated woodlands of the SWA IBRA region', of which 0.62 ha is in Excellent condition, 0.53 ha in Very Good condition and 0.57 ha in Good condition.
- Principle (e) due to clearing of two vegetation associations (VA 1000 and VA 968) that have been largely cleared within the SWA IBRA bioregion and Perth (SWA02) sub-region, to the extent that <30% of these associations remains at these scales. The Proposal requires clearing of 4.05 ha of native vegetation within the mapped extent of VA 1000 and 0.30 ha of native vegetation within the mapped extent of VA 968. The proposal also requires clearing of up to 4.36 ha of native vegetation which provides suitable foraging habitat for one or more species of Black Cockatoo, listed as threatened under both the EPBC Act and BC Act.
- Principle (f) due to clearing of 3.88 ha of native vegetation that is growing within the mapped extent of some intersecting Resource Enhancement and Multiple Use wetlands. The Proposal also requires approximately 0.17 ha of clearing within the Wellesley River. In addition, the CCW is located approximately 100 m from the Development Footprint.

The Proposal may also be at variance with principles (a), (b), (g) and (i).

- Principle (a) due to clearing of up to 1.72 ha of Priority 3 PEC '*Banksia* dominated woodlands of the SWA IBRA region' in Good or better condition. This PEC only occurs within the broader South West region of WA, an area which is recognised as one of the only two global biodiversity hotspots in Australia (DoEE 2016).
- Principle (b) due to clearing of suitable foraging habitat for all three species of Black Cockatoo, listed as threatened under both the EPBC Act and BC Act. Within the Development Footprint, approximately 5.25 ha is considered suitable foraging habitat for Carnaby's Black Cockatoos, approximately 5.76 ha is considered suitable foraging habitat for Baudin's Black Cockatoo and approximately 2.43 ha is considered suitable foraging habitat for Forest Red-tailed Black Cockatoo, with suitable habitat overlapping between the three species.
- Principle (g) due to the potential for exposure of ASS when clearing / establishing foundations for two (2) power poles within High to Moderate risk PASS areas.
- Principle (i) due to potential for low pH waters and/or ASS to form as a result of clearing / establishing foundations for two (2) power poles within High to Moderate risk PASS areas.

The DWER (2014) 'Clearing of native vegetation offsets procedure' states that "*Offsets are required when a clearing application is determined by the Department of Environment*

Regulation (DER) or Department of Mines and Petroleum (DMP) to be at variance with one or more of the biodiversity related clearing principles (principles a – f, h) and a significant residual impact remains following application of the mitigation hierarchy."

South Energy has applied the risk mitigation hierarchy of avoid – minimise – rehabilitate – offset to this Proposal. South Energy has worked closely with the design team to ensure the proposed alignment avoids (or otherwise minimises) impacts to environmental and heritage values within the DE (refer to Section 4). Furthermore, South Energy is committed to incorporating rehabilitation measures and other risk mitigation controls into the EMP. The residual impact of the proposed clearing is not considered to be significant, therefore, South Energy do not propose offsets for this Proposal.

Table 6-1: Assessment against the ten clearing principles

<table>
<tr><th>Clearing principle</th><th>Assessment of impacts</th><th>Outcome</th></tr>
<tr><td>a) Native vegetation should not be cleared if it comprises a high level of biological diversity</td><td>
The Proposal is situated in the South West Botanical Province of WA within the SWA bioregion and the Perth (SWA02) subregion as described by the IBRA. Beard (1979) pre-European vegetation mapping (1:1,000,000 scale) indicates that two VAs occur within the DE: Bassendean 1000 and Pinjarra 968. DBCA state-wide vegetation remaining extent calculations indicate that 26.41% of VA 1000, and 6.62% of VA 968 remains in the Perth (SWA02) sub-region (ELA 2020).

ELA (2020) undertook a detailed flora and vegetation survey of the 78.29 ha Project area and identified six (6) vegetation types (Figure 2, Appendix B):
• CcOW - Corymbia calophylla open woodland over a low grassland
• ErMrW - Eucalyptus rudis and Melaleuca rhaphiophylla closed forest over a low sparse forbland
• MpW - Melaleuca preissiana woodland over a tall sparse shrubland, over a tall open sedgeland
• BaEmW - Banksia attenuata and Eucalyptus marginata woodland over tall and low sparse shrubland
• EmAfW - Eucalyptus marginata and Agonis flexuosa woodland over tall sparse shrubland, over a mid sparse grassland
• Plantation - Pinus spp. and Eucalyptus spp.

ELA (2020) recorded 130 flora species within the DE representing 37 families and 96 genera. This total includes 94 native and 36 introduced species. Species richness per quadrat ranged from seven (7) to 37 species (ELA 2020).
Vegetation condition within the DE ranges from Excellent to Completely Degraded (Figure 4, Appendix B). Native vegetation in Good or better condition accounted for 28.02 ha (36% of the DE). The remaining 50.27 ha (64% of the DE) comprises plantations, degraded farmland and completely degraded farmland or areas cleared for roads, tracks, utilities and industrial facilities. The table below provides a breakdown of vegetation condition within the DE and the proposed Development Footprint.
<table>
<tr><th>Vegetation condition</th><th>Area within the DE (ha)</th><th>Area within the Development Footprint (ha)</th></tr>
<tr><td>Excellent</td><td>4.69</td><td>0.62</td></tr>
<tr><td>Very Good</td><td>8.14</td><td>1.08</td></tr>
<tr><td>Good</td><td>15.19</td><td>1.53</td></tr>
<tr><td>Degraded</td><td>9.48</td><td>1.13</td></tr>
<tr><td>Completely Degraded</td><td>18.9</td><td>2.69</td></tr>
<tr><td>Plantation</td><td>21.89</td><td>3.33</td></tr>
<tr><td>Total</td><td>78.29</td><td>10.38</td></tr>
</table>
Impacts to vegetation condition are primarily associated with clearing, erosion, weed spread, feral fauna and unrestricted vehicle access (ELA 2020). However, the presence of dead or dying species is more likely a result of drought or potential disease (e.g., Phytophthora cinnamomi dieback) (ELA 2020).
ELA (2020) identified one (1) PEC within the DE: ‘Banksia dominated woodlands of the SWA IBRA region’ listed as Priority 3 by DBCA. This community is also a listed TEC under the EPBC Act (refer to clearing principle ‘d’). The vegetation type representing this PEC is BaEmW, having a strong affiliation with FCT21a ‘Central Banksia attenuata – Eucalyptus marginata woodlands’ and to a lesser extent FCT 21c ‘Low lying Banksia attenuata woodlands or shrublands’ (ELA 2020). The Banksia dominated woodlands PEC only occurs on or adjacent to the SCP which stretches north and south of Perth, the broader region – southwest WA – is recognised as one of only two global biodiversity hotspots in Australia (DoEE 2016).
BaEmW is mapped across 16.41 ha of the DE. Areas of BaEmW in Completely Degraded condition (1.15 ha) were not found to be representative of this PEC (ELA 2020). Therefore, the total area of vegetation within the DE representing the Banksia dominated woodlands PEC is 15.26 ha and clearing of 1.72 ha is proposed. The condition of the Banksia dominated woodlands PEC within the DE and the Development Footprint is summarised in the table below.
<table>
<tr><th>Vegetation condition within mapped extent of ‘Banksia dominated woodlands of the SCP IBRA region’ PEC</th><th>Area within the DE (ha)</th><th>Area within the Development Footprint (ha)</th></tr>
<tr><td>Excellent</td><td>4.69</td><td>0.62</td></tr>
<tr><td>Very Good</td><td>4.32</td><td>0.53</td></tr>
</table>
</td><td>The proposed clearing may be at variance to this principle</td></tr>
</table>

Clearing principle	Assessment of impacts	Outcome
	<table><tr><td>Good</td><td>5.25</td><td>0.57</td></tr><tr><td>Degraded</td><td>1.00</td><td>-</td></tr><tr><td>Total</td><td>15.26</td><td>1.72</td></tr></table> ELA (2020) recorded two DBCA-listed Priority 4 flora species, *Pultenaea skinneri* and *Acacia semitrullata*, within the DE (Figure 2, Appendix B). The Development Footprint avoids recorded populations of these priority species. Based on the presence of suitable habitat and proximity of previous records, ELA (2020) identified six additional Priority flora as possibly occurring within the DE, however none were recorded within the DE: • *Pterostylis frenchii* (P2) • *Stylidium acuminatum* subsp. *acuminatum* (P2) • *Carex tereticaulis* (P3) • *Dillwynia dillwynioides* (P3) • *Lasiopetalum membranaceum* (P3) • *Verticordia attenuata* (P3). The majority of the DE (64%) comprises plantations, degraded farmland and completely degraded areas. The biological diversity of vegetation types mapped within the DE is expected to be similar to adjacent areas and representative of these vegetation types at both a local and regional scale. PEC '*Banksia* dominated woodlands of the SWA IBRA region' is a characteristic vegetation type of the southwest region of WA recognised for its high level of biological diversity. Consequently, the BaEmW vegetation type likely comprises a high level of biological diversity when compared with some other vegetation types and was noted to be in Good or better condition. However, given the fragmented distribution of this vegetation type within the DE and the vulnerability of this community to threatening processes being located adjacent to plantations and completely degraded areas; it is unlikely that BaEmW would comprise a greater diversity than vegetation representative of this PEC at both a local and regional scale. Furthermore, a very small area (1.72 ha) of this PEC is required to be cleared.	
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.	ELA (2020) identified six (6) fauna habitat types (Figure 3, Appendix B) comprising 59.39 ha of native and plantation vegetation. Degraded farmland and Completely Degraded (cleared) areas representing 18.9 ha (24.14% of the DE) provide lower value habitat for fauna. Fauna habitats included: • (1) CcOW - Mid *Corymbia calophylla* open woodland over a low grassland • (2) ErMrW - Mid *Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low sparse forbland • (3) MpW - Mid *Melaleuca preissiana* woodland over a tall sparse shrubland over a tall open sedgeland • (4) BaEmW - Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall sparse shrubland over a low sparse shrubland • (5) EmAfW - Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall sparse shrubland over a mid sparse grassland • (6) Plantation - *Pinus* spp. and *Eucalyptus* spp. Some fauna habitats within the DE are connected at a local scale to remnant vegetation north, south and west of the Proposal. However, while vegetation linkages remain the adjacent landscape is highly fragmented by roads, tracks, utility corridors, cleared farmland and industrial facilities. East of the Proposal, land has been extensively cleared for agriculture. This 10 - 15 km wide agricultural belt extends north (towards Perth) and south (towards Augusta) along the SWA. At a regional scale, vegetation is largely fragmented due to not only agriculture, but also urban development, mining and establishment of industry. ELA (2020) recorded a total of 31 native fauna species in the DE, including 25 birds, four (4) mammals and two (2) reptiles. Three (3) introduced (pest) fauna species (rabbit, cat and fox) were also recorded (ELA 2020). Of the 21 conservation significant fauna species identified from the desktop assessment as possibly occurring within the DE, the only species recorded by ELA (2020) was the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*). This species is listed as VU under the EPBC Act and BC Act [VU species are published under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018]. An additional five (5) conservation significant fauna species were identified by ELA (2020) as likely to occur in the DE based on presence of suitable habitat and proximity of previous records (however none were recorded): • Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (listed EN under the EPBC Act; EN [Schedule 2] under the BC Act) • Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) (listed EN under the EPBC Act; EN [Schedule 2] under the BC Act) • Carter's freshwater mussel (*Westralunio carteri*) (listed VU under the EPBC Act; VU [Schedule 3] under the BC Act) • Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) (listed CD [Schedule 6] under the BC Act)	The proposed clearing may be at variance to this principle

Clearing principle	Assessment of impacts	Outcome

- Quenda (*Isoodon obesulus* subsp. *fusciventer*) (P4 as listed by DBCA).

Of the 15 remaining species ELA (2020) considers that four (4) species have the potential to occur, seven (7) have potential to be vagrant visitors, and four (4) are unlikely to occur within the DE based on the habitat requirements of these species and proximity of previous records.

Vegetation within the DE was identified as suitable foraging habitat for all three black cockatoo species. The ELA (2020) assessment of foraging potential within the Development Footprint for each black cockatoo species is summarised in the table below. Only evidence of foraging by Forest Red-tailed Black Cockatoos and Carnaby's Black Cockatoos was observed (ELA 2020).

Fauna habitat	Carnaby's Black Cockatoos	Baudin's Black Cockatoos	Forest Red-tailed Black Cockatoo
CcOW		0.26	0.26
ErMrW		0.42	0.42
MpW		0.29	0.29
BaEmW	1.92		
EmAfW		1.45	1.45
6 (plantation)	3.33	3.33	
Total area of clearing	**5.25**	**5.75**	**2.42**
Total area of native vegetation clearing	**1.92**	**2.42**	**2.42**

Of the 38.30 ha of habitat present within the DE (refer to table Table 3-8) that is potentially suitable for foraging by Carnaby's Black Cockatoos, up to 5.25 ha is required to be cleared to establish the Proposal (1.92 ha of this habitat comprises native vegetation, the remainder is plantation).

Of the 42.98 ha of habitat present within the DE (refer to table Table 3-8) that is potentially suitable for foraging by Baudin's Black Cockatoo, up to 5.75 ha is required to be cleared to establish the Proposal (2.42 ha of this habitat comprises native vegetation, the remainder is plantation).

Of the 21.08 ha of habitat present within the DE (refer to table Table 3-8) that is potentially suitable for foraging by Forest Red-tailed Black Cockatoo, up to 2.42 ha is required to be cleared to establish the Proposal (all habitat comprises native vegetation).

Given suitable habitat overlaps between the three Black Cockatoo species, the total area of native vegetation to be cleared that represents suitable foraging habitat for one or more species of Black Cockatoo is 4.36 ha.

Potential breeding and roosting habitat for all species of black cockatoo comprised 142 potentially significant trees with a DBH greater than 500 mm (Marri, Jarrah, Flooded Gums). Nine (9) trees had hollows of greater than 100 mm (trunk and/or spout hollows) observed from the ground-based assessment (ELA 2020). Clearing of nine (9) significant trees (without hollows) is required to establish the Proposal. All trees with hollows will be avoided.

The population trend for all three species of Black Cockatoos is declining, due to habitat loss (and alteration) resulting from large-scale clearing across the south-west of WA. Black cockatoos require large hollows (>100 mm) for nesting, usually only found in trees that are more than 200 years old. Accordingly, the removal of significant trees to establish the Proposal may constitute removal of core habitat and refuge for black cockatoo species. The impact of removing this habitat is likely to become more pronounced in the future, as the surrounding area is further developed, and more fauna habitat and trees are removed. The transmission design and route selection has taken into account the location of all significant trees identified by ELA (2020) and has avoided impact to these trees as far as is practicable, working to avoid all significant trees with hollows as a priority.

Remaining patches of PEC '*Banksia* dominated woodlands of the SWA IBRA region' are recognised by DoEE (2016) as providing important wildlife corridors and refuges for fauna in a mostly fragmented landscape. ELA (2020) assessed vegetation type BaEmW to be representative of this PEC. Given the extent of fragmentation and disturbance to native vegetation both within and adjacent to the DE, and the absence of larger remnant patches of native vegetation nearby, it is unlikely that vegetation within the DE would comprise part of an ecological corridor, core habitat or refuge for native fauna. The exception to this is Wellesley River, with vegetation growing in association with the river providing a valuable ecological linkage within a landscape that is largely cleared.

South Energy is committed to minimising disturbance as far as reasonably practicable within the Wellesley River, with the Development Footprint only requiring up to 0.17 ha of native vegetation clearing within this ecological linkage. In addition, no poles will be placed within 30 m on either side of the Wellesley River to minimise ground disturbance. Furthermore, South Energy is committed to avoiding clearing within 100 m of the intersecting CCW.

<table>
<tr><th>Clearing principle</th><th>Assessment of impacts</th><th>Outcome</th></tr>
<tr><td></td><td>Given the minimal amount of clearing within the Wellesley River and the avoidance of the CCW, the Proposal is therefore unlikely to cause impact to aquatic fauna habitats.</td><td></td></tr>
<tr><td>c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora</td><td>The ELA (2020) desktop assessment identified 13 Threatened flora as known or likely to occur within 10 km of the DE based on DBCA database records and the Protected Matters Search Tool (PMST). However, no Threatened flora species listed under the EPBC Act or BC Act were recorded during the 2019 winter or spring surveys (ELA 2020).

Of the 13 Threatened flora identified from the desktop assessment, ELA (2020) identified three (3) species as having potential to occur within the DE due to the presence of suitable habitat and proximity of previous recent records:
• Drakaea elastica (listed EN under the EPBC Act; CR [Schedule 1] under the BC Act)
• Drakaea micrantha (listed VU under the EPBC Act; EN [Schedule 2] under the BC Act)
• Diuris micrantha (listed VU under the EPBC Act; VU [Schedule 3] under the BC Act).

The ELA 2019 winter survey (22 - 26 July and 15 - 16 August) was undertaken specifically to search for threatened orchid species Drakaea elastic and Drakaea micrantha. The survey team comprise four qualified consultants and the survey methodology involved personnel walking systematic foot-traverses of suitable habitat within the survey area. Given these species were not recorded within the DE, it is unlikely the proposed clearing represents removal of habitat necessary for the continued existence of these Threatened flora species.</td><td>The proposed clearing is not at variance to this principle.</td></tr>
<tr><td>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</td><td>ELA (2020) identified one (1) TEC within the DE: ‘Banksia Woodlands of the Swan Coastal Plain’, currently listed as Endangered under the EPBC Act. The vegetation type assessed to be representative of this community is BaEmW described as ‘Banksia attenuata and Eucalyptus marginata woodland over tall and low sparse shrubland’ (ELA 2020). The mapped extent of BaEmW within the DE is 14.26 ha of which 4.69 ha is of Excellent condition, 4.32 ha of Very Good condition and 5.25 ha of Good condition (ELA 2020). Areas of BaEmW in Degraded condition (1 ha) and Completely Degraded condition (1.15 ha) did not fulfil the key diagnostic characteristics for this TEC (ELA 2020; DoEE 2016). Clearing of up to 1.72 ha of this TEC is required to establish the Proposal (0.62 ha in Excellent condition, 0.53 ha in Very Good condition and 0.57 ha in Good condition).

Key threats to ‘Banksia Woodlands of the Swan Coastal Plain’ TEC include native vegetation clearing and associated fragmentation, dieback diseases (e.g., Phytophthora cinnamomi), invasive weeds and feral animals, changes to fire regimes, hydrological degradation (including changes to groundwater) and climate change (DoEE 2016).

The proposed clearing will impact a small portion (1.72 ha) of the ‘Banksia Woodlands of the Swan Coastal Plain’ TEC that is in Good or better condition. However, given vegetation type BaEmW (representing this TEC) is located adjacent to plantations and completely degraded areas, it is likely that the condition of this vegetation will continue to decline into the future (regardless of the proposed clearing) due to edge impacts (e.g., weeds, dieback).</td><td>The proposed clearing is at variance to this principle.</td></tr>
<tr><td>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</td><td>The DE is 78.29 ha, of which 36% represents native vegetation in Good or better condition. The remaining 64% comprises plantations, degraded farmland and cleared areas.

The Proposal is situated in the South West Botanical Province of WA within the SWA bioregion and the Perth (SWA02) subregion as described by the IBRA. Beard (1979) pre-European vegetation mapping (1:1,000,000 scale) indicates that two VAs occur within the DE:
• VA 1000 – described as ‘Banksia-paperbark woodlands and mixed heaths’
• VA 968 – described as ‘Variable vegetation includes jarrah, marri, wandoo, paperbark, sheoks and Eucalyptus rudis’.

The pre-European mapping has been adapted and digitised by Shepherd et al. (2002, as cited in ELA 2020). The extent of the VAs has been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (latest update March 2019 – GoWA 2020). The table below presents the % of each VA remaining at all scales (State, IBRA bioregion, IBRA subregion and Local Government Area).

<table>
<tr><th>Vegetation Association</th><th>Scale</th><th>Pre-European extent (ha)</th><th>Current extent (ha)</th><th>Remaining (%)</th></tr>
<tr><td>1000</td><td>State: WA</td><td>99,835.86</td><td>27,768.84</td><td>27.81</td></tr>
<tr><td></td><td>IBRA bioregion: SWA</td><td>94175.31</td><td>24,869.20</td><td>26.41</td></tr>
<tr><td></td><td>IBRA sub-region: Perth (SWA02)</td><td>94,175.31</td><td>24,869.20</td><td>26.41</td></tr>
<tr><td></td><td>LGA: Shire of Harvey</td><td>20121.61</td><td>8209.83</td><td>40.80</td></tr>
</table>
</td><td>The proposed clearing is at variance to this principle.</td></tr>
</table>

<table>
<tr><th>Clearing principle</th><th>Assessment of impacts</th><th>Outcome</th></tr>
<tr><td></td><td>
<table>
<tr><td>968</td><td>State: WA</td><td>296,877.84</td><td>95,048.82</td><td>32.02</td></tr>
<tr><td></td><td>IBRA bioregion: SWA</td><td>136188.20</td><td>9017.32</td><td>6.62</td></tr>
<tr><td></td><td>IBRA sub-region: Perth (SWA02)</td><td>136,188.20</td><td>9,017.32</td><td>6.62</td></tr>
<tr><td></td><td>LGA: Shire of Harvey</td><td>23465.19</td><td>1260.92</td><td>5.37</td></tr>
</table>

The DBCA calculations indicate that:
• 26.41% of VA 1000 remains in the SWA IBRA bioregion and Perth (SWA02) sub-region, with only 27.81% remaining within the State
• 6.62% of VA 968 remains in the SWA IBRA bioregion and Perth (SWA02) sub-region, with only 32.02% remaining within the State.
The Proposal requires clearing of 4.05 ha of native vegetation within the mapped extent of VA 1000 and 0.30 ha of native vegetation within the mapped extent of VA 968
• The proportion of VA 1000 to be cleared represents 0.02% of the remaining extent of this VA in the Perth (SWA02) IBRA sub-region, and 0.01% of the remaining extent in WA.
• The proportion of VA 968 to be cleared represents <0.01% of the remaining extent of this VA in the Perth (SWA02) IBRA sub-region, and <0.0001% of the remaining extent in WA.

While the area of proposed clearing represents a small percentage of the total area remaining for both associations, given the limited extent of these VAs remaining at all scales (particularly at the IBRA bioregion / sub-region scale), the proposed clearing will contribute to a further reduction in the extent of these VAs which have already been extensively cleared.</td><td></td></tr>
<tr><td>f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland</td><td>The DE intersects the following watercourse and wetlands (Figure 6, Appendix B):
• Wellesley River (DWER-031) and adjacent land of which approximately 12.02 ha may experience seasonal flooding (with approximately 10 - 30% of the zone at risk of inundation) (DWER-017, DWER-020). Wellesley River is a classified Other Heritage Place (ID 33865) and the portion intersecting the DE is also an EPA Redbook Recommended Conservation Reserve (DBCA-029) – South Energy is committed to minimising clearing within these areas.
• Geomorphic wetlands intersecting the DE (grouped based on land use) are listed in the table below (a full list of wetland IDs is provided in Table 3-2).
<table>
<tr><th>Wetland (land use)</th><th>Area within DE (ha)</th><th>Area comprising native vegetation within the DE (ha)</th><th>Area comprising native vegetation within the Development Footprint (ha)</th></tr>
<tr><td>One (1) Conservation Category wetland “Kemerton Wetlands” which is also a declared ESA</td><td>0.56</td><td>-</td><td>-</td></tr>
<tr><td>Six (6) Resource Enhancement wetlands</td><td>4.22</td><td>2.15</td><td>0.12</td></tr>
<tr><td>Three (3) Multiple Use wetlands</td><td>23.92</td><td>3.71</td><td>0.51</td></tr>
</table>

The Conservation Category wetland is buffered by native vegetation approximately >70 m wide (clockwise from south to north-north-west) and <30 m wide (clockwise from north-north-west to south). Where the vegetation buffer is <30 m, aerial imagery reveals vegetation that is sparse and dissected by access tracks. Much of the vegetation fringing the Resource Enhancement and Multiple Use wetlands has been cleared for livestock grazing. Only one of the wetlands retains a native vegetation buffer of approximately 50 m. The DE boundary is adjacent to the outer edge of this vegetation buffer.

The DE does not occur within or adjacent to wild rivers protected under the RiWI Act, wetlands listed under the Ramsar Convention, significant wetlands of the South Coast Region, or wetlands in the Directory of Important Wetlands in Australia.

The Proposal design has taken into account the value of intersecting wetlands and watercourses and South Energy are committed to minimising impacts to these areas. Freshwater habitats within the DE (for example, the Wellesley River) have been identified as suitable habitat for Carter’s freshwater mussel (Westralunio carteri) listed as VU under the EPBC Act and VU [Schedule 3] under the BC Act. Furthermore, the Wellesley River is</td><td>The proposed clearing is at variance to this principle.</td></tr>
</table>

Clearing principle	Assessment of impacts	Outcome
	valued as both an 'Other Heritage Place' and a Recommended Conservation Reserve. Clearing within the Wellesley River Waugal (ID 33865) will be minimised as far as reasonably practicable, with only 0.17 ha of native vegetation within this river required to be cleared to construct the transmission line. In addition, no poles will be placed within 30 m either site of the Wellesley River to minimise ground disturbance. Clearing will also be avoided within the mapped extent of the Conservation Category wetland; however, the Proposal may require removal of buffer vegetation within approximately 100 m of the waterbody as observed from aerial imagery. Clearing of buffer vegetation within 100 m of these waterbodies will be minimised as far as is practicable, with only key infrastructure established (e.g., power poles and the transmission corridor). Power pole footings will be located at least 100 m from the Wellesley River and the Conservation Category Wetland waterbodies. Remnant native vegetation that fringes both Resource Enhancement wetlands and Multiple Use wetlands intersecting the DE is both limited and generally degraded. Clearing of native vegetation within the mapped extent of these wetlands is unlikely to further compromise the condition of these wetlands given the limited extent of clearing (3.88 ha in total), seasonal filling of wetlands (through groundwater rise and/or rainfall), and sandy/loamy soils that are unlikely to erode or cause sedimentation impacts.	
g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation	The DE is located in an area with mostly Moderate to Low risk of PASS, with isolated areas of High to Moderate risk of PASS associated with intersecting geomorphic wetlands and the Wellesley River (Figure 6). The DE intersects a 12.02 ha flood risk zone that is approximately 250 m wide, of which 10 - 30% has the potential to become inundated during the winter months if the Wellesley River overflows. A large extent of this flood zone, particularly towards the east, has been previously cleared for intensive agriculture and is largely stabilised with grasses. The Proposal requires limited clearing (1.57 ha) within this area and is unlikely to exacerbate soil erosion or alter hydrological processes (e.g., flooding; waterlogging), to the extent that present or future land uses (primarily livestock grazing) would be affected. Only one power pole is located within this flood zone and is located approximately 115 m west of Wellesley River. A review of online databases indicates the DE is situated within the following WA Soil Groups: • SG 444 "pale deep sand" is the dominate soil type within the DE. Characterised by neutral to acidic sandy soils to depths greater than 80 cm (sometimes intermingled with ironstone gravel). These soils have a limited ability to hold water, consequently greater nutrient leaching and groundwater recharge is observed. • SG 103 "semi-wet soil" associated with intensive farmland within the eastern portion of the DE, and intersecting Conservation and Resource Enhancement wetlands. Characterised by non-saline soils (sands; loams; clays) with moderate to neutral pH, waterlogged to 30-80 cm for a major part of the year. • SG 441 "brown deep sand" associated with the bed and banks of the Wellesley River. Characterised by brown sands to depths greater than 80 cm, neutral to acid pH. • SG 105 "wet soil" associated with intersecting Multiple Use wetlands. Characterised by non-saline soils (sands; loams; clays) with acidic pH, waterlogged to <30 cm for a major part of the year. Located in a high rainfall region (989.9 mm per annum), with most rainfall occurring during the winter months of June, July and August (196.2 mm, 189.8 mm and 146.4 mm) (ELA 2020), there is potential for areas to become seasonally inundated where the superficial aquifer is very shallow. Intense rainfall events are unlikely to cause appreciable soil erosion due to dominance of sandy soils within the DE. The Proposal is unlikely to cause soil salinity due to the small area of clearing proposed (10.38 ha) and sandy soils that characterise the DE which are less susceptible to salt accumulation and thus salinization. Both the wet soils (SG 105) and semi-wet soils (SG 103) are specifically characterised as non-saline, and the other two soil types (SG 444 and 441) comprise deep sandy soils to depths greater than 80 cm. The majority of the DE is relatively flat with some gentle undulations (10 – 16 m AHD). The eastern extent of the DE drops away to 4 m AHD across a distance of 25 – 50 m meeting the Wellesley River and adjacent floodplain areas. Native vegetation adjacent to the Wellesley River comprises Eucalyptus and Melaleuca closed forest. High to Moderate risk PASS areas extend up to 135 m from Wellesley River and the proposed clearing area overlaps some of this PASS risk area. Clearing within this PASS risk zone will be limited to the minimum required to establish key project infrastructure (e.g., power poles and the transmission corridor). Clearing on adjacent sloping areas (west of Wellesley River) may also result in erosion if soils are left exposed to weathering elements (e.g., intense rainfall events and high velocity flows) throughout the winter months. Clearing a small area of vegetation within gently undulating sandy areas of the DE is not expected to cause appreciable land degradation. The proposed clearing area avoids nearly all High to Moderate risk PASS areas associated with the intersecting geomorphic wetlands.	The proposed clearing may 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	No DBCA managed lands or regional parks occur within or adjacent to the DE. The closest DBCA conservation area is Benger Swamp Nature Reserve (R 34811) located approximately 4 km north-east of the DE. The 577.62 ha reserve is vested with the Conservation Commission Of WA for the purpose of conserving flora and fauna. A review of aerial imagery shows that land between the DE and Benger Swamp has been almost entirely cleared for intensive agriculture, and there are no vegetation corridors connecting Benger Swamp with nearby remnant vegetation. Accordingly, vegetation within the DE does not represent a buffer, ecological linkage or outlier to this conservation area.	The proposed clearing is unlikely to be at variance to this principle.

Clearing principle	Assessment of impacts	Outcome
	Vegetation within the DE connects to larger areas of remnant vegetation which extend north however, given these areas are not held or managed for conservation, and appear from aerial imagery to be largely dissected by access tracks and consequently would have experienced a decline in vegetation health due to edge impacts (e.g., weeds; dieback), it is unlikely the proposed clearing would compromise the value currently provided by this vegetation. The southern reaches of the Wellesley River fall within EPA Redbook Recommended Conservation Reserve 'The Darling System' (No. C66) (DBCA-029). The northern most portion of this recommended reserve extends approximately 400 m north of the DE, with the southern reaches connecting to the Leschenault Estuary. Vegetation growing in association with the Wellesley River provides a valuable ecological linkage within a landscape that is largely cleared and assists with maintaining water quality within the Wellesley River (e.g., stabilising embankments; nutrient uptake). Up to 0.17 ha of native vegetation is required to be cleared within the Wellesley River area to construct the transmission line. No poles will be placed within 30 m either side of the Wellesley River to minimise ground disturbance to the ecological linkage. The avoidance of poles within the bed and banks of the Wellesley River will ensure that the river embankments remain stable, minimising impacts to water quality. Clearing within the Wellesley River has been minimised as far as practicable and it is unlikely that the clearing will have an impact on the environmental variables of the Wellesley River.	
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	***Soils present within the DE*** A review of online databases indicates the DE is situated within the following WA Soil Groups: • SG 444 "pale deep sand" is the dominate soil type within the DE. Characterised by neutral to acidic sandy soils to depths greater than 80 cm (sometimes intermingled with ironstone gravel). These soils have a limited ability to hold water, consequently greater nutrient leaching and groundwater recharge is observed. • SG 103 "semi-wet soil" associated with intensive farmland within the eastern portion of the DE, and intersecting Conservation and Resource Enhancement wetlands. Characterised by non-saline soils (sands; loams; clays) with moderate to neutral pH, waterlogged to 30-80 cm for a major part of the year. • SG 441 "brown deep sand" associated with the bed and banks of the Wellesley River. Characterised by brown sands to depths greater than 80 cm, neutral to acid pH. • SG 105 "wet soil" associated with intersecting Multiple Use wetlands. Characterised by non-saline soils (sands; loams; clays) with acidic pH, waterlogged to <30 cm for a major part of the year. • ***Risk of sedimentation (surface water)*** In general soils within the DE are sandy with little to no clay content. Such soils are unlikely to be unstable (e.g., slake or be dispersive) and consequently would cause negligible sedimentation impacts (e.g., turbidity) if disturbed and mobilised by surface water flows. ***Risk of salinization (groundwater and surface water)*** The DE is not located within a currently saline or valley hazard area (GoWA 2020b). Furthermore, the sandy soils that characterise the DE are less susceptible to salt accumulation and thus salinization. Both the wet soils (SG 105) and semi-wet soils (SG 103) are specifically characterised as non-saline, and the other two soil types (SG 444 and 441) comprise deep sandy soils to depths greater than 80 cm. It is unlikely the proposed clearing would cause salinity increases in ground or surface water resources given the low risk environment and small area of clearing required (10.66 ha). ***Risk of acidification (groundwater and surface water)*** The DE is located in an area with mostly Moderate to Low risk of PASS, with isolated areas of High to Moderate risk of PASS associated with intersecting geomorphic wetlands and the Wellesley River (Figure 6). Exposure of ASS (if present) has the potential to cause acidification of ground and surface water resources. To minimise the risk of ASS exposure, clearing within High to Moderate risk PASS areas will be minimised as far as is practicable. It is proposed that two (2) of the 20 power poles are located within higher risk PASS areas. ***Surface water resources*** No wetlands of international (Ramsar) or national importance occur within or adjacent to the DE. The closest nationally important wetland is Benger Swamp located approximately 4 km north-east (and up-gradient) of the Proposal. Past and present threatening processes include inappropriate fire regimes, altered drainage, acidification (resulting from ASS exposure) and weed invasion. Surface water resources intersecting the DE include a number of geomorphic wetlands and the Wellesley River (Figure 6, Appendix B). Up to 0.17 ha of native vegetation is required to be cleared within the Wellesley River. To minimise the potential for impact to these resources, no poles will be placed within 30 m either side of the Wellesley River and no clearing will occur within 100 m of the Conservation Category Wetland. In addition, some fringing vegetation is required to be cleared to establish key project infrastructure (e.g., power poles), however, this has been minimised as far as is practicable. Given most of the fringing vegetation will be retained; the minimal (0.17 ha) of clearing within and adjacent to the Wellesley River and the	The proposed clearing may be at variance to this principle.

Clearing principle	Assessment of impacts	Outcome
	avoidance of clearing within the Conservation Category Wetland; and that soils within the DE are of a sandy composition, it is unlikely the proposed clearing would cause sedimentation impacts to the identified surface water resources. ***Groundwater resources*** There are no PDWSAs located within 10 km of the DE. The closest PDWSA is Bunbury Water Reserve (a Priority 3 Protection Area) located approximately 5 km south of where the Wellesley River discharges into the Leschenault Estuary. The proposed clearing would not impact this PDWSA. The DE is located within the South West Coastal and Bunbury Proclaimed groundwater resources protected under the RiWI Act. However, given the small amount of clearing proposed (10.38 ha), it is unlikely that the Proposal would cause deterioration in the quality of underground water unless ASS were exposed. There are no WIR bores within or adjacent to the DE with recent records of groundwater levels that would represent depth to groundwater within the DE. It is expected that groundwater would occur within 5-10 m of the surface following winter recharge, and may occur within 1 - 5 m of the surface if shallow aquifers are present in lower-lying areas adjacent to the Wellesley River. It is understood that sandy soils present within the DE, would facilitate groundwater recharge and be susceptible to nutrient leaching. However, given the small area of clearing proposed (10.66 ha), it is unlikely the Proposal would cause noticeable increases in groundwater recharge, or result in elevated nutrient concentrations in surface and groundwater resources.	
j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding	The Proposal is Located in a high rainfall region (989.9 mm per annum), with most rainfall occurring during the winter months of June, July and August (196.2 mm, 189.8 mm and 146.4 mm) (ELA 2020). The majority of the DE is relatively flat with some gentle undulations (10 – 16 m AHD). The eastern extent of the DE drops away to 4 m AHD across a distance of 25 – 50 m meeting the Wellesley River and adjacent floodplain areas. The lower lying floodplain areas span approximately 250 m and are mapped as high risk for flooding during the winter months. A large extent of this flood zone, particularly towards the east, has been previously cleared for intensive agriculture and is largely stabilised with grasses. Some remnant native vegetation is present adjacent to the Wellesley River comprising Eucalyptus and Melaleuca closed forest. The proposed clearing is unlikely to cause, or exacerbate, flooding within this zone given clearing within the Wellesley River will be minimal (0.17 ha) and no poles will be placed within 30 m either side of the river, and that clearing of buffer vegetation (within the flood zone) will be restricted to the minimum required to establish key project infrastructure (e.g., one power pole and the connecting transmission corridor).	The proposed clearing is unlikely to be at variance to this principle.

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Appendices

Appendix A – Eco Logical Australia (2020) Detailed and Targeted Flora and Vegetation Survey and Level 1 Fauna Survey

Detailed and Targeted Flora and Vegetation Survey and Level 1 Fauna Survey
Benger Solar Farm

South Energy

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DOCUMENT TRACKING

Project Name	Detailed and Targeted Flora and Vegetation Survey and Level 1 Fauna Survey Benger Solar Farm
Project Number	14312
Project Manager	**Daniel Panickar**
Prepared by	**Daniel Marsh, Jeff Cargill**
Reviewed by	**Daniel Panickar, Jeff Cargill**
Approved by	**Daniel Panickar**
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Template 2.8.1

Contents

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
BAM Act	State *Biosecurity and Agriculture Management Act 2007*
BC Act	State *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CLUSTER	Hierarchical Clustering
DAFWA	Department of Agriculture and Food Western Australia
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation
DotEE	Department of Environment and Energy
DPIRD	Department of Primary Industries and Regional Development
DRF	Declared Rare Flora
DWER	Department of Water and Environmental Regulation
ELA	Eco Logical Australia
EP Act	State *Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas
FCT	Floristic Community Type
ha	hectares

Abbreviation	Description
IUCN	International Union for Conservation of Nature
km	kilometre
KPI	Key Performance Indicator
m	metre
MDS	Multi-Dimensional Scaling
mm	millimetre
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
PRIMER	Plymouth Routines in Multivariate Ecological Research
SIMPER	Similarity Percentages
TEC	Threatened Ecological Community
the City	City of Joondalup
TSSC	Threatened Species Scientific Committee
WA	Western Australia
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WAOL	Western Australian Organism List
WoNS	Weed of National Significance

Executive Summary

Eco Logical Australia (ELA) was engaged by South Energy to undertake a Detailed and Targeted flora survey and Level 1 Fauna survey of a proposed powerline route between Benger Solar Farm (in development) and the Marriot Road 132kV Terminal Station. The field survey was conducted in spring from 29th to 30th October 2019, with 13 10 x 10 metre quadrats being established. ELA previously undertook targeted flora surveys within the survey area and broader Kemerton area from 22nd to 26th July and 15th to 16th August 2019. The results of these winter surveys have been included in this report where they relate to the survey area.

A total of 130 taxa (94 native and 36 introduced taxa) from 96 genera and 37 families were recorded across the survey area, both from quadrats and opportunistic collections.

No Threatened (Declared Rare) flora species were recorded within the survey area. Two Priority 4 flora species were recorded within the survey area, namely *Pultenaea skinneri* (one individual plant) and *Acacia semitrullata* (8 individual plants).

Six vegetation communities were delineated and mapped within the survey area:

- **Vegetation community CcOW**: Mid *Corymbia calophylla* open woodland over a low **Hordeum leporinum* and **Lolium rigidum* grassland*;*
- **Vegetation community ErMrW**: Mid *Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low *Alternanthera nodiflora* and *Cassytha racemosa* forma *racemosa* sparse forbland;
- **Vegetation community MpW**: Mid *Melaleuca preissiana* woodland over a tall *Kunzea glabrescens* and *Astartea scoparia* sparse shrubland over a tall *Juncus pauciflorus* and *Lepidosperma longitudinale* open sedgeland;
- **Vegetation community BaEmW**: Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall *Kunzea glabrescens* sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland;
- **Vegetation community EmAfW**: Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall *Kunzea glabrescens* and *Hardenbergia comptoniana* sparse shrubland over a mid **Ehrharta calycina* sparse grassland; and
- **Vegetation community Plantation**: Plantation of *Pinus* spp. and *Eucalyptus* spp.

Quadrats within vegetation communities BaEmW showed primary affiliations with Floristic Community Types 21a, and to a lesser extent 21c, which are both recognised as being subcomponents of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, listed as Threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and as Priority 3 by the Department of Biodiversity Conservation and Attractions.

Following assessment of vegetation within the survey area against key diagnostic characteristics outlined in the Threatened Species Scientific Committee *'Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*', the BaEmW vegetation community was considered to represent floristic aspects of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community, listed as Endangered under the Commonwealth

Environment Protection and Biodiversity Conservation Act 1999. Approximately 14.3 hectares of this Threatened Ecological Community was mapped across the survey area.

Vegetation condition within the survey area ranged from Completely Degraded to Excellent condition, based on the Keighery (1994) vegetation scale provided in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). The majority of the survey area consisted of plantations of *Pinus* spp. and *Eucalyptus* spp. and areas considered to be Completely Degraded (including tracks and other cleared areas). Disturbances within the survey area included the presence of cleared areas, paddocks, sumps, weeds, rubbish dumping, feral fauna (scats, tracks or diggings) and the presence of tracks. Some vegetation health decline was recorded (dead or dying species) which may be attributed to drought or potential disease (dieback).

A total of 36 introduced (weed) species were recorded and of these, two species are listed as a Declared Plants under the BAM Act, namely **Gomphocarpus fruticosus* s22(2) (C3) and **Zantedeschia aethiopica* s22(2) (Exempt).

A total of 31 native fauna species were recorded during the field survey, comprising twenty-five birds, four mammals and two reptiles. Three introduced (pest) fauna species were recorded within the survey area, *Felis catus* (cat), *Oryctolagus cuniculus* (rabbit) and *Vulpes vulpes* (fox).

One Threatened fauna species, Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*), was observed within the survey area. This species is listed as Vulnerable under the EPBC Act and as Schedule 3 '*fauna that is rare or is likely to become extinct as vulnerable fauna*' under the BC Act. Three individuals of this species were observed roosting in Marri trees within survey area and recent feeding residue was also observed. Although not directly observed (or heard) within the survey area, feeding residue of pinecones was recorded which indicate that Carnaby's Black Cockatoo potentially utilise the pine plantations within the survey area as foraging habitat. Carnaby's Black Cockatoo have previously been recorded 0.3km from the survey area.

In addition to Forest Red-tailed Black Cockatoo and Carnaby's Black Cockatoo, the desktop assessment also identified Carter's freshwater mussel (*Westralunio carteri*), Brush-tailed Phascogale (*Phascogale tapoatafa* subsp*. wambenger) and* Quenda *(Isoodon obesulus fusciventer)* as being likely to occur within the survey area; this assessment was based on presence of suitable habitat and proximity of previous records.

The black cockatoo breeding habitat assessment identified 145 potentially significant trees within the survey area. These trees comprised 59 Marri (*Corymbia calophylla*), 59 Jarrah (*Eucalyptus marginata*) and 27 Flooded Gums (*Eucalyptus rudis*) trees. Of the 145 potentially suitable breeding trees recorded, nine had hollows over 100 mm (trunk and/or spout hollows) visible from the ground.

For the purposes of a Detailed and targeted flora and vegetation survey and Level 1 Fauna survey, adequate data was collected to define and assess the presence, extent and significance of flora and vegetation communities within the project area.

1. Introduction

1.1 Project background

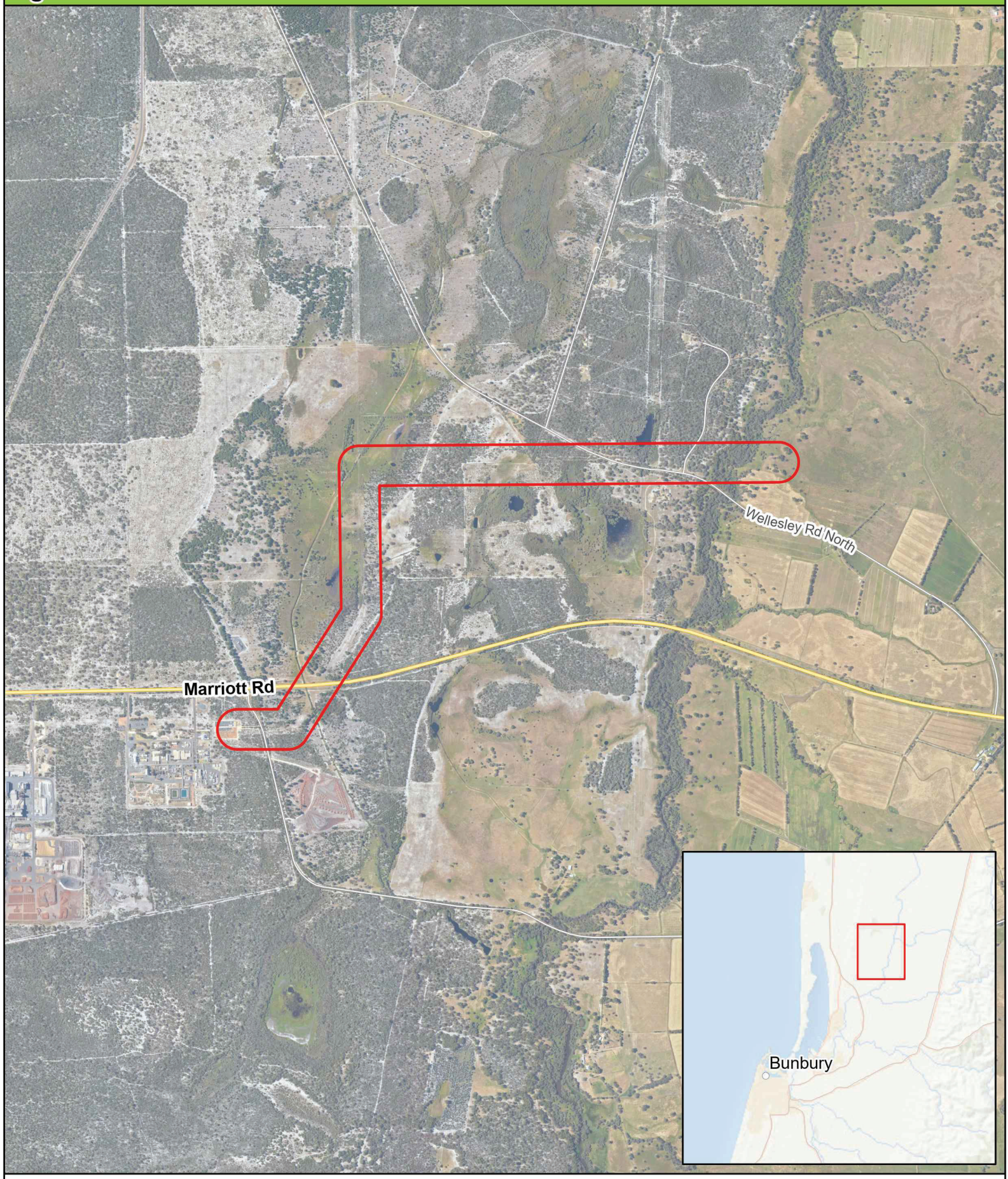
Eco Logical Australia (ELA) was engaged by South Energy to undertake a Detailed and Targeted flora survey and Level 1 Fauna survey (in spring 2019) of a proposed powerline routes between Benger Solar Farm (in development) and the Marriot Road 132kV Terminal Station (the survey area; Figure 1).

More specifically, the objectives of this survey include:

- An assessment of flora and vegetation communities in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a);
- Undertake a vegetation condition assessment using the Keighery vegetation condition scale (1994);
- A Targeted survey for State, Commonwealth and/or Department of Biodiversity, Conservation and Attractions (DBCA) listed conservation significant flora and vegetation;
- An assessment to verify if the vegetation meets the requirements specified in the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act) 'Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community', using the four-stage assessment process itemised in the Approved Conservation Advice (Threatened Species Scientific Committee [TSSC] 2016);
- A Level 1 fauna survey in accordance with the EPA Technical Guidance: *Terrestrial Fauna Surveys* (EPA 2016b); and
- A black cockatoo habitat assessment in accordance with the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) *EPBC Act referral guidelines for three threatened black cockatoo species* (SEWPaC 2012).

ELA previously undertook targeted flora surveys within the survey area and broader Kemerton area from 22nd to 26th July and 15th to 16th August 2019. The results of these winter surveys have been included in this report where they relate to the survey area.

Figure 1: Site Overview



Legend

Survey Area

0 250 500 750

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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A TETRA TECH COMPANY

Prepared by: GM Date: 28/02/2020

2. Environmental setting

2.1 Climate

The survey area occurs on the Swan Coastal Plain which experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell *et al.* 2002). Based on climate data from the nearby Bureau of Meteorology (BoM) Brunswick Junction weather station (station number 9513; climate data 9513 – current; located approximately 5.5 km east of the survey area) the area receives an annual average rainfall of 989.9 millimetres (mm), with most rainfall occurring during the winter months of June, July and August (196.2 mm, 189.8 mm and 146.4 mm, respectively; BoM 2020; Table 1).

In the 12 months preceding the spring field survey, the area received a total of 608.2 mm, which is below the long-term average (Table 1). A total of 240.8 mm of rainfall was recorded in the three months prior to the field survey at the end of October, which is lower than the long-term average for the same time period (303.8 mm). It is recognised that lower than average annual rainfall may have negatively impacted the presence and/or prevalence of annual species at the time of survey.

Based on temperature data from the nearby Wokalup weather station (station number 9642; climate data 1951 – current; located approximately 13.5km north-east of the survey area), mean minimum air temperature in the area ranges from 8.0°C in July to 15.5°C in January, while mean monthly maximum temperatures range from 16.7°C in July to 31.0°C in January (BoM 2020).

Table 1: Rainfall data recorded at the Brunswick Junction weather station (9513) 12 months prior to the field survey compared to the long-term average (BoM 2020)

Month	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Total monthly rainfall 2018-19 (mm)	7.0	7.0	13.0	0.0	9.8	19.2	43.0	180.0	88.4	158.2	38.4	44.2	**608.2**
Average monthly rainfall 1909 - 2019	31.7	15.1	12.3	13.3	23.4	49.9	139.0	196.2	189.8	146.4	97.5	59.9	**989.9**

2.2 Regional context

Environmental values for the region relevant to the survey area are presented in Table 2.

Table 2: Environmental values of the region

Existing environmental attributes	Survey area
Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion (DAWE 2020a)	Swan Coastal Plain (SWA)
IBRA Subregion	Perth (SWA02) – commonly characterised by Tuart and heath on limestone soils and Banksia-Jarrah-Marri woodland on sandy soils. The subregional area encompasses 1,333,901 ha (Mitchell *et al*. 2002).
Geology, landform and soils	Most of the survey area is situated in Bassendean System (Bassendean 1000) which consists of Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. The eastern 350 m of the survey area is situated in the Pinjarra System (Pinjarra 968) which is characterised as poorly drained coastal plain with variable alluvial and aeolian soils (Government of Western Australia 2020a).

2.3 Broad-scale vegetation mapping

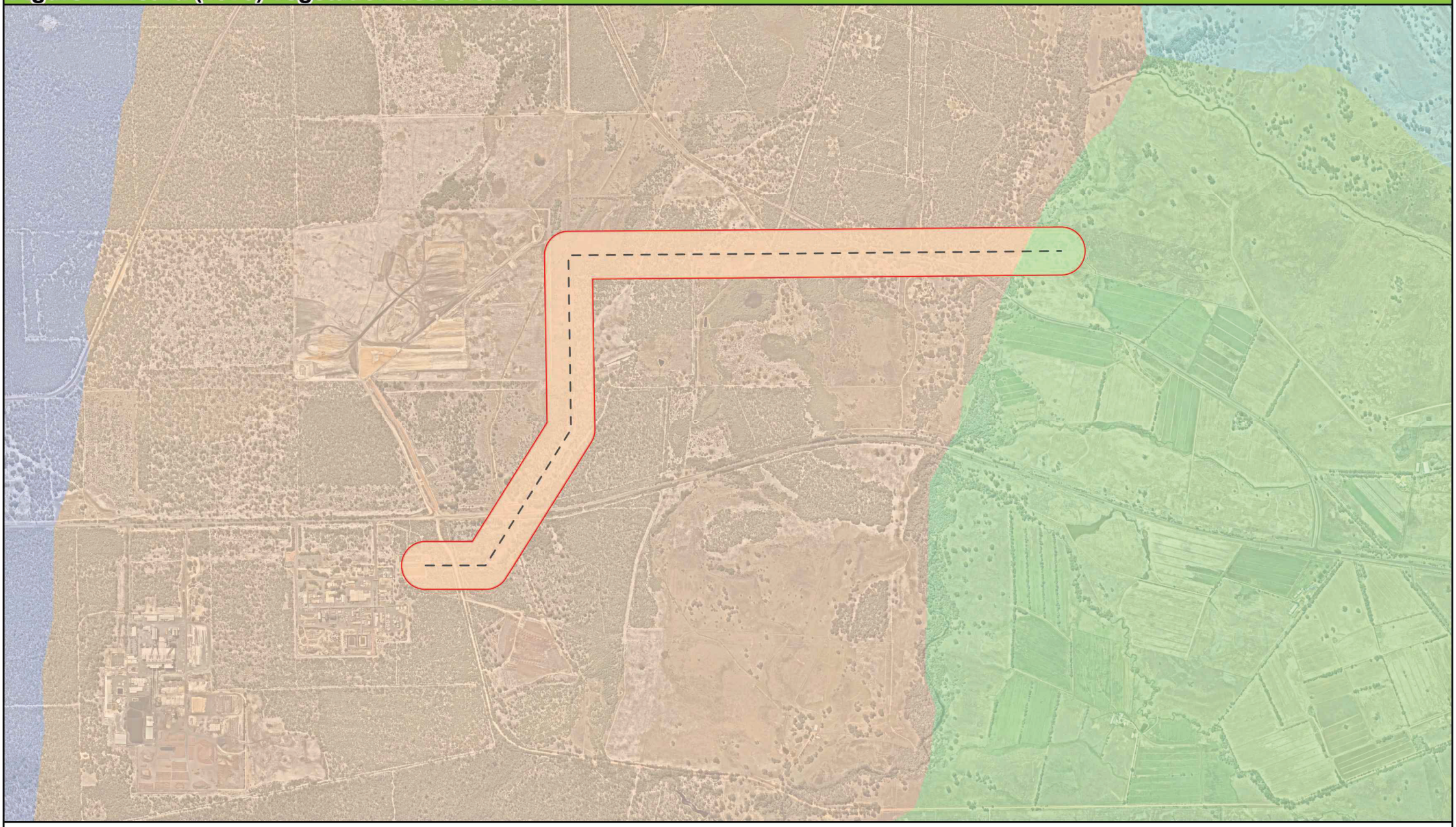
Vegetation type and extent have been mapped at a regional scale by Beard (1979) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, the Department of Primary Industries and Regional Development (DPIRD; previously Department of Agriculture and Food Western Australia [DAFWA]) has compiled a list of vegetation extent and types across WA (Shepherd *et al.* 2002).

Two vegetation associations occur within the survey area, namely 1000 and 968 (Table 3, Figure 2). The percentage remaining of each vegetation association's pre-European extent within the Swan Coastal Plain bioregion is also included in Table 3 (Government of Western Australia 2018).

Table 3: Beard (1979) / Shepherd *et al.* (2002) vegetation associations of the survey area

Vegetation association	Description	Pre-European extent (ha) within the Perth (SWA02) sub-region	Current extent (ha) within the Perth (SWA02) sub-region	Remaining (%)
1000	*Banksia*-paperbark woodlands and mixed heaths	94,175.31	24,869.20	26.41
968	Variable vegetation includes jarrah, marri, wandoo, paperbark, sheoks and *Eucalyptus rudis*	136,188.20	9,017	6.62

Figure 2: Beard (1979) vegetation associations



Legend

- Survey Area
- Survey Line

Beard (1979) vegetation associations

- Spearwood 6
- Pinjarra 968
- Bassendean 1000
- Bassendean 1182

0 250 500 750

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: GM Date: 28/02/2020

3. Methodology

3.1 Desktop review

3.1.1 Database searches and literature review

The following Commonwealth and State databases were searched for information relating to conservation listed flora and ecological communities in order to compile and summarise existing data to inform the field survey (Table 4). The EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act and DBCA and Western Australian Museum (WAM) NatureMap online database searches were undertaken around the central coordinate 385496 mE, 6325428 mN. Applied buffers below are considered suitable based on flora and fauna assemblages expected to occur within the survey area.

Formal database searches from DBCA were requested for Threatened and Priority flora, Threatened and Priority Ecological Communities' and Threatened and Priority fauna. In addition, *A Floristic Survey of the Southern Swan Coastal Plain* (Gibson *et al.* 1994) was reviewed for context.

Table 4: Database searches undertaken for the survey area

Database	Reference	Buffer (km)
EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act.	DAWE 2020b	10
DBCA and Western Australian Museum (WAM) NatureMap online database.	DBCA 2007-2019	10
DBCA Threatened and Priority flora database searches for Declared Rare Flora (DRF) listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority Flora.	DBCA 2019a	-
DBCA Threatened and Priority Ecological Communities' database search	DBCA 2019b	-
DBCA Threatened and Priority fauna database searches for Scheduled fauna listed under the EPBC Act or latest WA Wildlife Conservation (Specially Protected Fauna) Notice and Priority Fauna.	DBCA 2019c	-
DAFWA Western Australian Organism List (WAOL)	DAFWA 2020	-
DPIRD Soil Landscape Mapping	DPIRD 2019	-
Department of Water and Environmental Regulation (DWER) ESA Database	DWER 2019	-
Weeds Australia	Australian Weeds Committee 2015	-
International Union for Conservation of Nature (IUCN)	IUCN 2018	-

An initial 24 conservation listed flora and 21 conservation listed fauna species were identified as having potential to occur within the survey area site based on these database searches. A likelihood of occurrence assessment was undertaken to identify conservation listed flora and fauna species that have the potential to occur within the survey area, identified from a review of key datasets. Conservation listed flora and fauna Conservation codes, categories and criteria for flora and fauna protected under the EPBC Act and the State *Biodiversity Conservation Act 2016* (BC Act) are provided in Appendix A. Criteria used for this assessment is presented in Appendix B.

3.2 Field survey

3.2.1 Survey team and timing

The winter Targeted Threatened orchid survey was conducted by Dr. Jeff Cargill (Senior Botanist), Dr. Lachlan Copeland (Senior Botanist), Jeni Morris (Ecologist) and Sarah Muller (Environmental Scientist) from 22nd to 26th July and 15th to 16th August 2019.

The spring Detailed and Targeted flora and vegetation survey was conducted by Dr. Jeffry Cargill (Senior Ecologist) and Daniel Marsh (Botanist) from 29th to 30th October 2019. The survey team's relevant qualifications, experience and licences are provided in Table 5 below. There was no rainfall recorded during the field survey (BoM 2019).

Table 5: Survey team

Name	Qualification	Relevant experience	Licenses
Dr. Jeffry Cargill	BSc. Hons. PhD Environmental Sciences	Jeff has extensive experience in botanical and ecological studies throughout Western Australia including baseline vegetation studies (Reconnaissance and Detailed surveys), Targeted threatened and priority flora surveys, fauna and black cockatoo surveys, MNES surveys and rehabilitation and vegetation monitoring programs.	Flora collection: FB62000138 DRF licence: TFL 48-1920
Dr. Lachlan Copeland	BSc. Hons. PhD Plant Systematics	Lachlan has over 18 years' experience in vegetation survey techniques and specialises in the identification of native and naturalised vascular plant species; in particular, taxonomy and ecology of Australian Orchids.	N/A – no specimens collected, only photographs
Jeni Morris	BSc. Conservation and Wildlife Biology	Jeni has over four years' experience conducting flora, vegetation and fauna surveys across a range of Western Australian bioregions, including within the Swan Coastal Plain.	Flora collection: FB62000070 DRF licence: TFL 13-1920
Daniel Marsh	BSc. Hons Terrestrial Ecology	Daniel has extensive experience in botanical studies throughout Western Australia including baseline vegetation studies (Reconnaissance and Detailed surveys), Targeted threatened and priority flora surveys, and rehabilitation and vegetation monitoring programs.	Flora collection: FB62000074 DRF permit: TFL 14-1920
Daniel Brassington	BSc. Hons. Environmental Science	Daniel has experience in botanical surveys and environmental services throughout Western Australia. This includes baseline vegetation studies, threatened and priority flora surveys, weed surveys, rehabilitation and vegetation monitoring.	Flora scientific collection licence: SL012503 DRF permit: TFL 15-1920
Sarah Muller	BSc Environmental Science, Conservation and Wildlife Biology	Sarah has undertaken several flora and vegetation surveys for local government, resources and infrastructure projects across the Swan Coastal Plain.	Flora collection: FB62000011 DRF licence: TFL 12-1920

3.3 Flora and vegetation survey

3.3.1 Targeted Threatened orchid survey (winter)

The Targeted Threatened orchid survey was conducted in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). The Phase 1 survey was specifically designed to target the threatened orchid species *Drakaea elastica* and *Drakaea micrantha*. Surveys conducted in July and August are favoured for these species (particularly *D. elastica*), as both contain basal leaves that are relatively conspicuous in winter. Survey methodology involved personnel walking systematic foot-traverses of suitable habitat within the survey area.

Where orchid individuals were identified in the field (basal leaf), locations were physically marked with flagging tape to enable field staff to revisit these locations during spring flowering. For individual plants identified in the field, the following data was collected:

- GPS coordinates of location (points for each individual plant or discrete population);
- Number of individuals in the population (recording a range of co-ordinates if necessary);
- Reproductive phase (basal leaf, flowering etc.);
- Description of the vegetation community and associated species at each location;
- Details on landform, soil type and site conditions;
- Photographs of the plant in situ and broader habitat; and
- Relevant notes such as potential threats to individuals and/or populations (e.g. weeds, clearing, dieback, herbivory).

3.3.2 Detailed flora and vegetation survey (spring)

The Detailed and Targeted flora and vegetation survey was conducted in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

Wooden survey posts were used to temporarily mark all corners of each quadrat. Dominant vegetation communities were described, with respect to dominant species, structure and overall condition. The survey involved the use of 10 x 10 m quadrats as recommended for the Swan Coastal Plain bioregion (EPA 2016). Opportunistic sampling of species not recorded within the quadrats was undertaken to supplement the existing list of species recorded from within the survey area.

A total of 13 quadrats were surveyed across the survey area (Figure 3). The number of quadrats sampled per vegetation community was dependent on the size, extent and condition of the community. Photos were taken from the northwest corner of each quadrat facing south-east. The following data was recorded within each quadrat:

- Site details (site name, site number, observers, date and location);
- Environmental information including landform, soil type and colour, bare ground and leaf litter cover, rock outcropping and time since last fire event; and
- Biological information including vegetation structure, vegetation condition in accordance with Keighery (1994), degree of disturbance, species present and species percentage cover.

A targeted survey was completed within the survey area to identify any conservation significant flora or ecological communities potentially occurring, including:

- Threatened flora or TECs listed under the EPBC Act or BC Act;
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice under the State *Biodiversity Conservation Act 2016* (BC Act);
- PEC's endorsed by the Western Australian Minister for the Environment;
- Priority (P) flora recognised by DBCA; and

The survey methodology involved personnel walking transects across remnant areas of vegetation within the survey area, with transects spaced (on average) 5-20 metres (m) apart depending on factors such as habitat type, disturbance (e.g. tracks) and landform. Flora species able to be identified in the field were recorded, and voucher specimens of unfamiliar species were collected for later identification. All collections were assigned a unique collecting number. For conservation significant flora species identified in the field, the following was recorded:

- A colour photograph;
- GPS location;
- Population size estimate;
- Location of population boundaries;
- Associated habitat/landscape element;
- Time and date observed;
- Observer details; and
- A voucher specimen suitable for use as a reference specimen (if appropriate to do so for conservation significant flora).

3.4 Fauna survey and black cockatoo habitat assessment

A Level 1 fauna survey was undertaken to assess for the presence of fauna species and species assemblages within the survey area and to assess fauna habitat for its ability to support and sustain populations of fauna, including species of conservation significance.

Opportunistic fauna observations were made during the field survey, including visual sightings of active fauna such as reptiles and birds, records of bird calls and signs of species presence such as tracks, diggings, burrows, scats or any other signs of fauna activity.

An assessment of black cockatoo habitat was undertaken in accordance with the EPBC Act referral guidelines (SEWPaC 2012). This involved assessing all significant tree species known to support potential suitable breeding, roosting and foraging habitat. Significant breeding trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 millimetres (mm; > 300 mm for salmon gum and wandoo) (SEWPaC 2012). Trees with a DBH greater than 500 mm (or >300 mm for salmon gum and wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). All potential breeding trees with a DBH of 500 mm or greater encountered within the survey area were recorded.

Vegetation present within the survey area was assessed for its potential to provide foraging and roosting habitat for black cockatoos as per the SEWPaC guidelines (SEWPaC 2012), and the extent of potential suitable habitat within the survey area was mapped.

Observations were also made of any black cockatoo foraging activity or feeding residue such as chewed Banksia, Jarrah and Marri nuts, and any black cockatoo individuals observed within the survey area.

3.5 Data analysis

3.5.1 Flora species accumulation curve

A flora species accumulation curve was undertaken to indicate adequacy of the survey effort (Clarke and Gorley 2006). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered adequate.

3.5.2 Vegetation communities

Plymouth Routines in Multivariate Ecological Research v6 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites based on their species composition (Clarke and Gorley 2006). A presence/absence transformation was applied to the dataset to align with Gibson *et al.* (1994). Introduced species (weeds), specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component) were excluded from the data set prior to analysis. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities.

3.5.2.1 FCT analysis

Species within the Gibson *et al*. (1994) data set were updated to align with current names as specified by FloraBase (DBCA and WAH 2019). Using current records, a number of species in the Gibson *et al*. (1994) data set were shown to be significant range extensions from the Swan Coastal Plain, where appropriate such cases were removed. In addition, excluded and misapplied names were removed from the data set and infra-specific names were reduced. The merged dataset was analysed using a combination of pre-treatments such as the inclusion and/or removal of introduced species and singletons. The removal of both singletons and introduced species from the merged dataset, an accepted pre-treatment for such analysis, produced the best results (e.g. stronger correlations; Clarke and Gorley 2006). Inclusion of such data (i.e. weeds and singletons) merely served to confound the dataset by introducing stochastic and 'site' artefact data. Transformed data were analysed using a combination of multivariate analysis routines including Bray-Curtis Similarity Matrices, Cluster Analysis (Flexible Beta) and Multi-Dimensional Scaling (MDS).

To identify potential TECs and PECs in the survey area, ELA quadrats and vegetation communities were compared to FCTs defined by Gibson *et al*. (1994). To identify the presence of FCT's appropriate multivariate analyses comparing current data to that of Gibson *et al*. (1994) species by quadrat data, and inferences based on dominant species and geomorphology were used. Given the nature of the data

(e.g. spatial and temporal differences), results and subsequent extrapolations, assigned FCT's within the survey area were inferred and not absolute, i.e. a vegetation code assigned to an FCT was inferred to comprise, to varying degrees, floristic aspects of that FCT as defined by Gibson *et al*. (1994). These FCTs were subsequently compared with vegetation communities delineated by ELA and Syrinx Environmental (2014).

3.5.2.2 Assessment of diagnostics to assess presence of Threatened Ecological Communities

The 'Banksia Woodlands of the Swan Coastal Plain' TEC is listed as Endangered under the EPBC Act (TSSC 2016). For information to assist in referral, environmental assessment and compliance issues, it has been recommended to refer to the Listing Advice and/or Conservation Advice and Recovery Plan on the Department of Agriculture, Water and the Environment (DAWE) Species Profile and Threats Database (TSSC 2016). The Listing Advice and/or Conservation Advice defines the national ecological community and includes key diagnostic characteristics, condition thresholds and additional considerations (TSSC 2016).

In order to determine whether the 'Banksia Woodlands of the Swan Coastal Plain' TEC is present in the survey area key diagnostic characteristics must be met under Section 2 of the Conservation Advice (TSSC 2016). The four-stage assessment identified by DAWE to ascertain the presence of the Banksia woodlands endangered ecological community within the site was undertaken by ELA following the field survey.

The 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community is listed as Critically Endangered under the EPBC Act (DAWE 2019a). For information to assist in referral, environmental assessment and compliance issues, it has been recommended to refer to the Listing Advice and/or Conservation Advice on the DAWE Species Profile and Threats Database (DAWE 2019a). The Listing Advice and/or Conservation Advice defines the national ecological community and includes key diagnostic characteristics, condition thresholds and additional considerations (DAWE 2019a).

In order to determine whether the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC is present in the survey area key diagnostic characteristics must be met under Section 3.2 of the Conservation Advice (DAWE 2019a). The assessment identified by DAWE to ascertain the presence of the Tuart (*Eucalyptus gomphocephala*) woodlands endangered ecological community within the site was undertaken by ELA following the field survey.

3.6 Flora identification and nomenclature

Flora specimen identification was undertaken by ELA Botanists Daniel Marsh and Daniel Brassington, with the Western Australian Herbarium (WAH)also utilised to confirm additional specimens. Species identification utilised taxonomic literature and keys and where required specimens were confirmed using the WAH collection. Where considered appropriate, specimens that meet WAH specimen lodgement requirements (e.g. Threatened and Priority Flora, range extensions), will be submitted along with Threatened and Priority Report forms to DBCA. Nomenclature used for the flora species within this report follows the WA Plant Census as available on FloraBase (DBCA and WAH 2019).

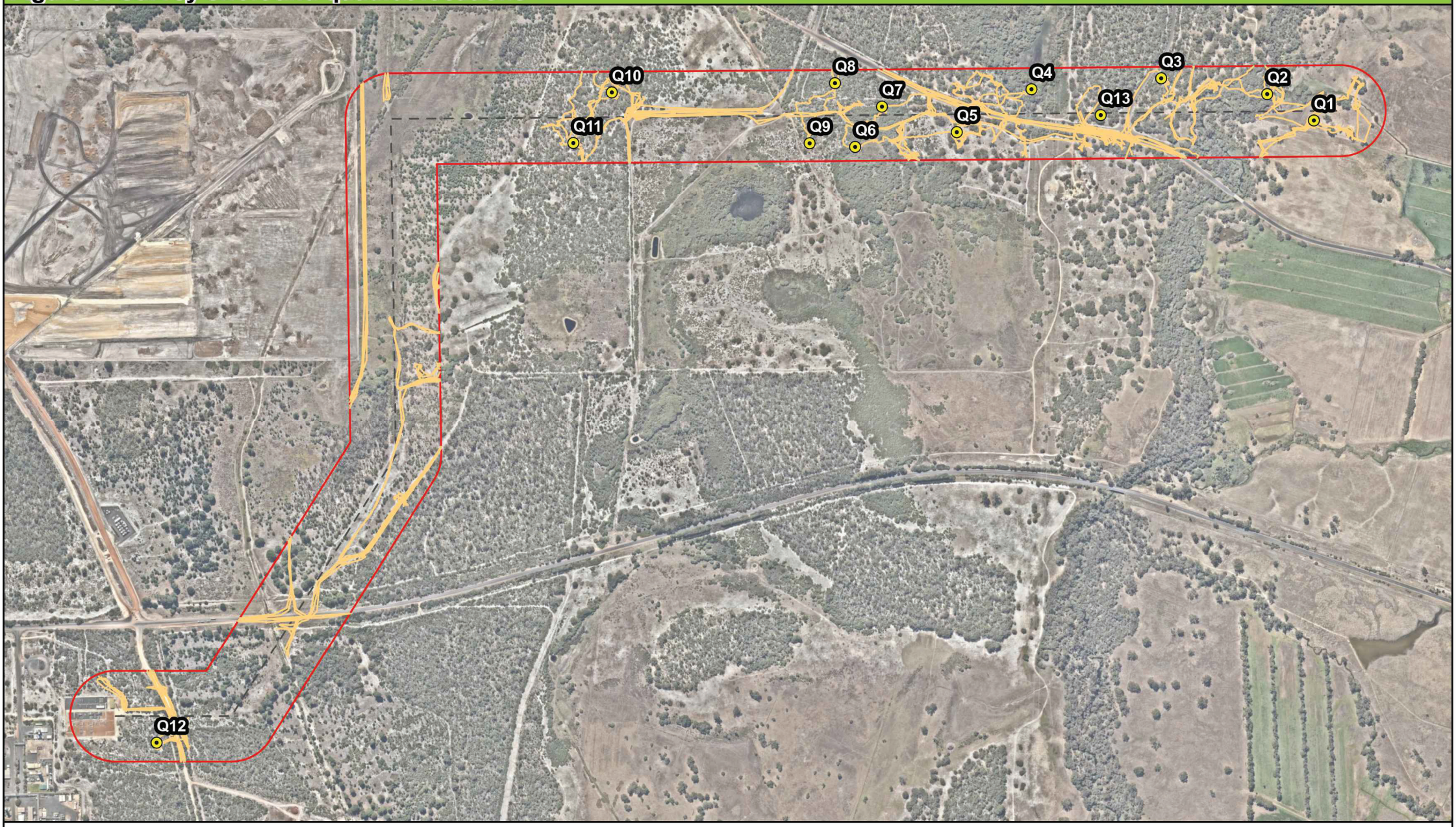
3.7 Limitations

The EPA *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) recommends including discussion of the constraints and limitations of the survey methods used. A constraints and limitations assessment for the Detailed and Targeted flora and vegetation surveys undertaken within the survey area summarised in Table 6 below. No constraints were identified.

Table 6: Survey limitations

Constraint	Limitations
Sources of information	**Not a constraint:** The Swan Coastal Plain has been well surveyed, with increasing survey work occurring due to the ongoing urban development. A number of flora and fauna surveys have been undertaken in the survey area which have been utilised for the purposes of this survey. Gibson *et al.* 1994 was a primary source for determination of methods, analysis and results for assessing FCTs. Broad-scale vegetation mapping at a scale of 1:1,000,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. The information which was available was sufficient and as such sources of information were not considered a major limitation.
Scope of work	**Not a constraint:** The survey requirement for a Detailed and Targeted flora and vegetation survey in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) was adequately met.
Completeness of survey	**Not a constraint:** The area was surveyed to the satisfaction of the scope and a Detailed and Targeted flora and vegetation survey as per relevant guidelines.
Intensity of survey	**Not a constraint:** Survey effort was considered adequate to meet objectives of the scope. The area was surveyed for conservation significant flora species and vegetation communities by field staff undertaking transects across the remnant areas of vegetation within the survey area spaced 5-20 m apart on average. This method provided an accurate assessment of habitat characteristics and likelihood of conservation significant species. The number of quadrats established was sufficient to determine the vegetation communities present and to identify any vegetation of conservation significance. Adequacy of the current sampling effort was tested via a species accumulation curve; approximately 58.0% of the flora potentially present within the survey area was recorded.
Timing, weather, season, cycle	**Not a constraint:** The survey area is located in the Swan Coastal Plain bioregion of Western Australia. Recommended survey timing for this region is in spring (September – November; EPA 2016). The field survey was undertaken at the end of October. Many flora species were flowering at the time of the field survey or had sufficient material (fruit) available to identify the dominant and target species. The timing was appropriate for conducting this level of survey. The Targeted orchid survey was undertaken in July and August, which is appropriate timing for species targeted during this survey.
Disturbances	**Not a constraint:** Disturbances within the survey area included the presence of weeds, unauthorised access (walk trails and bike tracks) and edge effects. These disturbances did not negatively impact the ability to meet objectives outlined in the scope of works.
Resources	**Not a constraint:** The personnel conducting this field survey were both suitably qualified to identify specimens, having previously undertaken flora and vegetation assessments on the Swan Coastal Plain, including in several reserves for the City of Joondalup.
Accessibility	**Not a constraint:** All relevant areas of the survey area were easily accessed and able to be surveyed.

Figure 3: Survey effort and quadrat locations



Legend

- Survey Line
- Survey Area
- Quadrat Locations
- Survey Effort

0 100 200 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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4. Results

4.1 Desktop review

4.1.1 Conservation significant flora species

A DBCA Threatened and Priority Flora and Communities database search (DBCA 2019a and DBCA 2019b, respectively), PMST search (DAWE 2019b) and Naturemap search (DBCA 2007-2019) were undertaken to identify conservation significant species and communities recorded within, or nearby to, the survey area (current and historic). Of the 24 conservation listed flora species identified from the desktop assessment as possibly occurring within the survey area, two species, *Pultenaea skinneri* (P4) and *Caladenia speciosa* (P4) have previously been recorded within the survey area (Figure 4). Of the 22 remaining conservation significant flora species initially considered to possibly occur within the survey area, nine were considered to have the potential to occur due to the presence of suitable habitat and proximity of previous recent records to the survey area. The flora likelihood of occurrence assessment is presented in Appendix C.

4.1.2 Environmentally sensitive areas and Conservation significant ecological communities

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under section 51B of the State *Environmental Protection Act 1986* (EP Act). ESAs include areas declared as World Heritage, included on the Register of the National Estate, defined wetlands, and vegetation containing rare (Threatened) flora and Threatened Ecological Communities (TECs).

A TEC is defined under the EP Act as an ecological community listed, designated or declared under a written law or a law of the Australian Government as Threatened, Endangered or Vulnerable. There are four State categories of TECs (DEC 2010) and some Western Australian TECs listed under the EP Act are also listed as Threatened under the EPBC Act. Under the EPBC Act, a person must not undertake an action that has or will have a significant impact on a listed TEC without approval from the Australian Government Minister for the Environment, unless those actions are not prohibited under the EPBC Act.

Priority Ecological Communities (PECs) are biological flora or fauna communities that are recognised by the WA Minister for Environment to be of significance, but which do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under State or Commonwealth legislation.

The DBCA Threatened and Priority Flora communities search identified twenty known occurrences of one conservation significant ecological community which occurs, or has buffers which occur, across the majority of the survey area, namely Banksia dominated woodlands of the Swan Coastal Plain IBRA region (Figure 4, DBCA 2019b). This is a Priority 3 listed PEC, however, is a listed TEC under the EPBC Act, namely, Banksia Woodlands of the Swan Coastal Plain.

The PMST search identified Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community and Banksia Woodlands of the Swan Coastal Plain as likely to occur within the survey area.

4.1.3 Conservation significant wetlands

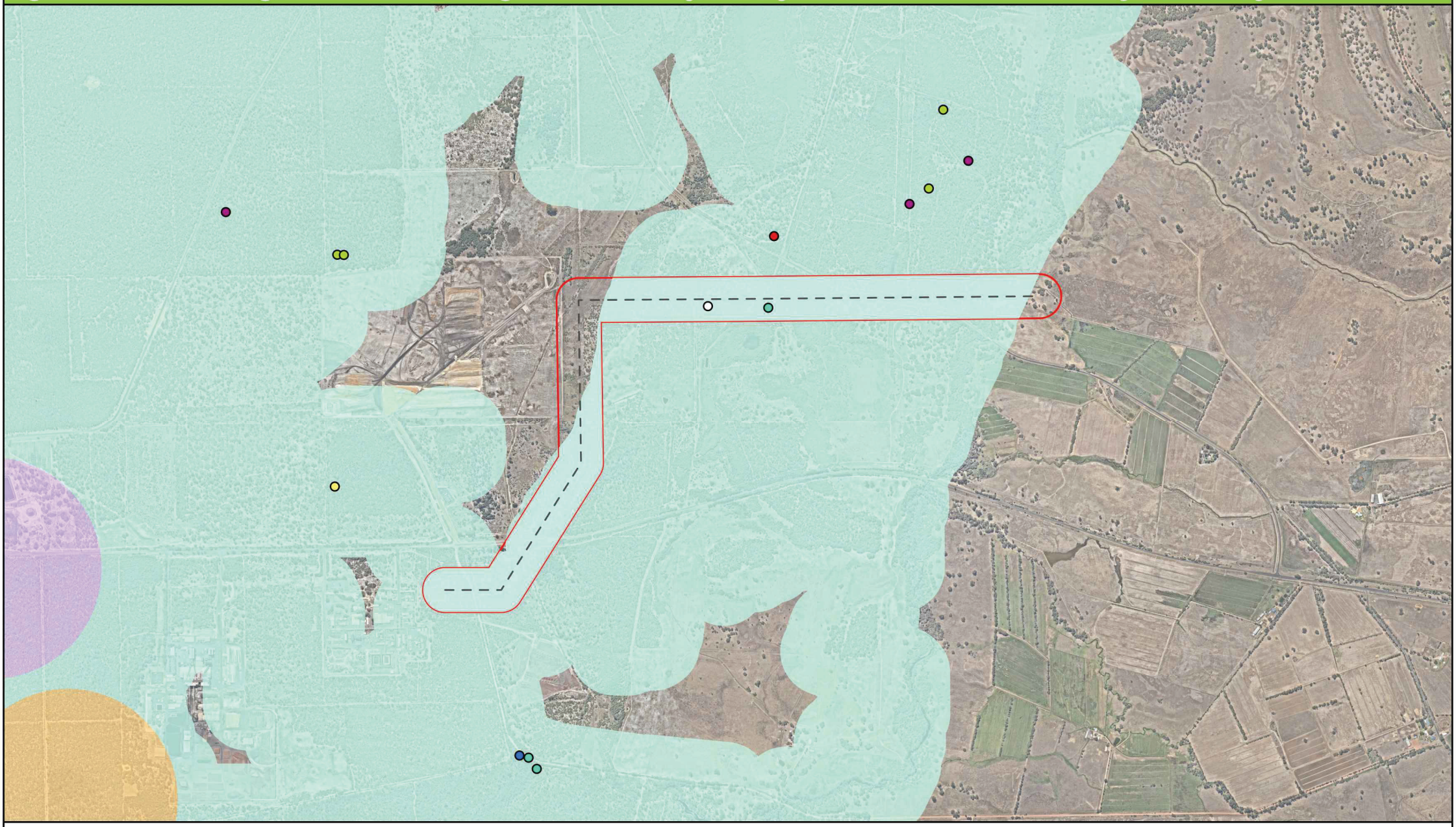
The PMST search identified that the RAMSAR wetland Peel-Yalgorup system occurs within 10 km of the survey area.

Analysis of spatial data of geomorphic wetlands of the Swan Coastal Plain identified ten wetlands that intersect the survey area (Figure 5, Table 7, Government of Western Australia 2020b).

Table 7: Geomorphic Wetlands intersecting the survey area.

UFI	Wetland Name	Landform	Category	Land Use
14483	Kemerton Wetlands	Basin	Sumpland	Resource Enhancement
1502	Unknown	Basin	Sumpland	Multiple Use
1675	Unknown	Basin	Dampland	Resource Enhancement
1699	Unknown	Basin	Dampland	Multiple Use
1530	Unknown	Basin	Dampland	Resource Enhancement
14481	Kemerton Wetlands	Basin	Sumpland	Resource Enhancement
15225	Unknown	Flat	Palusplain	Multiple Use
1837	Unknown	Basin	Sumpland	Resource Enhancement
14482	Kemerton Wetlands	Basin	Sumpland	Resource Enhancement
14551	Kemerton Wetlands	Basin	Sumpland	Conservation

Figure 4: Conservation significant flora and ecological communities previously recorded within and in the vicinity of the survey area



Legend

- Survey Line
- Survey Area

Previous Flora Search Reults - TPFL and WA Herbarium

- *Diuris micrantha* Threatened
- *Drakaea elastica* Threatened
- *Drakaea micrantha* Threatened
- *Pterostylis frenchii* Priority 2
- *Acacia semitrullata* Priority 4
- *Caladenia speciosa* Priority 4
- *Pultenaea skinneri* Priority 4

ELA TEC and PEC Database Search Results

- Banksia WL SCP
- SCP21c
- SCP25

0 250 500 750
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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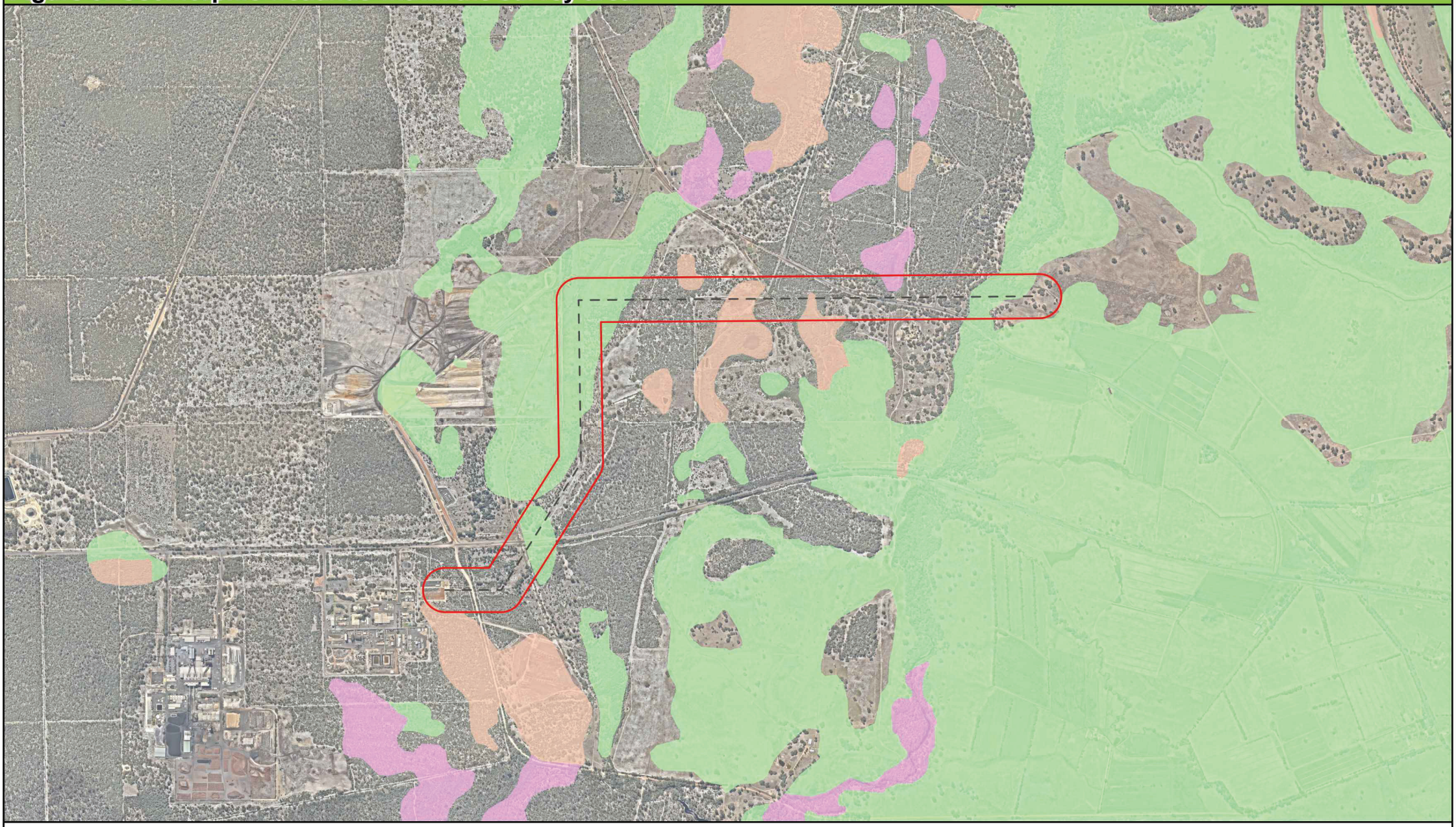
Figure 5: Geomorphic wetlands within the survey area



Legend

- Survey Line
- Survey Area

Geomorphic Wetlands - Use Category

- Conservation
- Resource Enhancement
- Multiple Use

0 250 500 750

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4.2 Flora and vegetation survey

4.2.1 Flora overview

A total of 130 taxa (94 native and 36 introduced taxa) from 96 genera and 37 families were recorded across 13 quadrats established within the survey area and from opportunistic collections. One opportunistic collection, **Gomphocarpus fruticosus*, was recorded approximately 7 m outside the survey boundary but was included in the results of this survey as this species is a declared pest and GPS units can have errors of 3-20 m (subject to availability of satellites on the day) with an average of 5 m. A flora species list is provided in Appendix D. Average species richness per quadrat was 17.7 species, ranging from a low of 7 species at ELA04 to a high of 37 species at ELA03. Families with the highest number of species included Fabaceae (13 species), Asteraceae (10 species), Poaceae (10 species) and Myrtaceae (8 species). *Acacia, Juncus* and *Banksia* were the best represented genera throughout the survey area with 4 taxa recorded from each. Quadrat site data is presented in Appendix E.

4.2.2 Accumulated species – site surveyed (species-area curve)

A species accumulation curve (Figure 6) was used to evaluate the adequacy of sampling (Clarke and Gorley 2006). Only species data recorded from defined quadrats were used; no opportunistic flora collections were included. The asymptotic value was determined using Michaelis Menten modelling. Using this analysis, the incidence-based coverage estimator of species richness was calculated to be 224.34. Based on this value, and the total of 130 species recorded within quadrats, approximately 58.0% of the flora species potentially present within the survey area were recorded. This figure is typical of linear corridors where the survey area intersects a small portion of numerous discrete vegetation communities and additional site replication is not feasible given the small size of remnant pockets of vegetation.

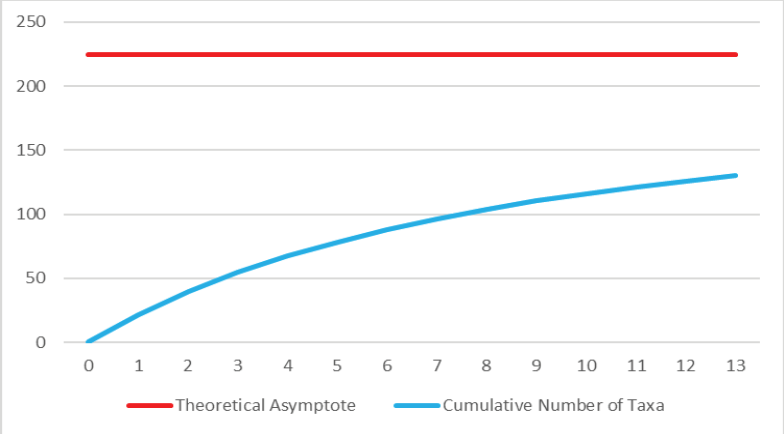


Figure 6: Average randomised species accumulation curve

Note: Only species recorded from quadrats were used to calculate the species accumulation curve and theoretical maximum number of species (asymptotic value).

4.2.3 Conservation significant flora

No Threatened flora species listed under the EPBC Act or the BC Act were recorded within the survey area during the winter 2019 or spring 2019 surveys.

One individual plant of the conservation significant flora species, *Pultenaea skinneri* (listed as P4 by DBCA); was recorded within the survey area (Figure 7). This species was recorded toward the south of the survey area (approximately 0.5km north of Marriot Rd) within a plantation and was in flower at the time of the field survey.

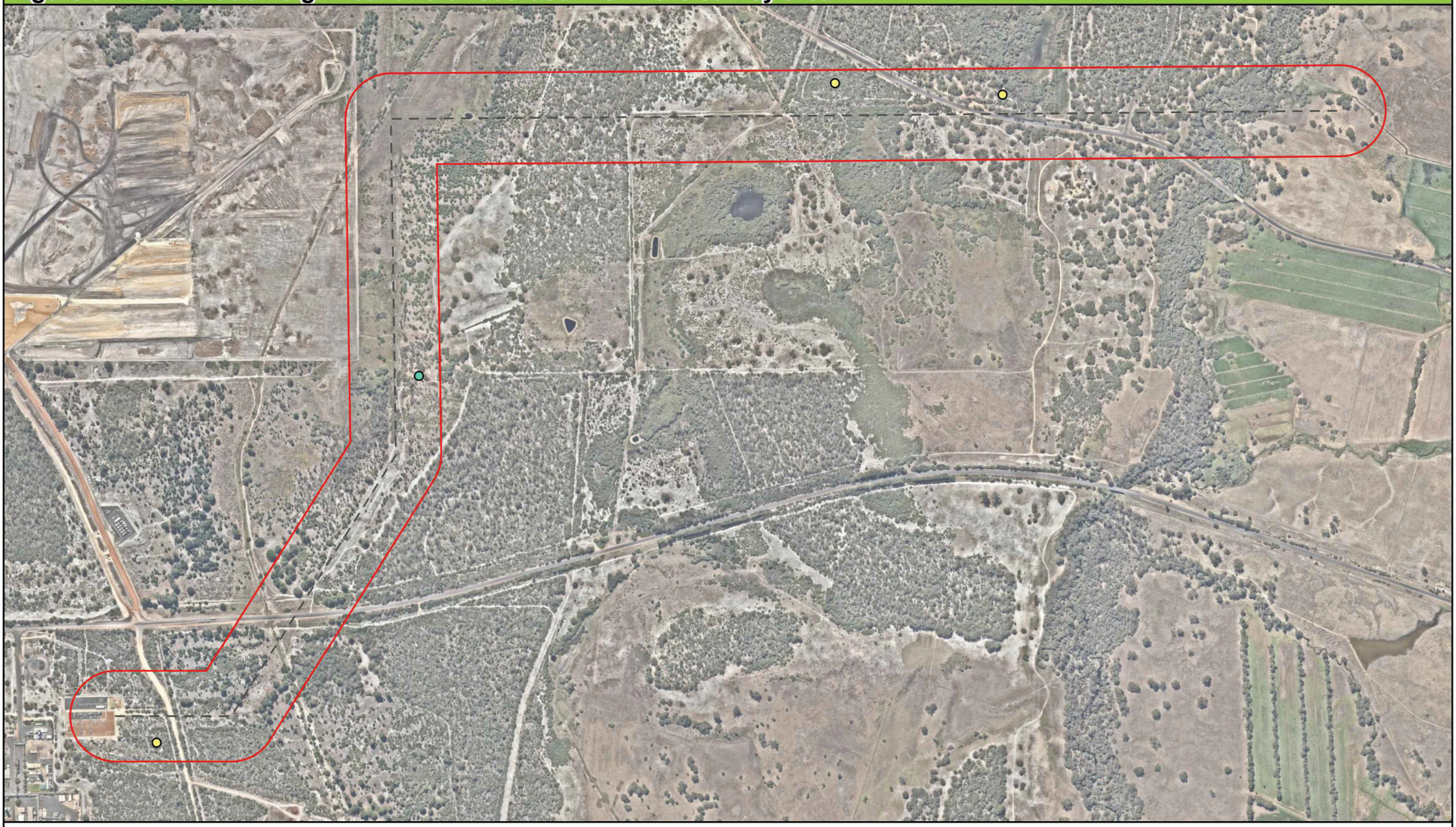
Eight plants of the conservation significant flora species, *Acacia semitrullata* (listed as P4 by DBCA); was recorded within the survey area (Figure 8). One plant of this species was recorded in quadrat ELA08 and six plants were recorded in quadrat ELA12. Both quadrats were within Vegetation Community BaEmW: Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall Kunzea glabrescens sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland. One plant was recorded opportunistically.

Locations of these conservation significant species are depicted in Figure 9.

Figure 7: *Acacia semitrullata* (P4) recorded within the survey area

Figure 8: *Pultenaea skinneri* (P4) recorded within the survey area

Figure 9: Conservation significant flora recorded within the survey area



Legend

- Survey Line
- Survey Area

Species observed by ELA

- *Acacia semitrullata* Priority 4
- *Pultenaea skinneri* Priority 4

0 100 200 300
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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4.2.4 Introduced flora

A total of 36 introduced (weed) species were recorded within the survey area, representing 27.7% of the total species recorded. One opportunistic collection, **Gomphocarpus fruticosus*, was recorded approximately 7 m outside the survey boundary but was included in the survey results as detailed in section 4.2.1.

Two recorded species, **Gomphocarpus fruticosus* and **Zantedeschia aethiopica* are listed as a Declared Plant under the BAM Act. Declared pests "must satisfy any applicable import requirements when imported and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia" (DAFWA 2020). **Gomphocarpus fruticosus* is categorised as s22(2) (C3). This species "should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism" (DPIRD 2019). **Zantedeschia aethiopica* (Arum Lily) is categorised as s22(2) (exempt).

4.2.5 Vegetation communities

A total of six vegetation communities were delineated and mapped within the survey area. Descriptions of the six communities are presented in Table 8. Mapping of vegetation communities is presented in Figure 10. Native vegetation accounted for 36.39 ha (46.42%) of the survey area, 23.11 ha (29.47%) was defined as plantations with the remaining 18.90 ha (24.10%) mapped as tracks or cleared areas.

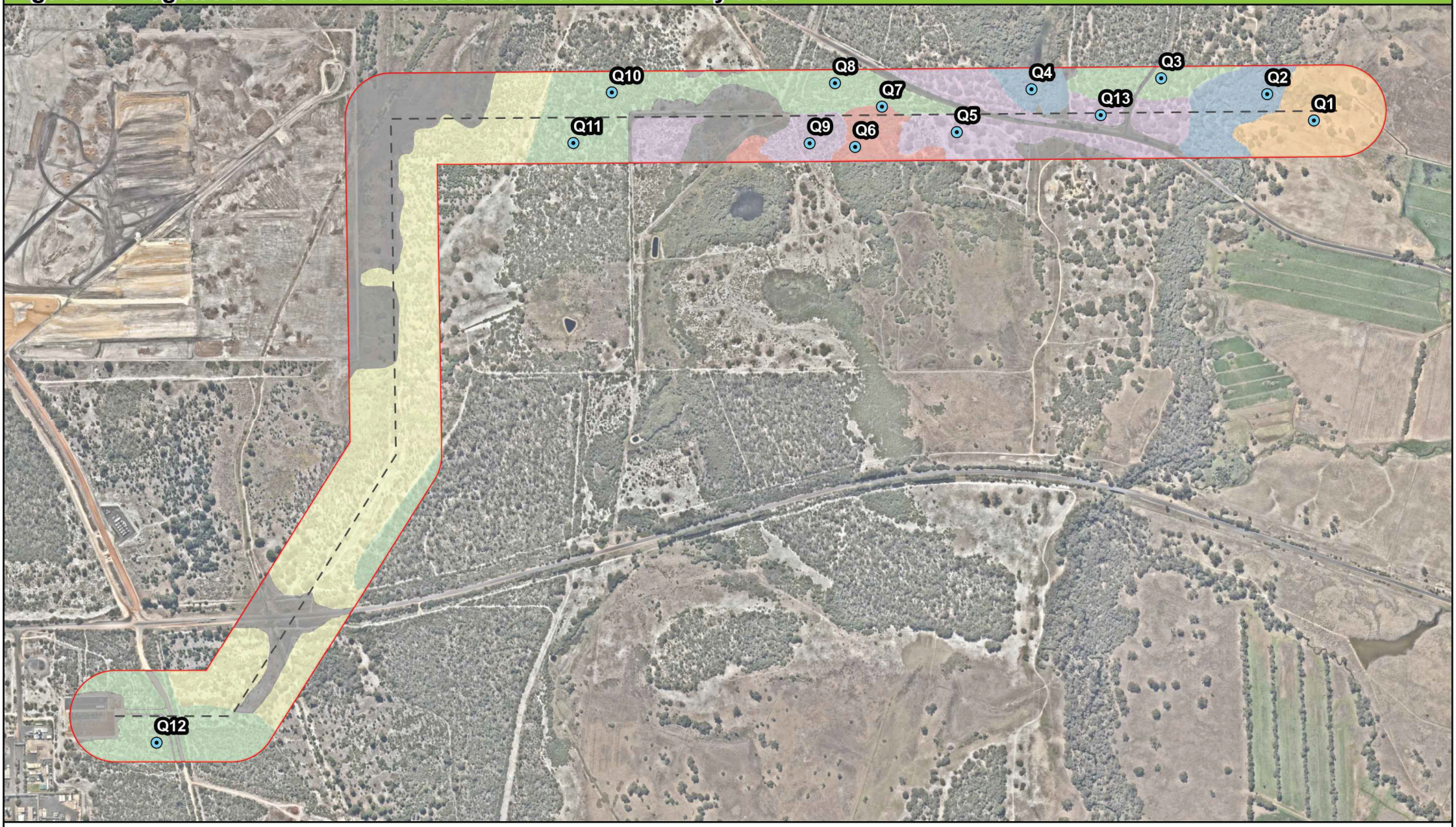
Table 8: Vegetation communities recorded within the survey area

Image	Vegetation community	Vegetation description	Quadrats	Extent within the survey area (ha)	Proportion of the survey area (%)
	CcOW	Mid *Corymbia calophylla* open woodland over a low **Hordeum leporinum* and **Lolium rigidum* grassland.	ELA01	4.84	6.17
	ErMrW	Mid *Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low *Alternanthera nodiflora* and *Cassytha racemosa* forma *racemosa* sparse forbland.	ELA02, ELA04	4.45	5.68

Image	Vegetation community	Vegetation description	Quadrats	Extent within the survey area (ha)	Proportion of the survey area (%)
	MpW	Mid *Melaleuca preissiana* woodland over a tall *Kunzea glabrescens* and *Astartea scoparia* sparse shrubland over a tall *Juncus pauciflorus* and *Lepidosperma longitudinale* open sedgeland.	ELA06, ELA07	2.09	2.67
	BaEmW	Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall *Kunzea glabrescens* sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland.	ELA03, ELA08, ELA10, ELA11, ELA12	15.30	19.52
	EmAfW	Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall *Kunzea glabrescens* and *Hardenbergia comptoniana* sparse shrubland over a mid **Ehrharta calycina* sparse grassland	ELA05, ELA09, ELA13	9.71	12.38

Image	Vegetation community	Vegetation description	Quadrats	Extent within the survey area (ha)	Proportion of the survey area (%)
	Plantation	Plantation of *Pinus* spp. and *Eucalyptus* spp.	NA	23.11	29.47
			Tracks and cleared areas	18.90	24.10
			Total	**78.40**	**100**

Figure 10: Vegetation communities recorded within the survey area



Legend

- Survey Line
- Survey Area
- Quadrat Locations

Vegetation Communities

- CcOW
- ErMrW
- BaEmW
- EmAfW
- MpW
- Plantation
- Cleared

0 100 200 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4.2.6 Conservation significant ecological communities

To identify potential TECs and PECs in the survey area, ELA quadrats and vegetation communities were compared to FCTs defined by Gibson *et al*. (1994). Results of this analysis are shown below in Table 9.

Results of the multivariate analysis showed that quadrats within Vegetation Community BaEmW had a close affiliation with FCT 21a. This community, covering a total area of 15.30 ha (19.83% of the survey area), was considered to predominantly represent floristic aspects of FCT 21a and to a lesser extent 21c and more so 20b. FCT 21a, 21b, 21c and 20b are all recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as Threatened under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA.

Quadrat ELA11 showed no clear affiliation to FCT's defined by Gibson but was most closely grouped with ELA quadrats that were affiliated with the of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community (Appendix F); *Banksia attenuata* was a dominant species in this community. Similarly, species composition within ELA01 and ELA13 comprised a high proportion of weed species to the exclusion of natives and as a result no clear affiliations with FCT's defined by Gibson were present.

No other vegetation communities within the survey area were considered to represent TECs or PECs.

A graphical representation of relationships between ELA vegetation communities and Floristic Community Types (FCTs) defined by Gibson *et al.* (1994) is shown in Appendix G.

Table 9: Relationships between ELA vegetation communities and FCTs defined by Gibson *et al.* (1994)

FCT	Vegetation community	Benger quadrat number	Closest affiliated sites (Gibson *et al*. 1994)
NA	CcOW	ELA01	N/A
13 17	ErMrW	ELA02	MILT-2 (13), POSSUM5 (17), COOL01 (17)
		ELA04	MCLART-1 (13), PAGA-2 (13), MILT-2 (13)
21a 21c	BaEmW	ELA03	CAPEL-7 (21a), CARB-3 (21b), KELLY02 (21b)
		ELA08	FL-4 (21a), MODO-2 (21c), PLINE-7 (21c)
		ELA10	CAPEL-7 (21a), NINE-1 (21a), MODO-2 (21c)
		ELA11	N/A
		ELA12	CARD8 (20b), CARD9 (20b), PLINE6 (22)
22 6	EmAfW	ELA05	PLINE-6 (22)
		ELA09	PEARCE-1(6)
		ELA13	N/A
11	MpW	ELA06	MODO-3 (11), HYMUS01 (11), TWIN-11 (11)
		ELA07	MODO-3 (11), HYMUS01 (11), TWIN-11 (11)

4.2.6.1 Banksia Woodlands of the Swan Coastal Plain TEC diagnostic

Vegetation communities were assessed against key diagnostic characteristics outlined in the Banksia Woodlands of the Swan Coastal Plain TEC approved conservation advice (TSSC 2016) in order to determine the presence of this TEC within the survey area. To be considered as part of the Banksia Woodlands TEC a patch needs to meet at least the 'Good' condition category (TSSC 2016), therefore

areas of Degraded or Completely Degraded condition within the survey area were not included in this assessment. Several of these diagnostic characteristics were met by Vegetation Community BaEmW:

- **Location/landform** – the ecological community in question within the survey area is located on the Swan Coastal Plain and occurs on the Bassendean Dune System.
- **Structure and composition** – vegetation within the survey area is dominated or co-dominated by *Banksia attenuata*, with emergent trees of *Eucalyptus marginata, Corymbia calophylla* and sometimes *Allocasuarina* species present. A number of indicator species are also present. The understory contains high species diversity.
- **Condition thresholds** - the community was assessed and sampled in the highest condition representation available in the survey area and was completed in the most appropriate season for the Swan Coastal Plain.
- **Minimum patch size** – vegetation meets the minimum patch size requirements for vegetation in Good or greater condition. Areas in Degraded condition are not considered part of the EPBC Act ecological community.

A total of 14.3 ha of vegetation within the survey area was assessed as likely to represent the Banksia Woodlands of the Swan Coastal Plain TEC, comprising of 4.69 ha of Excellent condition, 4.32 ha of Very Good condition and 5.25 ha of Good condition (Figure 11). Approximately 1 ha of vegetation community BaEmW was considered to be in Degraded condition, therefore did not fulfil the key diagnostic characteristics for this TEC. The full four-stage assessment against the key diagnostic characteristics for this TEC are presented in Appendix H.

4.2.7 Vegetation condition

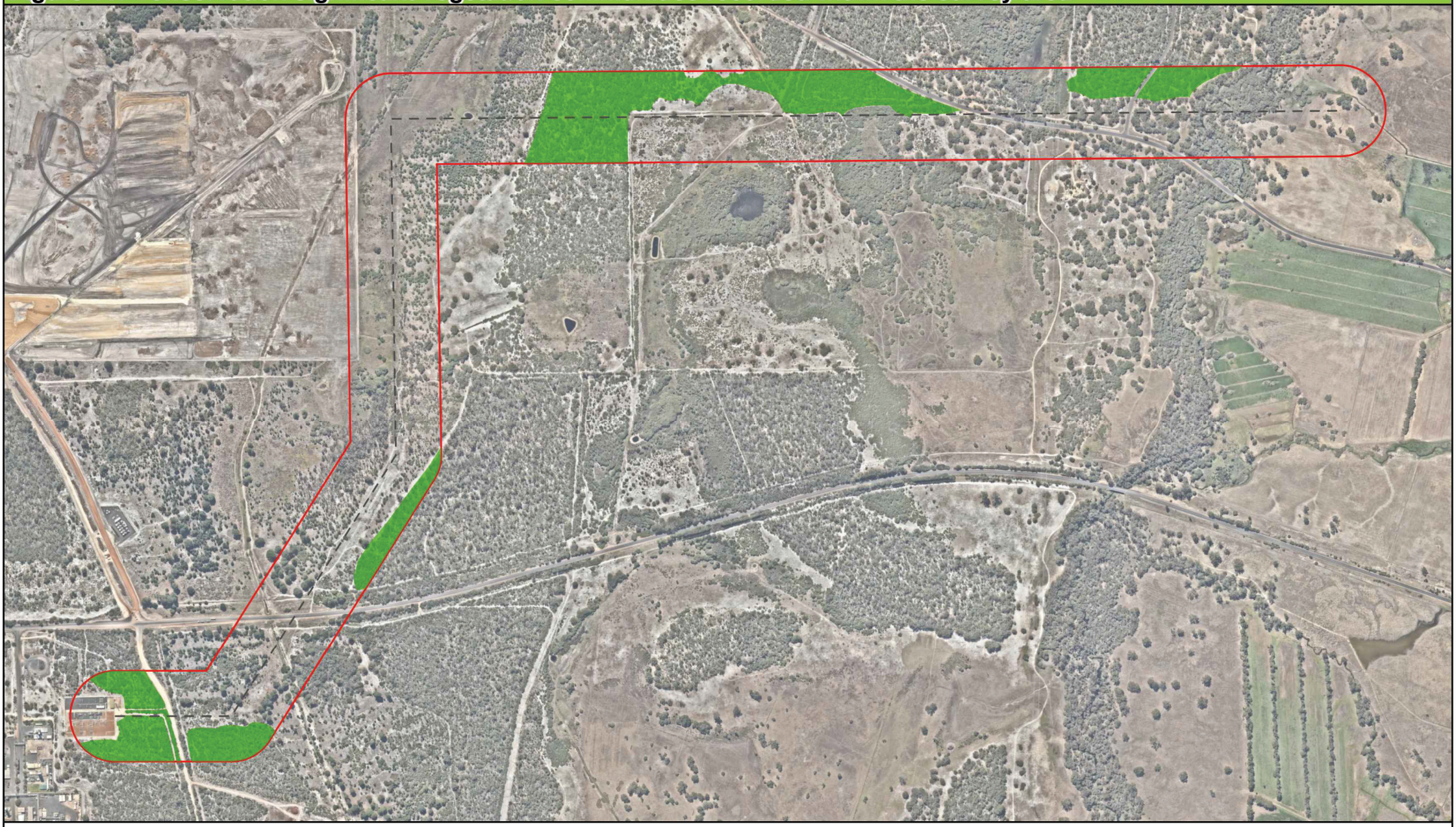
Vegetation condition within the survey area ranged from Completely Degraded to Excellent condition, based on the Keighery (1994) vegetation scale provided in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). Majority of the survey area consisted of plantations of *Pinus* spp. and *Eucalyptus* spp. Areas of excellent condition accounted for 4.69 ha (6.07%), and 8.14 ha (10.55%) was found to be in Very Good condition. Areas of Good condition accounted for 13.97 ha of the survey area (18.10%), areas of Degraded condition 9.48 ha (12.28%) and areas of Completely Degraded (including tracks and other cleared areas) accounted for 19.01 ha (24.64%) of the survey area. Areas classified as 'Plantation' comprised the remaining 29.47% of the survey area.

Disturbances within the survey area included the presence of cleared paddocks, weeds, tracks, rubbish dumping, feral fauna (rabbit diggings, droppings) and the presence of tracks. Some vegetation health decline was recorded (dead or dying species) which may be attributed to drought or potential disease (dieback). Vegetation condition within the survey area is presented in Table 10 and in Figure 12Table 10.

Table 10: Vegetation condition within the survey area

Vegetation condition	Total area (ha)	Proportion of the survey area (%)
Pristine	0	0
Excellent	4.69	5.98
Very Good	8.14	10.39
Good	15.19	19.37
Degraded	9.48	12.09
Completely Degraded	19.01	24.25
Plantation	21.89	27.92
Total	**78.40**	**100**

Figure 11: Conservation significant vegetation communities recorded within the survey area



Legend

- Survey Line
- Survey Area

Conservation significant communities

- Banksia Woodlands of the Swan Coastal Plain ecological community

0 100 200 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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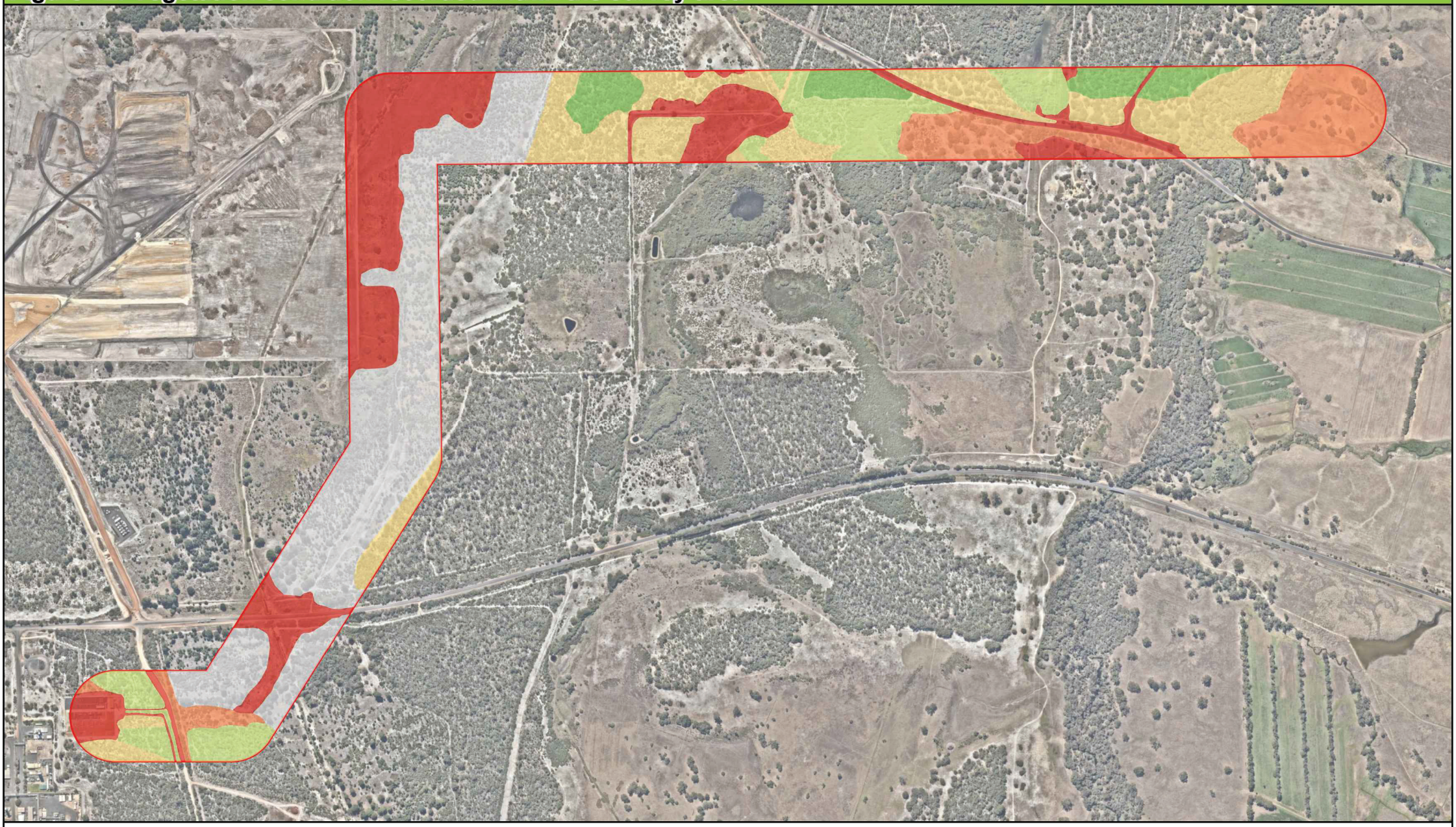
Figure 12: Vegetation condition recorded within the survey area



Legend

Survey Area

Vegetation Condition

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Plantation

0 100 200 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4.2.8 Fauna

A total of 31 native fauna species were recorded during the field survey, comprising twenty-five birds, four mammals and two reptiles (Table 11Table 11). One of these species, the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) is listed as Vulnerable under the EPBC Act and as Schedule 3 '*fauna that is rare or is likely to become extinct as vulnerable fauna*' under the BC Act.

The Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) was the only recorded occurrence of the 21 conservation significant fauna species identified in the desktop survey as possibly occurring within the survey area. Of the remaining 20 species, Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), Carter's freshwater mussel (*Westralunio carteri*), Brush-tailed Phascogale (*Phascogale tapoatafa* subsp*. wambenger) and* Quenda *(Isoodon obesulus fusciventer)* are considered as likely to occur, based on presence of suitable habitat and proximity of previous records (DBCA 2007-2019). Of the remaining 15 species, four are considered as having the potential to occur, seven are considered as having the potential to be vagrant and four are considered as being unlikely to within the survey area. This assessment is based on habitat requirements of these species, adequacy of search effort undertaken within the survey area and proximity of previous records (DBCA 2007-2019). The fauna likelihood of occurrence assessment is presented in Appendix I.

Three introduced (pest) fauna species were recorded within the survey area, *Felis catus* (cat), *Oryctolagus cuniculus* (rabbit) and *Vulpes vulpes* (fox).

Table 11: Fauna species recorded within the survey area

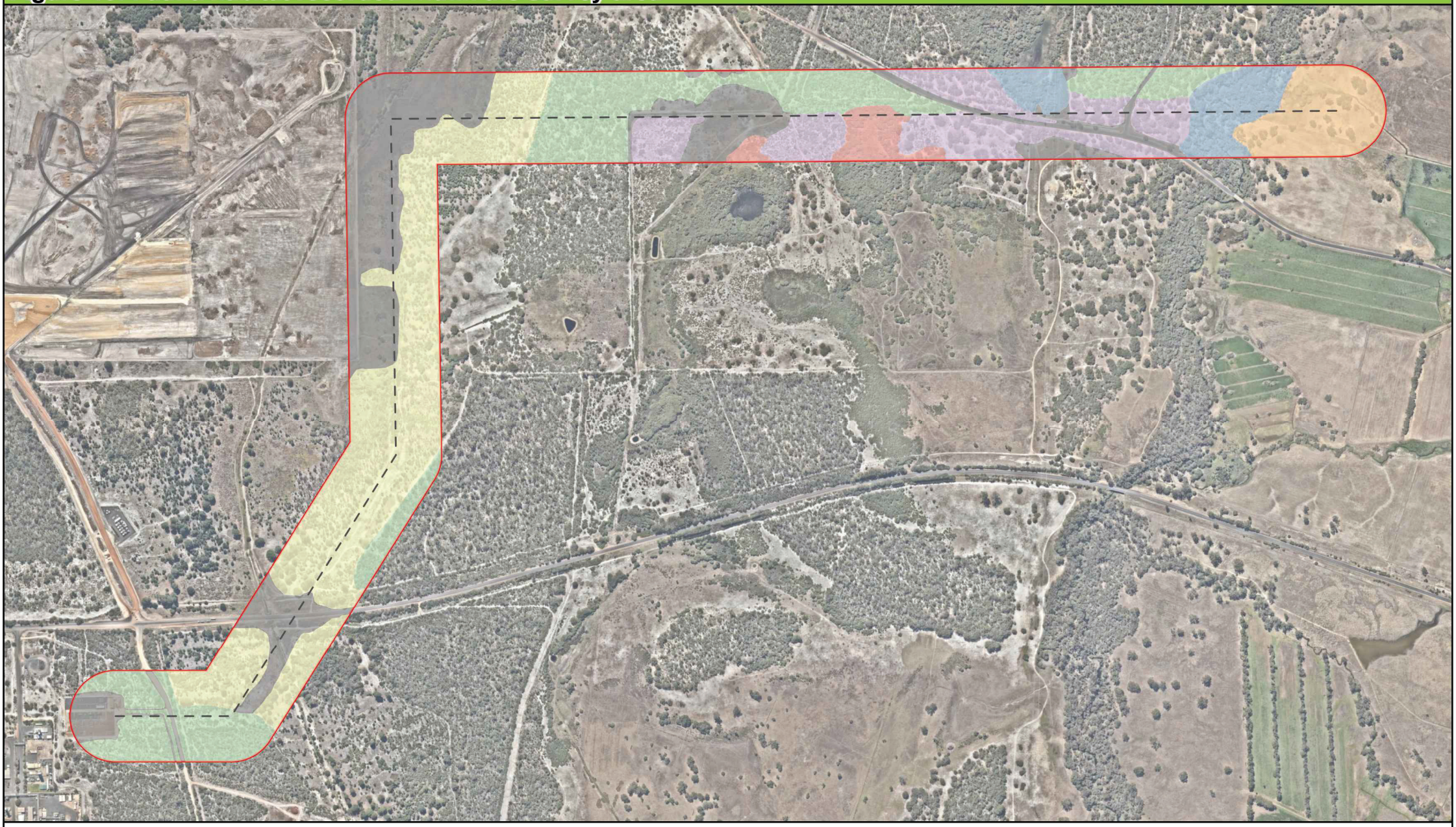
Type	Species	Common name	Evidence type
Bird	*Anas superciliosa*	Pacific Black Duck	Directly observed
	Anthochaera carunculate	Red Wattlebird	Directly observed
	Anthus novaeseelandiae	Australian Pipit	Directly observed
	Banardius zonarius	Australian Ringneck	Directly observed
	Cacatua pastinator butleri	Western Long-billed Corella	Feeding residue
	Corvus coronoides	Pied Butcherbird	Directly observed
	Calyptorhynchus banksii subsp. *naso*	Forest Red-tailed Black Cockatoo	Directly observed, feeding residue
	Chenonetta jubata	Australian Wood Duck	Directly observed
	Cracticus nigrogularis	Pied Butcherbird	Directly observed
	Cracticus tibicen	Australian Magpie	Directly observed
	Corvus coronoides	Australian Raven	Directly observed
	Dacelo novaeguineae	Laughing Kookaburra	Directly observed
	Hirundo neoxena	Welcome Swallow	Directly observed
	Lichenostomus virescens	Singing Honeyeater	Directly observed
	Lichmera indistincta	Brown Honeyeater	Directly observed
	Malurus pulcherrimus	Blue-breasted Fairywren	Directly observed
	Pelicanus conspicillatus	Australian Pelican	Directly observed

Type	Species	Common name	Evidence type
	Phaps chalcopetra	Common Bronzewing	Directly observed
	Purpureicephalus spurius	Red-capped parrot	Feeding residue
	Rhipidura albiscapa	Grey Fantail	Directly observed
	Rhipidura leucophyrs	Willy Wagtail	Directly observed
	Smicrornis brevirostris	Weebill	Directly observed
	Strepera versicolor	Grey Currawong	Directly observed
	Tadorna tadornoides	Australian Shelduck	Directly observed
	Threskiornis moluccus	Australian White Ibis	Directly observed
Mammal	*Felis catus*	Cat	Tracks and scats
	Macropus fuliginosus	Western Grey Kangaroo	Directly observed
	Oryctolagus cuniculus	Rabbit	Directly observed
	Vulpes vulpes	Fox	Tracks and scats
Reptiles	*Pseudonaja affinis*	Dugite	Directly observed
	Tiliqua rugosa	Bobtail	Directly observed

Six fauna habitats were recorded within the survey area (Figure 13):

- **Fauna habitat 1**: Mid *Corymbia calophylla* open woodland over a low **Hordeum leporinum* and **Lolium rigidum* grassland. (4.84 ha [6.17%] of the survey area); and
- **Fauna habitat 2**: Mid *Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low *Alternanthera nodiflora* and *Cassytha racemosa* forma *racemosa* sparse forbland. (4.45 ha [5.68%] of the survey area).
- **Fauna habitat 3**: Mid *Melaleuca preissiana* woodland over a tall *Kunzea glabrescens* and *Astartea scoparia* sparse shrubland over a tall *Juncus pauciflorus* and *Lepidosperma longitudinale* open sedgeland (2.09 ha [2.67%] of the survey area).
- **Fauna habitat 4**: Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall *Kunzea glabrescens* sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland (16.41 ha [20.93%] of the survey area).
- **Fauna habitat 5**: Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall *Kunzea glabrescens* and *Hardenbergia comptoniana* sparse shrubland over a mid **Ehrharta calycina* sparse grassland (9.71 ha [12.38%] of the survey area).
- **Fauna habitat 6**: Plantation of *Pinus* spp. and *Eucalyptus* spp. (21.89 ha [27.91%] of the survey area).

Figure 13: Fauna habitat recorded within the survey area



Legend

- Survey Line
- Survey Area

Fauna Habitat Types

- 1: Mid *Corymbia calophylla* open woodland over a low **Hordeum leporinum* and **Lolium rigidum* grassland
- 2: Mid *Eucalyptus rudis* and *Melaleuca raphiophylla* closed forest over a low *Alternanthera nodiflora* and *Cassytha racemosa* forma *racemosa* sparse forbland
- 3: Mid *Melaleuca preissiana* woodland over a tall *Kunzea glabrescens* and *Astartea scoparia* sparse shrubland over a tall *Juncus pauciflorus* and *Lepidosperma longitudinale* open sedgeland
- 4: Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall *Kunzea glabrescens* sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland
- 5: Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall *Kunzea glabrescens* and *Hardenbergia comptoniana* sparse shrubland over a mid **Ehrharta calycina* sparse grassland
- 6: Plantation of *Pinus* spp. and *Eucalyptus* spp.
- Cleared

0 100 200 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: GM Date: 28/02/2020

4.2.9 Black cockatoo habitat assessment

Three Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) individuals were observed roosting in Marri trees within the survey area (Figure 14).

Foraging habitat for black cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). Food availability for black cockatoo is a function of the diversity, abundance, distribution, energetic and nutritional qualities, and seasonality (phenology) of the food sources within a particular area.

Black cockatoo foraging habitat has been determined using vegetation associations defined in the vegetation assessment and from ground-truthing in the field. The quality of foraging habitat for black cockatoo species within the survey site (as defined in Table 12Table 12 below) has been assessed based on the availability and density of plant food sources as observed on site.

Table 12: Definition of black cockatoo foraging habitat quality

Foraging quality	Justification
Excellent	High density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
Good	High density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (e.g. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (e.g. canopy and midstorey).
Poor	Low density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (e.g. canopy).
Very Poor	Very low density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species <10%) and presence of food sources at only one stratum (e.g. canopy).
Nil	Cleared areas or no suitable vegetation present.

Foraging habitat for all three black cockatoo species within the survey area ranged from 'good' quality to 'Nil' (Figure 16). Jarrah and Marri woodlands and forests within the survey area provide foraging habitat for both the Baudin's and Forest Red-tailed Black Cockatoo, while native shrubland (particularly *Banksia* spp.) provides foraging for the Carnaby's Black Cockatoo (SEWPaC 2012). Pine plantations within the survey area provide foraging habitat for Baudin's and Carnaby's Black Cockatoo.

Marri nuts chewed by Forest Red-tailed Black Cockatoos were observed during the field survey (Figure 15). Feeding residue of pinecones were observed which indicate that Carnaby's Black Cockatoo potentially utilise the pine plantations within the survey area as foraging habitat. Carnaby's Black Cockatoo have previously been recorded 300 m from the survey area.

The black cockatoo breeding habitat assessment identified 145 potentially significant trees within the survey area (Figure 16). These trees comprised 59 Marri (*Corymbia calophylla*), 59 Jarrah (*Eucalyptus marginata*) and 27 Flooded Gums (*Eucalyptus rudis*) trees. Of the 145-potentially suitable breeding trees recorded, nine had hollows over 100 mm (trunk and/or spout hollows) visible from the ground. Detection of hollows via ground-based observations can be difficult and is therefore a limitation to

breeding habitat assessments. In assessing a tree's potential age and likelihood of hollows, the tree DBH measurement is more reliable and precise.

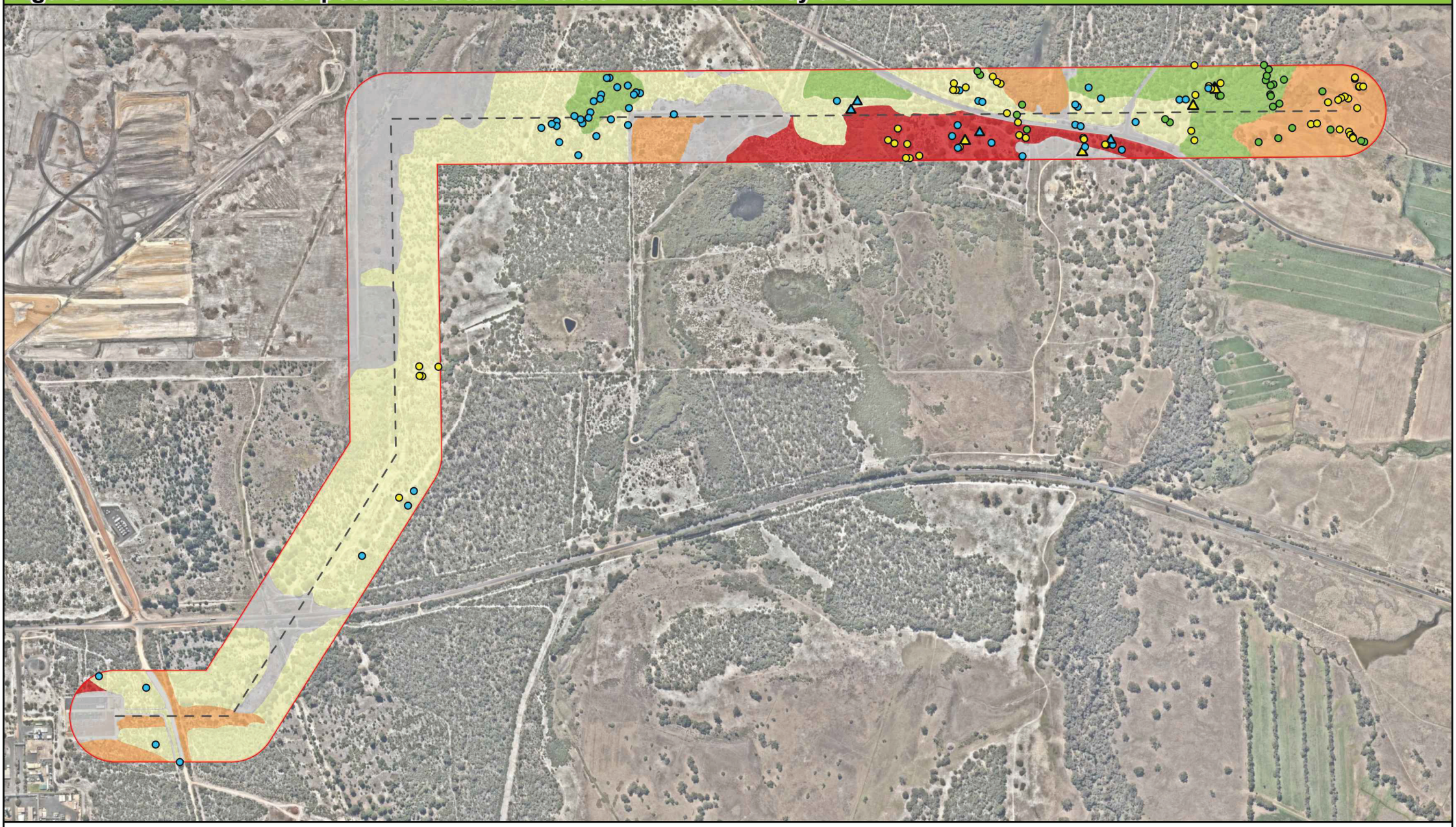
All breeding trees recorded from the survey area also provide potential suitable roosting habitat for black cockatoos as defined by the referral guidelines (SEWPaC 2012). Jarrah and Marri trees are primary roosting species for Forest Red-tailed and Baudin's Black Cockatoo, while Marri is considered a primary roosting species for Carnaby's Black Cockatoo (SEWPaC 2012).

Although not directly observed during the field survey, both the Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are considered as likely to occur within the survey area as it provides suitable breeding, roosting and foraging habitat for these species and occurs within the species' ranges.

Figure 14: Forest Red-tailed Black Cockatoo utilising a Marri tree for roosting.

Figure 15: Chewed Marri nuts (left) and pinecones (right) observed within the survey area

Figure 16: Black Cockatoo potential suitable habitat within the survey area



Legend

- Survey Line
- Survey Area

Foraging Quality

- Good
- Moderate
- Poor
- Very Poor
- Nil

Significant Trees

- *Corymbia calophylla*, Hollows Present
- *Corymbia calophylla*, No Hollows
- *Eucalyptus marginata*, Hollows Present
- *Eucalyptus marginata*, No Hollows
- *Eucalyptus rudis*, No Hollows

0 100 200 300
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

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Prepared by: GM Date: 28/02/2020

5. Discussion

5.1 Flora

A total of 130 taxa (94 native and 36 introduced taxa) from 96 genera and 37 families were recorded across 13 quadrats established within the survey area and from opportunistic collections. Average species richness per quadrat was 17.7 species, ranging from a low of 7 species at ELA04 to a high of 37 species at ELA03. Families with the highest number of species included Fabaceae (13 species), Asteraceae (10 species), Poaceae (10 species) and Myrtaceae (8 species). *Acacia* and *Juncus* and *Banksia* were the best represented genera throughout the survey area with 4 taxa recorded each.

A total of 36 introduced (weed) species were recorded within the survey area, representing 27.7% of the total species recorded. A high frequency and abundance of introduced species is expected in areas that traverse highly fragmented vegetation and are inclusive of pasture and plantations. Two recorded weeds species, **Gomphocarpus fruticosus* and **Zantedeschia aethiopica* are listed as Declared Plants under the BAM Act.

One individual of **Gomphocarpus fruticosus* was opportunistically recorded approximately 7 m outside the survey boundary. **Gomphocarpus fruticosus* is categorised as s22(2) (C3) indicating that this species "should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism" (DPIRD 2019); DBCA considers this species to have a rapid invasiveness rating (DBCA 2020).

**Zantedeschia aethiopica* (Arum Lily) was predominantly recorded in low lying areas, this species is categorised as s22(2) (exempt). DBCA considers this species to have a moderate invasiveness rating and a high ecological impact (DBCA 2020). DBCA prioritises early detection and rapid response to new infestations and introductions of all weed species, populations that are still small enough for eradication to be achieved and high impact, rapidly-moderately invasive species that are impacting high conservation value conservation assets (DBCA 2020).

No Threatened flora species listed under the EPBC Act or the BC Act were recorded within the survey area during the winter 2019 and spring 2019 surveys. Two Priority 4 flora species were recorded within the survey area, namely *Pultenaea skinneri* and *Acacia semitrullata.*

One individual plant of the conservation significant flora species, *Pultenaea skinneri* (listed as P4 by DBCA); was recorded within the survey area. This individual was recorded toward the south of the survey area (approximately 0.5km north of Marriot Rd) within a plantation and was in flower at the time of the field survey.

Eight plants of the conservation significant flora species, *Acacia semitrullata* (listed as P4 by DBCA); were recorded within the survey area. One individual was recorded in quadrat ELA08 and six plants were recorded in quadrat ELA12. Both locations were mapped within vegetation community BaEmW: Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall Kunzea glabrescens sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland.

5.2 Vegetation

Majority of the survey area comprised plantations 23.11 ha (29.47%) and cleared areas 18.90 ha (24.10%), with native vegetation accounting for 36.39 ha (46.42%). Six vegetation communities were delineated and mapped within the survey area:

- **Vegetation community CcOW**: Mid *Corymbia calophylla* open woodland over a low **Hordeum leporinum* and **Lolium rigidum* grassland*;*
- **Vegetation community ErMrW**: Mid *Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low *Alternanthera nodiflora* and *Cassytha racemosa* forma *racemosa* sparse forbland;
- **Vegetation community MpW**: Mid *Melaleuca preissiana* woodland over a tall *Kunzea glabrescens* and *Astartea scoparia* sparse shrubland over a tall *Juncus pauciflorus* and *Lepidosperma longitudinale* open sedgeland;
- **Vegetation community BaEmW**: Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall *Kunzea glabrescens* sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland;
- **Vegetation community EmAfW**: Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall *Kunzea glabrescens* and *Hardenbergia comptoniana* sparse shrubland over a mid **Ehrharta calycina* sparse grassland; and
- **Vegetation community Plantation**: Plantation of *Pinus* spp. and *Eucalyptus* spp.

One conservation significant vegetation community was inferred to occur with the survey area, namely 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as Threatened under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA. Multivariate analysis showed that quadrats within the BaEmW vegetation community had a strong (predominant) affiliation with FCT21a – Central *Banksia attenuata – Eucalyptus marginata* woodlands, and to a lesser extent FCT 21c – Low lying *Banksia attenuata* woodlands or shrublands (Listed as Priority 3 by DBCA). The BaEmW vegetation community was mapped across a total area of 15.30 ha (19.83% of the survey area).

The BaEmW vegetation community was assessed against key diagnostic characteristics outlined in the Banksia Woodlands of the Swan Coastal Plain TEC approved conservation advice (TSSC 2016), in order to determine the presence of this TEC within the survey area. To be considered as part of the Banksia Woodlands TEC a patch needs to meet at least the 'Good' condition category (TSSC 2016), therefore areas of Degraded or Completely Degraded condition within the survey area were not included in this assessment. A total of 14.30 ha of vegetation within the survey area was assessed as likely to represent the Banksia Woodlands of the Swan Coastal Plain TEC, comprising of 4.69 ha of Excellent condition, 4.32 ha of Very Good condition and 5.25 ha of Good condition. Approximately 1 ha of vegetation community BaEmW was observed to be in Degraded condition, and therefore did not fulfil the key diagnostic characteristics for this TEC.

Vegetation condition within the survey area ranged from Completely Degraded to Excellent condition, based on the Keighery (1994) vegetation scale provided in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). Majority of the survey area consisted of plantations of *Pinus* spp. and *Eucalyptus* spp. Areas of excellent condition accounted for 4.69 ha (6.07%), and 8.14 ha (10.55%) was found to be in Very Good condition. Areas of Good condition accounted for 13.97 ha of the survey area (18.10%), areas of Degraded condition 9.48 ha (12.28%) and

areas of Completely Degraded (including tracks and other cleared areas) accounted for 19.01 ha (24.64%) of the survey area.

Disturbances within the survey area included the presence of cleared paddocks, weeds, tracks, rubbish dumping, feral fauna (rabbit diggings, droppings) and the presence of tracks. Some vegetation health decline was recorded (dead or dying species) which may be attributed to drought or potential disease (dieback).

5.3 Fauna

A total of 31 native fauna species were recorded during the field survey, comprising twenty-five birds, four mammals and two reptiles. One of these species, the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) is listed as Vulnerable under the EPBC Act and as Schedule 3 '*fauna that is rare or is likely to become extinct as vulnerable fauna*' under the BC Act.

The Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) was the only recorded occurrence of the 21 conservation significant fauna species identified in the desktop survey as possibly occurring within the survey area. Of the remaining 20 species, Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), Carter's freshwater mussel (*Westralunio carteri*), Brush-tailed Phascogale (*Phascogale tapoatafa* subsp*. wambenger) and* Quenda *(Isoodon obesulus fusciventer)* are considered as likely to occur, based on presence of suitable habitat and proximity of previous records (DBCA 2007-2019). Of the remaining 15 species, four are considered as having the potential to occur, seven are considered as having the potential to be vagrant and four are considered as being unlikely to within the survey area. This assessment is based on habitat requirements of these species, adequacy of search effort undertaken within the survey area and proximity of previous records.

Three introduced (pest) fauna species were recorded within the survey area, *Felis catus* (cat), *Oryctolagus cuniculus* (rabbit) and *Vulpes vulpes* (fox).

Six fauna habitats were recorded within the survey area:

- **Fauna habitat 1**: Mid *Corymbia calophylla* open woodland over a low **Hordeum leporinum* and **Lolium rigidum* grassland. (4.84 ha [6.17%] of the survey area); and
- **Fauna habitat 2**: Mid *Eucalyptus rudis* and *Melaleuca rhaphiophylla* closed forest over a low *Alternanthera nodiflora* and *Cassytha racemosa* forma *racemosa* sparse forbland. (4.45 ha [5.68%] of the survey area).
- **Fauna habitat 3**: Mid *Melaleuca preissiana* woodland over a tall *Kunzea glabrescens* and *Astartea scoparia* sparse shrubland over a tall *Juncus pauciflorus* and *Lepidosperma longitudinale* open sedgeland (2.09 ha [2.67%] of the survey area).
- **Fauna habitat 4**: Mid *Banksia attenuata* and *Eucalyptus marginata* woodland over a tall *Kunzea glabrescens* sparse shrubland over a low *Xanthorrhoea gracilis* and *Gompholobium tomentosum* sparse shrubland (16.41 ha [20.93%] of the survey area).
- **Fauna habitat 5**: Mid *Eucalyptus marginata* and *Agonis flexuosa* woodland over a tall *Kunzea glabrescens* and *Hardenbergia comptoniana* sparse shrubland over a mid **Ehrharta calycina* sparse grassland (9.71 ha [12.38%] of the survey area).

- **Fauna habitat 6**: Plantation of *Pinus* spp. and *Eucalyptus* spp. (21.89 ha [27.91%] of the survey area).

5.4 Black Cockatoo

Foraging habitat for all three black cockatoo species within the survey area range from 'good' quality to 'Nil'. Jarrah and Marri woodlands and forests within the survey area provide foraging habitat for both the Baudin's and Forest Red-tailed Black Cockatoo, while native shrubland (particularly *Banksia* spp.) provides foraging for the Carnaby's Black Cockatoo (SEWPaC 2012). Pine plantations within the survey area provide foraging habitat for Baudin's and Carnaby's Black Cockatoo.

Three Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) individuals were observed roosting in Marri trees within the survey area, and marri nuts chewed by Forest Red-tailed Black Cockatoos were observed during the field survey. Feeding residue of pinecones were observed which indicate that Carnaby's Black Cockatoo potentially utilise the pine plantations within the survey area as foraging habitat. Carnaby's Black Cockatoo have previously been recorded 0.3 km from the survey area.

The black cockatoo breeding habitat assessment identified 145 potentially significant trees within the survey area. These trees comprised 59 Marri (*Corymbia calophylla*), 59 Jarrah (*Eucalyptus marginata*) and 27 Flooded Gums (*Eucalyptus rudis*) trees. Of the 145 potentially suitable breeding trees recorded, nine had hollows over 100 mm (trunk and/or spout hollows) visible from the ground. Detection of hollows via ground-based observations can be difficult and is therefore a limitation to breeding habitat assessments. In assessing a tree's potential age and likelihood of hollows, the tree DBH measurement is more reliable and precise.

Although not directly observed during the field survey, both the Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are considered as likely to occur within the survey area as it provides suitable breeding, roosting and foraging habitat for these species and occurs within the species' ranges.

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Appendix A Framework for conservation significant flora and fauna ranking

CATEGORIES OF THREATENED SPECIES UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Species listed as 'conservation dependent' and 'extinct' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa has not been recorded in its known and/or expected habitat at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (M)	Not an IUCN category. Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • the agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA); • the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or • the agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).

CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

The Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Specially protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

Threatened species (T)
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

Category	Code	Description
Critically Endangered species	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. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
Endangered species	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. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
Vulnerable species	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. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild, as follows:

Category	Code	Description
Extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
Extinct in the wild species	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). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting 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 species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

Categories are detailed below.

Category	Code	Description
Migratory species	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. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
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, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Other specially protected species	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). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Priority species (P)

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 fauna or flora.

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.

Category	Code	Definition
Priority 1	P1	*Poorly-known species* 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	P2	*Poorly-known species* 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	P3	*Poorly-known species* 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	P4	*Rare, Near Threatened and other species in need of monitoring* (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within survey area from DBCA database search results and/or from previous surveys of the survey area, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
Likely	The species has not previously been recorded from within the survey area. However, (to qualify requires one or more criteria to be met): • the species has been recorded in close proximity to the survey area, and occurs in similar habitat to that which occurs within the survey area • core habitat and suitable landforms for the species occurs within the survey area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present • there is a medium to high probability that a species uses the survey area.
Potential	The species has not previously been recorded from within the survey area. However, (one or more criteria requires to be met): • targeted surveys may locate the species based on records occurring in proximity to the survey area and suitable habitat occurring in the survey area • the survey area has been assessed as having potentially suitable habitat through habitat modelling • the species is known to be cryptic and may not have been detected despite extensive surveys • the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys The species has been recorded in the survey area by a previous consultant survey or there is historic evidence of species occurrence within the survey area. However, (one or more criteria requires to be met): • doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution) • coordinates are doubtful.
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the survey area and • it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded • it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the survey area through DBCA database searches. The species has not been recorded in the survey area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.

Likelihood rating	Criteria
Does not occur (one or more criteria requires to be met).	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the survey area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat. The survey area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within survey area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix C Flora likelihood of occurrence assessment

Species	Conservation status		Habitat*	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
Caladenia procera	CR	S1	Occurs in *Eucalyptus marginata*, *Corymbia calophylla* and *Agonis flexuosa* woodland on alluvial sandy-clay loam flats amongst dense heath and sedges or low dense shrubs. *Acacia stenoptera*, *Anigozanthos manglesii* and *Pimelea sylvestris* are associated species.	PMST	Unlikely	This species is known from five subpopulations. No records of *Caladenia procera* occur within the survey area. This species has been extensively surveyed by WA DEC in conjunction with the Western Australia Native Orchid Study and Conservation Group. It is unlikely that further surveys will discover new populations (WA CALM 2006).
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	S1	This species is known from five subpopulations south of Perth from Serpentine to Dardanup. It occurs on grey, clayey sand with lateritic pebbles in low woodland areas near winter-wetflats. Associated species include *Kennedia prostrata*, *Xanthorrhoea preissii*, *Conostylis* sp. and *Synaphea stenoloba*. Two subpopulations occur in seasonally wet *Pericalymma ellipticum* dominated shrubland, with *Leptospermum* sp., *Lechenaultia biloba*, *Mesomelaena tetragona*, *Adenanthos meisneri*, *Hypocalymma angustifolium* and *Allocasuarina humilis*.	PMST	Unlikely	No suitable habitat
Synaphea sp. Serpentine (G.R. Brand 103)	CR	S1	Known from six populations, four locations, occurring in a narrow band from the northernmost point west of Byford (38 km SSE of Perth) to south of Serpentine (54 km SSE of Perth), over a range of 18 km. Synaphea sp. Serpentine occurs	PMST	Unlikely	Nearest record approximately 100km north of the survey area

Species	Conservation status		Habitat*	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
			predominantly on flat terrain on grey-brown sandy loams to clay in seasonally wet areas. Heath of *Pericalymma ellipticum*, *Xanthorrhoea preissii*, *Kunzea micrantha, Adenanthos meisneri*. Open Woodland to Very Open Woodland of *Corymbia calophylla* over Very Open Shrubland of *Xanthorrhoea preissii, Kingia australis, Adenanthos meisneri* over Very Open Herbland of *Tricoryne elatior* and Sedgeland of *Mesomelaena tetragona, Tetraria octandra Synaphea sp. Serpentine is a part of, but does not rely on, three TECs. 1) SCP3a - Corymbia calophylla – Kingia australis woodlands on heavy soils, Swan Coastal Plain (WA: CR; Cth: EN); 2) SCP20b - Banksia attenuata and/or Eucalyptus marginata woodlands of the eastern side of the Swan Coastal Plain (EN) and 3) SCP10a - Shrublands on dry clay flats (EN) that is also listed under the Commonwealth's EPBC Act 1999 as Critically Endangered.*			
Andersonia gracilis	EN	S3	*Andersonia gracilis* is currently known from the Badgingarra, Dandaragan and Kenwick areas where it is found on seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus*, *Verticordia densiflora* and *Kunzea recurva* over sedges.	PMST	Unlikely	Nearest record approximately 100km north of the survey area
Austrostipa bronwenae	EN	S2	Swan Coastal Plain, south-Western Australia. Austrostipa bronwenae is currently known from two sub-populations at Kenwick (~16 km SE of Perth) one population at Kemerton (131 km S of Perth) and one population at Bunbury (191 km S of Perth) (see map below from Western Australian Herbarium (1998–). *Austrostipa bronwenae* grows within the Swan Coastal Plain in flat low-lying calcareous winter wet grey-brown sandy loam or	PMST	Unlikely	No suitable habitat

Species	Conservation status		Habitat*	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
			dark brown loam over clay. Two of the sites are examples of Muchea Limestone. At Kemerton, plants grow under *Eucalyptus decipiens* over *Gahnia trifida.*			
Caladenia huegelii	EN	S1	This species occurs in scattered localities within 20 km of the coast, from the Upper Swan and Gnangara areas north of Perth, through suburban Perth and southwards to Gracetown and the Scott River in the Margaret River area of Western Australia. It grows in well-drained, deep sandy soils in low mixed woodlands of *Banksia attenuata, B. menziesii, Banksia ilicifolia, Allocasuarina fraseriana* and *Eucalyptus marginata*. It tends to favour areas of lush undergrowth. The preferred soil conditions are variable and range from wet to moist to dry.	PMST	Unlikely	Nearest record > 10km from the survey area
Drakaea elastica	CR	S1	*Drakaea elastica* is currently known only from the Swan Coastal Plain over a range of approximately 350 km between Cataby in the north and Busselton in the south. The species grows on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in banksia (*Banksia menziesii, B. attenuata* and *B. ilicifolia*) woodland or *Kunzea glabrescens* thicket vegetation. *D. elastica* often occurs with other orchid species such as *Drakaea glyptodon*, *D. livida* and *Paracaleana nigrita*. The increased rates of survival in sites with relatively little direct sun exposure indicate a requirement for shady canopy cover to be present.	PMST, TPFL	Potential	Suitable habitat Nearest record approximately 0.4km north of the survey area
Diuris purdiei	EN	S2	*Diuris purdiei* occurs in Western Australia, from Perth south to near the Whicher Range, within the Swan (Western Australia) Natural Resource Management Region. It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with	PMST	Unlikely	Nearest record > 10km from the survey area

Species	Conservation status		Habitat*	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
			scattered emergent *Melaleuca preissiana*, *Eucalyptus calophylla*, *E. marginata* and *Nuytsia floribunda*.			
Synaphea stenoloba	EN	S1	*Synaphea stenoloba* is known from 11 subpopulations south of Perth, from Pinjarra to Boyanup (a range of approximately 40 km north to south). It occurs on loamy soils in low lying areas that are occasionally inundated. Associated vegetation is generally swampy heath to 1 m high with scattered	PMST	Unlikely	Nearest record > 10km from the survey area
Diuris drummondii	VU	S3	There are 12 populations known between Perth and Walpole. *Diuris drummondii* is found in low-lying depressions in peaty and sandy clay swamps. Plants are frequently observed standing in several centimetres of water even during the summer flowering period.	PMST	Unlikely	Nearest record > 10km from the survey area
Diuris micrantha	VU	S3	Dwarf Bee-orchid is known from seven populations, from east of Kwinana and south towards the Frankland area, Western Australia. It is found in small populations, on dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps. The bases of the flowering plants are often covered with shallow water.	PMST, TPFL	Potential	Nearest record approximately 0.2km north of the survey area
Drakaea micrantha	VU	S2	*Drakaea micrantha* is known from 32 small, scattered populations from Perth to Albany. The populations are often very difficult to locate from year-to-year, as they do not necessarily flower annually. This species is usually found on cleared firebreaks or open sandy patches that have been disturbed, where competition from other plants has been removed. This suggests that the plants may need a disturbance event at some point, and that plants regenerate from soil stored seed after such an event	PMST, TPFL	Potential	Suitable habitat Nearest record approximately 0.4km north of the survey area

Species	Conservation status		Habitat*	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
			It occurs in infertile grey sands, in *Eucalyptus marginata* and *Allocasuarina fraseriana* woodland or forest associated with *Banksia* species. It is often found under thickets of *Kunzea ericifolia* with the *Paracaleana nigrita* and other *Drakaea* species.			
Eleocharis keigheryi	VU	S3	Keighery's Eleocharis grows in small clumps in a substrate of clay or sandy loam. This species is emergent in freshwater creeks and claypans. Associated species include *Melaleuca glateritia* and herbs such as *Wurmbea*, *Tribonanthes* and *Leptocarpus* spp..	PMST	Unlikely	No suitable habitat Nearest record > 10km from the survey area
Pterostylis frenchii		P2	Sand, calcareous sand with limestone, laterite. Flatlands and gentle slopes. *Kunzea* with *Nuytsia*, *Kunzea* in marri forest, Banksia and peppermint woodland.	WA Herb	Potential	Suitable habitat Nearest record approximately 0.65km south of the survey area
Stylidium acuminatum subsp. acuminatum		P2	Brown lateritic soils, brown loam, brown gravelly clay/loam, grey/yellow sand. Roadside and hillsides. Jarrah-Marri forest,	Naturemap	Potential	Suitable habitat
Acacia oncinophylla subsp. oncinophylla		P3	Granitic soils, loam with exposed granite.	Naturemap	Unlikely	No suitable habitat
Carex tereticaulis		P3	Black peaty sand, dark grey sandy clay. Minor drainage lines, riparian zones, creek banks.	WA Herb	Potential	Suitable habitat Nearest record approximately 3.65km south of the survey area
Dillwynia dillwynioides		P3	Sandy soils. Winter-wet depressions.	WA Herb, TPFL	Potential	Suitable habitat Nearest record approximately 2.1km west of the survey area

Species	Conservation status		Habitat*	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
Lasiopetalum membranaceum		P3	Grey sand, sand over limestone.	WA Herb, TPFL	Potential	Suitable habitat Nearest record approximately 3.4km west of the survey area
Verticordia attenuata		P3	White or grey sand. Winter-wet depressions.	WA Herb	Potential	Suitable habitat Nearest record approximately 3.5km north-west of the survey area
Acacia semitrullata		P4	White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	WA Herb	Detected on site	Suitable habitat Nearest record approximately 0.6km north-west of the survey area
Caladenia speciosa		P4	White, grey or black sand.	TPFL	Recorded	Previously recorded within the survey area.
Pultenaea skinneri		P4	Sandy or clayey soils. Winter-wet depressions.	WA Herb, TPFL	Recorded Detected on site	Previously recorded within the survey area.
Senecio leucoglossus		P4	Gravelly lateritic or granitic soils. Granite outcrops, slopes.	Naturemap	Unlikely	No suitable habitat

*Habitat information was sourced from EPBC recovery plans and Florabase.

[1]EPBC Act = Flora listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

CR = listed as Critically Endangered under the EPBC Act

EN = listed as Endangered under the EPBC Act

VU = listed as Vulnerable under the EPBC Act

[2]BC Act = Flora listed under the State *Biodiversity Conservation Act 2016*.

S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora

S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora

[3]DBCA = Flora listed as Priority species under the Department of Biodiversity, Conservation and Attractions

P1 = Priority 1: Species that are known from one or a few locations (generally five or less) which are potentially at risk. Listed by DBCA

P3 = Priority 3: Poorly known species that are known from several locations and the species does not appear to be under imminent threat. Listed by DBCA.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring. Listed by DBCA.

[4]NatureMap = NatureMap database search (DBCA 2007-2019)

PMST = EPBC Act Protected Matters Search Tool report (DotEE 2018b).

Appendix D Flora species list

Family	Species	ELA001	ELA002	ELA003	ELA004	ELA005	ELA006	ELA007	ELA008	ELA009	ELA010	ELA011	ELA012	ELA013	Opp
Alismataceae	***Plantago lanceolata**		X												
Alismataceae	***Plantago major**		X				X								
Amaranthaceae	***Alternanthera nodiflora**		X		X		X								
Apiaceae	***Centella asiatica**						X								
Apiaceae	***Platysace compressa**			X					X		X	X	X		
Apocynaceae	***Gomphocarpus fruticosus**		X												
Araceae	***Zantedeschia aethiopica**		X					X							
Araliaceae	***Trachymene pilosa**			X					X		X		X		
Asparagaceae	***Lomandra hermaphrodita**			X									X		
Asparagaceae	***Lomandra sonderi**								X			X			
Asparagaceae	***Thysanotus manglesianus**								X		X				
Asparagaceae	***Thysanotus multiflorus**								X						
Asteraceae	***Arctotheca calendula**	X													
Asteraceae	***Asteraceae sp.**						X								
Asteraceae	***Cirsium vulgare**				X										
Asteraceae	***Conyza bonariensis**						X	X							
Asteraceae	***Conyza sp.**				X										
Asteraceae	***Hypochaeris glabra**	X		X		X		X	X	X	X	X		X	
Asteraceae	***Lagenophora huegelii**			X							X				
Asteraceae	***Pseudognaphalium luteoalbum**				X		X								
Asteraceae	***Senecio glomeratus**		X					X							
Asteraceae	***Sonchus oleraceus**		X			X	X							X	
Asteraceae	***Ursinia anthemoides**			X						X		X		X	
Colchicaceae	***Burchardia congesta**			X					X		X				
Crassulaceae	***Crassula colorata**									X			X		
Cyperaceae	***Bolboschoenus caldwellii**		X												
Cyperaceae	***Isolepis marginata**			X									X		
Cyperaceae	***Lepidosperma longitudinale**						X	X							

Family	Species	ELA001	ELA002	ELA003	ELA004	ELA005	ELA006	ELA007	ELA008	ELA009	ELA010	ELA011	ELA012	ELA013	Opp
Cyperaceae	***Lepidosperma squamatum***			X											
Dasypogonaceae	***Dasypogon bromeliifolius***			X					X		X	X	X		
Dilleniaceae	***Hibbertia hypericoides***			X											
Dilleniaceae	***Hibbertia subvaginata***			X							X		X		
Dilleniaceae	***Hibbertia vaginata***												X		
Droseraceae	***Drosera menziesii***			X									X		
Droseraceae	***Drosera porrecta***			X							X		X		
Ericaceae	***Conostephium pendulum***			X									X		
Ericaceae	***Leucopogon propinquus***										X	X			
Fabaceae	****Acacia longifolia***												X		
Fabaceae	***Acacia huegelii***												X		
Fabaceae	***Acacia pulchella***			X									X		
Fabaceae	***Acacia semitrullata*** **(P4)**								X				X		
Fabaceae	***Aotus gracillima***							X							
Fabaceae	***Bossiaea eriocarpa***								X		X		X		
Fabaceae	***Daviesia physodes***												X		
Fabaceae	***Gastrolobium ebracteolatum***							X							
Fabaceae	***Gompholobium knightianum***			X											
Fabaceae	***Gompholobium tomentosum***			X					X		X			X	
Fabaceae	***Hardenbergia comptoniana***			X		X								X	
Fabaceae	***Hovea trisperma***			X					X		X		X		
Fabaceae	***Jacksonia furcellata***										X	X			
Fabaceae	***Jacksonia horrida***									X			X		
Fabaceae	***Kennedia prostrata***			X											
Fabaceae	****Lotus uliginosus***	X					X								
Fabaceae	****Ornithopus compressus***													X	
Fabaceae	***Pultenaea skinneri*** **(P4)**														X
Geraniaceae	****Pelargonium capitatum***							X							

Family	Species	ELA001	ELA002	ELA003	ELA004	ELA005	ELA006	ELA007	ELA008	ELA009	ELA010	ELA011	ELA012	ELA013	Opp
Goodeniaceae	***Dampiera alata***			X				X							
Haemodoraceae	***Anigozanthos sp.***										X				
Haemodoraceae	***Conostylis aculeata***			X											
Haemodoraceae	***Conostylis juncea***								X		X				
Haemodoraceae	***Phlebocarya ciliata***			X					X				X		
Hemerocallidaceae	***Tricoryne elatior***								X						
Iridaceae	***Patersonia occidentalis***										X				
Iridaceae	****Romulea rosea***	X		X		X									
Iridaceae	****Watsonia sp.***		X												
Juncaceae	****Juncus usitatus***		X												
Juncaceae	***Juncus kraussii subsp. australiensis***						X								
Juncaceae	***Juncus pallidus***				X										
Juncaceae	***Juncus pauciflorus***						X	X							
Lamiaceae	****Mentha pulegium***						X	X							
Lauraceae	***Cassytha racemosa forma racemosa***		X		X		X								
Myrtaceae	***Agonis flexuosa***			X		X		X						X	
Myrtaceae	***Astartea scoparia***				X		X	X							
Myrtaceae	***Calytrix flavescens***												X		
Myrtaceae	***Corymbia calophylla***	X		X		X									
Myrtaceae	***Eucalyptus marginata***			X		X			X	X	X	X	X	X	
Myrtaceae	***Eucalyptus rudis***		X		X										
Myrtaceae	***Hypocalymma angustifolium***								X	X					
Myrtaceae	***Kunzea glabrescens***			X			X	X	X	X	X	X	X	X	
Myrtaceae	***Melaleuca preissiana***						X	X							
Myrtaceae	***Melaleuca rhaphiophylla***		X		X		X								
Myrtaceae	***Melaleuca thymoides***								X				X		
Orchidaceae	***Caladenia flava***							X							
Orchidaceae	****Disa bracteata***					X				X				X	

Family	Species	ELA001	ELA002	ELA003	ELA004	ELA005	ELA006	ELA007	ELA008	ELA009	ELA010	ELA011	ELA012	ELA013	Opp
Orchidaceae	***Microtis media***						X		X						
Orchidaceae	***Pterostylis sp.***													X	
Orchidaceae	***Pyrorchis nigricans***			X					X						
Orchidaceae	***Thelymitra benthamiana***			X		X						X			
Orchidaceae	***Thelymitra macrophylla***										X				
Oxalidaceae	****Oxalis pes-caprae***	X	X			X									
Oxalidaceae	***Oxalis exilis***													X	
Pittosporaceae	***Billardiera laxiflora***			X					X		X				
Poaceae	****Avena barbata***	X													
Poaceae	****Briza maxima***			X				X	X		X	X			
Poaceae	****Briza minor***	X										X			
Poaceae	****Bromus diandrus***	X				X					X				
Poaceae	****Bromus hordeaceus***	X													
Poaceae	****Cynodon dactylon***		X				X								
Poaceae	****Ehrharta calycina***			X		X			X	X	X	X		X	
Poaceae	****Ehrharta longiflora***					X									
Poaceae	****Festuca arundinacea***		X												
Poaceae	****Holcus lanatus***						X	X							
Poaceae	****Hordeum leporinum***	X													
Poaceae	****Lolium perenne x rigidum***							X				X			
Poaceae	****Lolium rigidum***	X	X			X									
Poaceae	****Vulpia myuros***									X			X		
Polygonaceae	****Rumex sp.***		X												
Proteaceae	***Adenanthos meisneri***			X											
Proteaceae	***Banksia attenuata***			X					X		X	X			
Proteaceae	***Banksia grandis***			X											
Proteaceae	***Banksia ilicifolia***								X		X	X	X		
Proteaceae	***Persoonia longiflora***										X				

Family	Species	ELA001	ELA002	ELA003	ELA004	ELA005	ELA006	ELA007	ELA008	ELA009	ELA010	ELA011	ELA012	ELA013	Opp
Proteaceae	***Petrophile linearis***			X							X				
Proteaceae	***Xylomelum occidentale***			X											
Restionaceae	***Desmocladus fasciculatus***			X											
Restionaceae	***Desmocladus flexuosus***										X				
Restionaceae	***Hypolaena exsulca***			X					X		X		X		
Restionaceae	***Leptocarpus decipiens***						X								
Restionaceae	***Lyginia barbata***			X					X				X		
Restionaceae	***Lyginia imberbis***										X				
Solanaceae	****Solanum nigrum***				X		X								
Stylidiaceae	***Stylidium brunonianum***			X					X		X		X		
Stylidiaceae	***Stylidium piliferum***			X											
Stylidiaceae	***Stylidium schoenoides***			X					X		X				
Typhaceae	***Typha orientalis***				X										
Xanthorrhoeaceae	***Chamaescilla corymbosa***			X							X				
Xanthorrhoeaceae	***Xanthorrhoea brunonis***									X					
Xanthorrhoeaceae	***Xanthorrhoea gracilis***			X					X		X	X	X		
Xanthorrhoeaceae	***Xanthorrhoea preissiana***												X		
Zamiaceae	***Macrozamia riedlei***										X	X	X		

* Exotic species

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring. Listed by DBCA.

Appendix E Quadrat data

Site name and number	Date	Site type	Observer
ELA001	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Very poor	Grazing, weeds and clearing (paddock with trees)	>20	CrOW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Isolated trees over pasture	Slope	West	1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Brown	Fine	Sandy loam (clay elements)	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	387129	6325442

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Corymbia calophylla	70	U	Tree, mallee
**Arctotheca calendula*	0.01	G	Herb
**Avena barbata*	1	G	Herb, grass-like

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Briza minor*	0.1	G	Herb, grass-like
**Bromus diandrus*	2	G	Herb, grass-like
**Bromus hordeaceus*	0.5	G	Herb, grass-like
**Hordeum leporinum*	30	G	Herb, grass-like
**Hypochaeris glabra*	0.05	G	Herb
**Lolium rigidum*	40	G	Herb, grass-like
**Lotus uliginosus*	5	G	Herb
**Oxalis pes-caprae*	0.3	G	Herb
**Romulea rosea*	0.01	G	Herb

Site name and number	Date	Site type	Observer
ELA002	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Good	Grazing and weeds (adjacent to flowing water)	>20	ErMrW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Creek zone with trees over grasses and herbs	Drainage line	N/A	0
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Grey	Fine	Clay loam	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	387026	6325501

Site name and number	Date	Site type	Observer

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Alternanthera nodiflora	1.5	G	Herb
Bolboschoenus caldwellii	0.25	M	Herb, grass-like
Cassytha racemosa forma *racemosa*	2.5	Climber	Herb, climber
Eucalyptus rudis	60	U	Tree
Melaleuca rhaphiophylla	25	U	Tree, shrub
Senecio glomeratus	0.1	M	Herb
**Cynodon dactylon*	1	G	Herb, grass-like
**Festuca arundinacea*	6	M	Herb, grass-like
**Gomphocarpus fruticosus*	1	M	Herb, shrub
**Juncus usitatus*	0.5	G	Herb
**Lolium rigidum*	30	G	Herb, grass-like
**Oxalis pes-caprae*	0.5	G	Herb
**Plantago lanceolata*	0.5	G	Herb
**Plantago major*	7	M	Herb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Rumex sp.*	3	M	Herbs, herbaceous climbers, shrubs
**Sonchus oleraceus*	2	G	Herb
**Watsonia sp.*	5	G	Herbs
**Zantedeschia aethiopica*	0.05	G	Herb, tuber-like

Site name and number	Date	Site type	Observer
ELA003	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Excellent	Weeds	>20	BaEmW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Banksia, E. marginate, A. flexuosa and *Corymbia calophylla* woodland over native understorey	Slope	South-east	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
White/brown	Fine	Sand	Moist
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386793	6325535

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia pulchella	0.2	G	Shrub
Adenanthos meisneri	0.7	G	Shrub
Agonis flexuosa	10	U	Shrubs, trees
Banksia attenuata	8	U	Tree, shrub
Banksia grandis	6	M	Tree, shrub
Billardiera laxiflora	0.02	Climber	Shrub, climber
Burchardia congesta	0.01	G	Herb
Chamaescilla corymbosa	0.02	G	Herb
Conostephium pendulum	0.8	G	Shrub
Conostylis aculeata	10	G	Herb, grass-like
Corymbia calophylla	0.1	U	Tree, mallee
Dampiera alata	0.01	G	Herb
Dasypogon bromeliifolius	0.2	G	Herb
Desmocladus fasciculatus	3	G	Herb
Drosera menziesii	0.01	Climber	Herb, climber
Drosera porrecta	0.01	G	Herb
Eucalyptus marginata	16	M	Tree
Gompholobium knightianum	0.1	G	Shrub
Gompholobium tomentosum	0.3	G	Shrub
Hardenbergia comptoniana	0.3	Climber	Twining shrub, climber
Hibbertia hypericoides	1	G	Shrub, spreading
Hibbertia subvaginata	0.02	G	Shrub, strangling or spreading
Hovea trisperma	0.02	G	Shrub
Hypolaena exsulca	0.2	G	Herb, tussock-like
Isolepis marginata	0.01	G	Herb, grass-like
Kennedia prostrata	0.1	G	Shrub
Kunzea glabrescens	3	M	Shrub
Lagenophora huegelii	0.01	G	Herb
Lepidosperma squamatum	2	M	Herb, grass-like (sedge)
Lomandra hermaphrodita	0.01	G	Herb
Lyginia barbata	15	G	Herb
Petrophile linearis	0.02	G	Shrub
Phlebocarya ciliata	6	G	Herb, grass-like

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Platysace compressa	0.08	G	Herb
Pyrorchis nigricans	0.01	G	Herb
Stylidium brunonianum	0.01	G	Herb
Stylidium piliferum	0.01	G	Herb
Stylidium schoenoides	0.5	G	Herb
Thelymitra benthamiana	0.01	G	Herb
Trachymene pilosa	0.1	G	Herb
Xanthorrhoea gracilis	0.3	M	Tree-like monocot
Xylomelum occidentale	5	M	Tree, shrub
**Briza maxima*	0.1	G	Herb, grass-like
**Ehrharta calycina*	0.1	M	Herb, grass-like
**Hypochaeris glabra*	0.01	G	Herb
**Romulea rosea*	0.01	G	Herb
**Ursinia anthemoides*	0.01	G	Herb

Site name and number	Date	Site type	Observer
ELA004	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Very good	Weeds	?20	ErMrW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
E. rudis and *M. rhaphiophylla* closed woodland over sedges	Wetland	East	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Dark brown	Course	Loam (deep humus)	Moist
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386506	6325511

Site name and number	Date	Site type	Observer

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Alternanthera nodiflora	0.02	G	Herb
Astartea scoparia	2	M	Shrub
Cassytha racemosa forma *racemosa*	0.3	Climber	Herb, climber
Conyza sp.	0.05	G	Herbs
Eucalyptus rudis	15	U	Tree
Juncus pallidus	5	M	Herb
Melaleuca rhaphiophylla	65	M	Tree, shrub
Pseudognaphalium luteoalbum	0.2	G	Herb
Typha orientalis	0.1	M	Herb
**Cirsium vulgare*	0.5	G	Herb
**Solanum nigrum*	0.05	G	Herb, shrub

Site name and number	Date	Site type	Observer
ELA005	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Degraded	Weeds	>20	EmAfW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Remnant tall trees over weeds	Slope	South west	1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Dark brown	Fine	Sandy loam	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386342	6325417

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Agonis flexuosa	20	U	Shrubs, trees
Corymbia calophylla	60	U	Tree, mallee
Eucalyptus marginata	1	M	Tree
Hardenbergia comptoniana	2.5	Climber	Twining shrub, climber
Thelymitra benthamiana	0.01	G	Herb
**Bromus diandrus*	30	G	Herb, grass-like

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Disa bracteata*	0.01	G	Herb
**Ehrharta calycina*	4	M	Herb, grass-like
**Ehrharta longiflora*	0.2	G	Herb, grass-like
**Hypochaeris glabra*	0.01	G	Herb
**Lolium rigidum*	30	G	Herb, grass-like
**Oxalis pes-caprae*	0.01	G	Herb
**Romulea rosea*	0.01	G	Herb
**Sonchus oleraceus*	0.01	G	Herb

Site name and number	Date	Site type	Observer
ELA006	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Very good	Weeds	>20	MpW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
M. rhaphiophylla and *M. preissiana* with Kunzea over sedges and grasses	Wetland	South east	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Dark brown	Course	Humus	Moist
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386117	6325385

Site name and number	Date	Site type	Observer

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Alternanthera nodiflora	0.5	G	Herb
Astartea scoparia	1.5	M	Shrub
Asteraceae sp.	0.2	M	Herbs, trees, shrubs, herbaceous climbers
Cassytha racemosa forma *racemosa*	1	Climber	Herb, climber
Centella asiatica	0.5	G	Herb, creeper
Juncus kraussii subsp. australiensis	18	G	Herb
Juncus pauciflorus	6	M	Herb
Kunzea glabrescens	0.5	M	Shrub
Lepidosperma longitudinale	35	M	Herb, grass-like (sedge)
Leptocarpus decipiens	1.5	M	Herb
Melaleuca preissiana	0.1	U	Tree, shrub
Melaleuca rhaphiophylla	40	U	Tree, shrub
Microtis media	0.01	G	Herb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Pseudognaphalium luteoalbum	0.05	G	Herb
**Conyza bonariensis*	0.01	G	Herb
**Cynodon dactylon*	18	G	Herb, grass-like
**Holcus lanatus*	0.01	G	Herb, grass-like
**Lotus ulignosus*	0.01	G	Herb
**Mentha pulegium*	1	G	Herb
**Plantago major*	0.02	G	Herb
**Solanum nigrum*	0.1	M	Herb, shrub
**Sonchus oleraceus*	0.01	G	Herb

Site name and number	Date	Site type	Observer
ELA007	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Good	Weeds, tracks and rubbish	>20	MpW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
M. preissiana and *Kunzea* and *Agonis* closed woodland over weeds and sedges	Wetland	N/A	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Dark brown	Course	Humus	Moist
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386177	6325473

Site name and number	Date	Site type	Observer

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Agonis flexuosa	0.5	M	Shrubs, trees
Aotus gracillima	0.1	G	Shrub
Astartea scoparia	1	M	Shrub
Caladenia flava	0.01	G	Herb
Dampiera alata	0.3	G	Herb
Gastrolobium bracteolosum	0.1	G	Shrub, strangling
Juncus pauciflorus	0.1	M	Herb
Kunzea glabrescens	15	M	Shrub
Lepidosperma longitudinale	20	M	Herb, grass-like (sedge)
Melaleuca preissiana	40	M	Tree, shrub
Senecio glomeratus	0.02	G	Herb
**Briza maxima*	7	G	Herb, grass-like
**Conyza bonariensis*	1.5	G	Herb
**Holcus lanatus*	0.2	G	Herb, grass-like
**Hypochaeris glabra*	2.5	G	Herb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Lolium perenne x rigidum*	3	G	Herb, grass-like
**Mentha pulegium*	0.02	G	Herb
**Pelargonium capitatum*	0.02	G	Herb, straggling
**Zantedeschia aethiopica*	0.05	G	Herb, tuber-like

Site name and number	Date	Site type	Observer
ELA008	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Excellent	Weeds (some drought death)	>20	BaEmW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Low *B. attenuata, Kunzea, B. ilicifolia* over native understorey	Flat	N/A	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Brown/grey	Fine	Sandy loam	Moist
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386073	6325525

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia semitrullata	0.02	G	Shrub
Banksia attenuata	30	M	Tree, shrub
Banksia ilicifolia	4	M	Tree, shrub
Billardiera laxiflora	0.1	Climber	Shrub, climber
Bossiaea eriocarpa	0.02	G	Shrub
Burchardia congesta	0.01	G	Herb
Conostylis juncea	0.3	G	Herb, grass-like
Dasypogon bromeliifolius	4.5	G	Herb
Eucalyptus marginata	3	U	Tree
Eucalyptus marginata	0.1	G	Tree
Gompholobium tomentosum	0.3	G	Shrub
Hovea trisperma	0.2	Climber	Shrub
Hypocalymma angustifolium	0.3	G	Shrub
Hypolaena exsulca	0.01	G	Herb, tussock-like
Kunzea glabrescens	12	M	Shrub
Lomandra sonderi	0.03	G	Herb
Lyginia barbata	0.02	G	Herb
Melaleuca thymoide	0.3	M	Tree, shrub
Microtis media	0.01	G	Herb
Phlebocarya ciliata	5	G	Herb, grass-like
Platysace compressa	0.01	G	Herb
Pyrorchis nigricans	0.01	M	Herb
Stylidium brunonianum	0.05	G	Herb
Stylidium schoenoides	0.01	G	Herb
Thysanotus manglesianus	0.01	Climber	Herb
Thysanotus multiflorus	0.01	G	Herb
Trachymene pilosa	0.01	G	Herb
Tricoryne elatior	1.5	G	Herb
Xanthorrhoea gracilis	4	M	Tree-like monocot
**Briza maxima*	0.2	G	Herb, grass-like
**Ehrharta calycina*	0.02	G	Herb, grass-like
**Hypochaeris glabra*	0.01	M	Herb

Site name and number	Date	Site type	Observer
ELA009	29-10-2019	Quadrat	DM/JC

Site name and number	Date	Site type	Observer
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Good	Weeds	1-10 years	EmAfW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Emergent *Kunzea* and *E. marginata* over *Xanthorrhoea* and weeds	Flat	N/A	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Grey	Fine	Sandy loam	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386017	6325393

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Crassula colorata	0.01	G	Herb
Eucalyptus marginata	0.1	M	Tree
Hypocalymma angustifolium	0.1	G	Shrub
Jacksonia horrida	0.2	G	Shrub
Kunzea glabrescens	20	M	Shrub
Xanthorrhoea brunonis	30	M	Tree-like monocot

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Disa bracteata*	0.01	G	Herb
**Ehrharta calycina*	0.4	M	Herb, grass-like
**Hypochaeris glabra*	0.01	G	Herb
**Ursinia anthemoides*	1	G	Herb
**Vulpia myuros*	1	G	Herb, grass-like

Site name and number	Date	Site type	Observer
ELA010	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Very good	Weeds	>20	BaEmW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
E. marginata, B. attenuata and *Kunzea* over *Xanthorrhoea* and weeds	Hill	N/A	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Grey	Fine	Sand	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	385582	6325496

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Anigozanthos sp.	0.01	G	Herbs
Banksia attenuata	10	U	Tree, shrub
Banksia ilicifolia	0.2	G	Tree, shrub
Billardiera laxiflora	0.01	Climber	Shrub, climber
Billardiera laxiflora	0.01	Climber	Shrub, climber
Bossiaea eriocarpa	0.02	G	Shrub
Burchardia congesta	0.01	G	Herb, sedge-like
Chamaescilla corymbosa	0.01	G	Herb
Conostylis juncea	0.1	G	Herb, grass-like
Dasypogon bromeliifolius	0.1	G	Herb
Desmocladus flexuosus	0.02	G	Herb (sedge-like)
Drosera porrecta	0.01	G	Herb
Eucalyptus marginata	35	U	Tree
Gompholobium tomentosum	0.1	G	Shrub
Hibbertia subvaginata	0.01	G	Shrub, strangling or spreading
Hovea trisperma	0.01	G	Shrub
Hypolaena exsulca	0.01	G	Herb, tussock-like
Jacksonia furcellata	0.01	G	Shrub
Kunzea glabrescens	7	M	Shrub
Lagenophora huegelii	0.01	G	Herb
Leucopogon propinquus	0.05	G	Shrub
Lyginia imberbis	0.05	G	Herb, grass-like
Macrozamia riedlei	0.01	G	Tree, cycad
Patersonia occidentalis	0.3	G	Herb
Persoonia longiflora	0.1	M	Shrub, tree
Petrophile linearis	0.01	G	Shrub
Platysace compressa	0.8	G	Herb
Stylidium brunonianum	0.1	G	Herb
Stylidium schoenoides	0.05	G	Herb
Thelymitra macrophylla	0.01	G	Herb
Thysanotus manglesianus	0.01	Climber	Herb
Trachymene pilosa	0.1	G	Herb
Xanthorrhoea gracilis	1	M	Tree-like monocot
**Briza maxima*	1	G	Herb, grass-like

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Bromus diandrus*	0.5	G	Herb, grass-like
**Ehrharta calycina*	0.1	G	Herb, grass-like
**Hypochaeris glabra*	0.3	G	Herb

Site name and number	Date	Site type	Observer
ELA011	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Good	Weeds	>20	BaEmW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
B. attenuata, E. marginata, Kunzea over weeds and few natives	Slope	South	1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Dark Grey	Fine	Sand	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	385497	6325393

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Banksia attenuata	20	U	Tree, shrub
Banksia ilicifolia	0.1	M	Tree, shrub
Dasypogon bromeliifolius	0.2	G	Herb
Eucalyptus marginata	10	U	Tree
Jacksonia furcellata	0.01	G	Shrub
Kunzea glabrescens	8	M	Shrub
Leucopogon propinquus	0.7	G	Herb
Lomandra sonderi	0.8	G	Herb
Macrozamia riedlei	0.15	G	Tree, cycad
Platysace compressa	0.2	G	Herb
Thelymitra benthamiana	0.01	G	Herb
Xanthorrhoea gracilis	0.25	M	Tree-like monocot
**Briza maxima*	5	G	Herb, grass-like
**Briza minor*	0.01	G	Herb, grass-like
**Ehrharta calycina*	2.5	G	Herb, grass-like
**Hypochaeris glabra*	0.3	G	Herb
**Lolium perenne x rigidum*	0.5	G	Herb, grass-like
**Ursinia anthemoides*	3.5	G	Herb

Site name and number	Date	Site type	Observer
ELA012	29-10-2019	Quadrat	DM/JC
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Very good	Weeds	>20	BaEmW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
E. marginata, B. ilicifolia, Kunzea over native understorey	Slope	South east	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Grey	Fine	Sandy loam	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	384578	6324071

Site name and number	Date	Site type	Observer

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Acacia huegelii	0.01	G	Shrub
Acacia pulchella	0.05	G	Shrub
Acacia semitrullata	0.02	G	Shrub
Banksia ilicifolia	0.5	G	Tree, shrub
Bossiaea eriocarpa	0.5	G	Shrub
Calytrix flavescens	0.01	G	Shrub
Conostephium pendulum	0.7	G	Shrub
Crassula colorata	0.01	G	Herb
Dasypogon bromeliifolius	0.7	G	Herb
Daviesia physodes	0.3	G	Shrub
Drosera menziesii	0.01	G	Herb, climber
Drosera porrecta	0.01	G	Herb
Eucalyptus marginata	20	U	Tree
Hibbertia subvaginata	0.1	G	Shrub, strangling or spreading
Hibbertia vaginata	0.05	G	Shrub, spreading

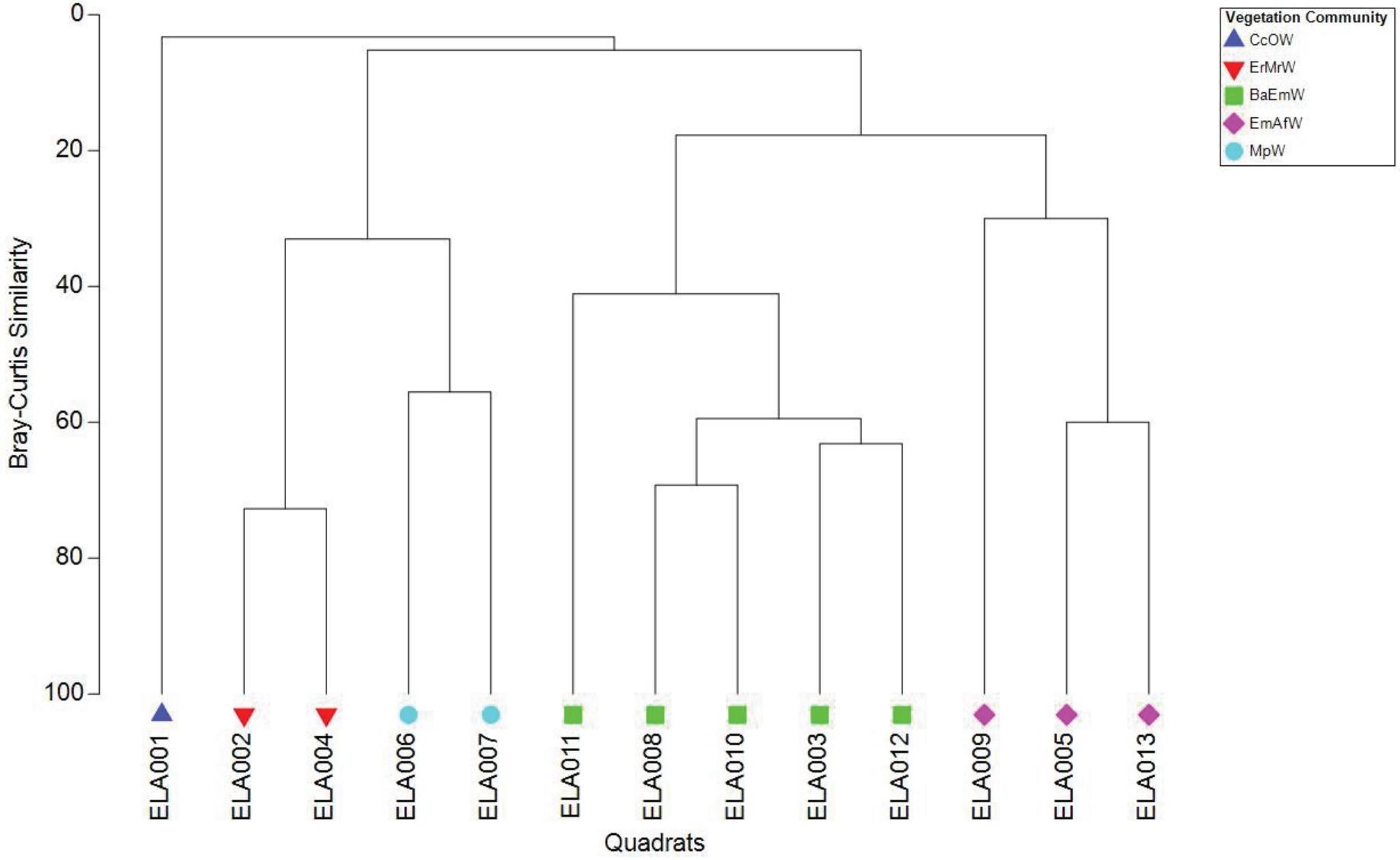
Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Hovea trisperma	0.2	Climber	Shrub
Hypolaena exsulca	0.1	G	Herb, tussock-like
Isolepis marginata	0.01	G	Herb, grass-like
Jacksonia horrida	0.4	G	Shrub
Kunzea glabrescens	15	M	Shrub
Lomandra hermaphrodita	0.01	G	Herb
Lyginia barbata	0.1	G	Herb
Macrozamia riedlei	0.1	G	Tree, cycad
Melaleuca thymoides	1	M	Tree, shrub
Phlebocarya ciliata	10	G	Herb, grass-like
Platysace compressa	0.05	G	Herb
Stylidium brunonianum	0.02	G	Herb
Trachymene pilosa	0.02	G	Herb
Xanthorrhoea gracilis	1	M	Tree-like monocot
Xanthorrhoea preissiana	1	M	Tree-like monocot
**Acacia longifolia*	0.01	G	Tree, shrub
**Ursinia anthemoides*		G	Herb
**Vulpia myuros*	0.01	G	Herb, grass-like
**Vulpia myuros*	0.01	G	Herb, grass-like

Site name and number	Date	Site type	Observer
ELA013	17-10-2019	Quadrat	DB/DM
Vegetation condition	**Disturbance notes**	**Age since fire**	**Vegetation type**
Good	Grazing, weeds, looks like ex-pastoral land, not much understorey left	>20	EmAfW
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Agonis/Jarrah open woodland over grasses on sandy plain	Flat	North west	<1
Soil colour	**Soil texture**	**Soil type**	**Soil condition**
Grey/brown	Fine	Sandy loam	Dry
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	386656	6325454

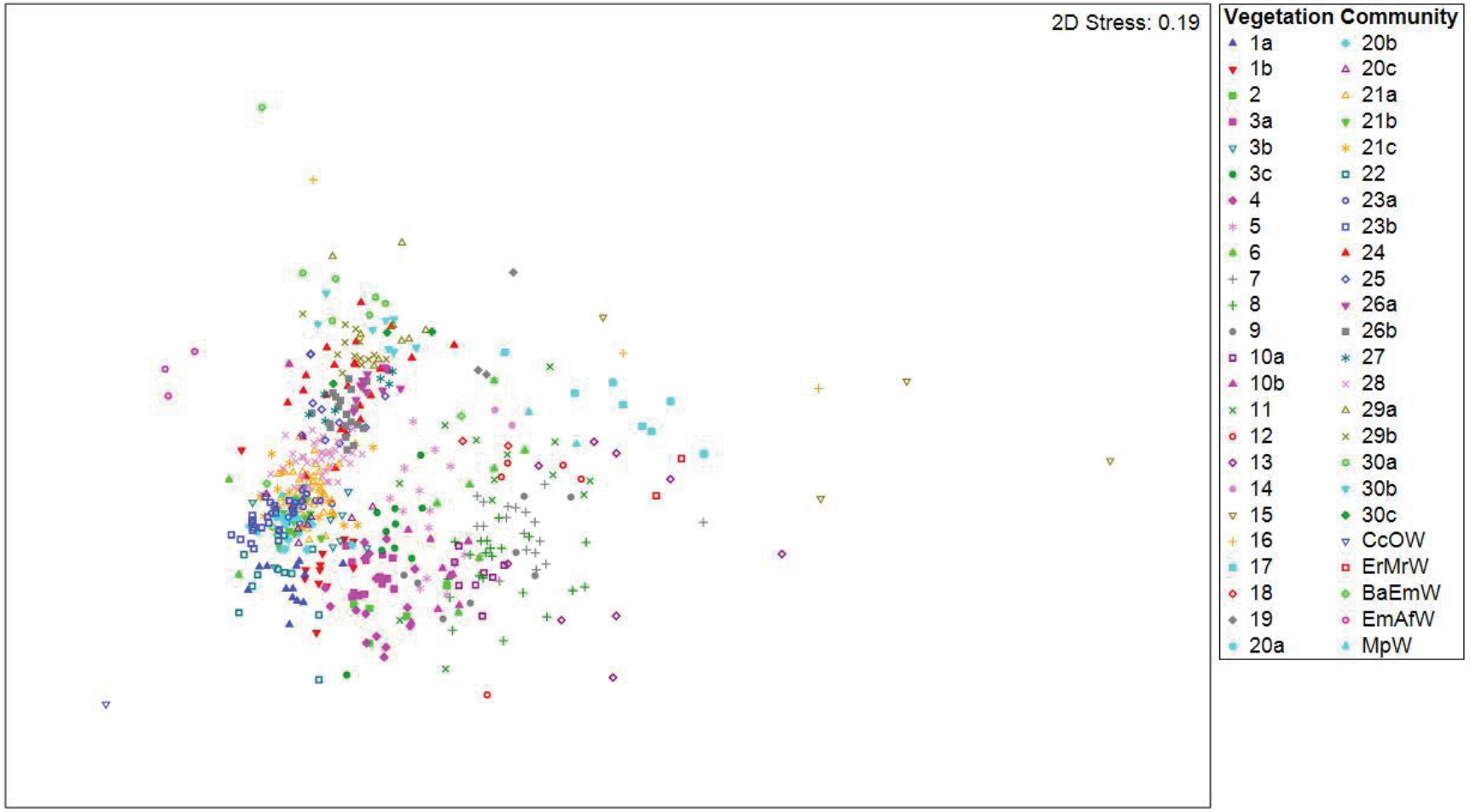
Site name and number	Date	Site type	Observer

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Agonis flexuosa	50	U	Shrubs, trees
Eucalyptus marginata	12	M	Tree
Gompholobium tomentosum	0.05	G	Shrub
Hardenbergia comptoniana	0.1	M	Twining shrub, climber
Kunzea glabrescens	2	M	Shrub
Oxalis exilis	0.01	G	Herb
Pterostylis sp.	0.01	G	Herbs
**Disa bracteata*	0.01	G	Herb
**Ehrharta calycina*	18	G	Herb, grass-like
**Hypochaeris glabra*	0.1	G	Herb
**Ornithopus compressus*	0.01	G	Herb
**Sonchus oleraceus*	0.01	G	Herb
**Ursinia anthemoides*	1	G	Herb

Appendix F Hierarchical clustering dendrogram


Vegetation Community
CcOW
ErMrW
BaEmW
EmAfW
MpW
Bray-Curtis Similarity
0
20
40
60
80
100
ELA001
ELA002
ELA004
ELA006
ELA007
ELA011
ELA008
ELA010
ELA003
ELA012
ELA009
ELA005
ELA013
Quadrats

Appendix G MDS: Relationships between ELA vegetation communities and Floristic Community Types (FCTs) defined by Gibson et al. (1994)


2D Stress: 0.19
Vegetation Community
1a
1b
2
3a
3b
3c
4
5
6
7
8
9
10a
10b
11
12
13
14
15
16
17
18
19
20a
20b
20c
21a
21b
21c
22
23a
23b
24
25
26a
26b
27
28
29a
29b
30a
30b
30c
CcOW
ErMrW
BaEmW
EmAfW
MpW

Appendix H Banksia Woodlands TEC assessment

Step	Key diagnostic characteristics	Outcome
1	**Location and physical environment** The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion	The survey area is located on the Swan Coastal Plain
	Soil and landform The *Banksia* Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands	The survey area is located on the Bassendean and Pinjarra systems

	Structure
	The structure of the Banksia Woodlands is a low woodland to forest with these features:
	• A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the *Banksia* species identified under composition
	• Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the Banksia canopy
	• An often highly species-rich understorey that consists of:
	  ○ A layer of sclerophyllous shrubs of various heights; and,
	  ○ A herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.
		One vegetation community conforms to this structure. It is:
		Vegetation community BaEmW: Mid Banksia attenuata and Eucalyptus marginata woodland over a tall Kunzea glabrescens sparse shrubland over a low Xanthorrhoea gracilis and Gompholobium tomentosum sparse shrubland.
		This vegetation community has a species rich understorey that consists of a layer of sclerophyllous shrubs of various heights, and an herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. Refer to **Appendix E** for quadrat site data.

	Composition
	• The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B. ilicifolia* (holly-leaved banksia); and
	• The patch must include at least one of the following diagnostic species:
	  ○ *Banksia attenuata* (candlestick banksia)
	  ○ *Banksia menziesii* (firewood banksia)
	  ○ *Banksia prionotes* (acorn banksia)
		The canopy is dominated by the key diagnostic species *Banksia attenuata* in Vegetation Community BaEmW. There is the presence of other co-dominant species including *Eucalyptus marginata* subsp. *marginata*. Emergent *Eucalyptus marginata* and *Corymbia calophylla* were present. These communities have a high diversity of shrubs and herb species with many indicator species recorded.
		The contra-indicator species *Banksia littoralis* and *Banksia burdettii* were not recorded. None of these communities represent FCT 20c – Eastern shrublands and woodlands.

Step	Key diagnostic characteristics	Outcome
	○ *Banksia ilicifolia* (holly-leaved banksia). • If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and • Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and • The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch*** • Contra-indicators: ○ Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. ○ Patches clearly dominated by *Banksia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. ○ FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	
2	**Condition thresholds** • Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch. • Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species.	The community was assessed and sampled in the highest condition representation available in the survey area. The survey was completed in spring, which is the most appropriate season to survey on the Swan Coastal Plain. The vegetation community was been determined to represent the FCT 21a Central *Banksia attenuata - Eucalyptus marginata* woodlands (Gibson et al. 1994) and to a lesser extent FCT 21c Low lying Banksia attenuata woodlands and shrublands (P3). FCT 21a

Step	Key diagnostic characteristics	Outcome
	• The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds. • Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (TSSC 2016). • A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition.	and FCT 21c form part of the Banksia Woodlands ecological community listing (TSSC 2016).
3	**Minimum patch size** Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: • 'Pristine' – no minimum patch size applies • 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) • 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) • 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m). Note: To be considered as part of the EPBC Act ecological community, a patch should meet at least the Good Condition category.	The areas of vegetation communities present within the survey area are presented in **Table 8**. See **Figures 10-12** for spatial representation
4	**Further information to assist in determining the presence of the ecological community and significant impacts** • The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes • A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present.	A total of 14.26 ha of vegetation within the survey area was assessed as representing the Banksia Woodlands of the Swan Coastal Plain ecological community (TEC), comprising 4.69 ha of Excellent condition, 4.32 ha of Very Good condition and 6.25 ha of Good condition.

Step	Key diagnostic characteristics	Outcome
	• Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. • A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. • The recommended minimum buffer zone for the ecological community is 20–50 m from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	

*The term 'woodland' has been chosen as the most typical structure, but the ecological community may also be considered to include examples of shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history. Similarly, component species of the dominant upper sclerophyllous layer may be variously considered 'tall or large shrubs' or 'small trees'.

** Refers to relevant *Banksia* species typically being amongst the most common plant species in the upper sclerophyllous layer. There may be localised exceptions to this, either as natural variation or due to disturbance history (e.g. fire).

*** Key species in the sclerophyllous shrub layer of the ecological community include members of the families Asteraceae, Dilleniaceae, Ericaceae, Fabaceae, Myrtaceae and Proteaceae. Widespread species include *Adenanthos cygnorum* (woolly bush), *Allocasuarina humilis* (dwarf sheoak), *Bossiaea eriocarpa* (common brown pea), *Conostephium pendulum* (pearl flower), *Daviesia* spp., *Eremaea pauciflora*, *Gompholobium tomentosum* (hairy yellow pea), *Hibbertia hypericoides* (yellow buttercups), *Jacksonia* spp., *Kunzea glabrescens, Petrophile linearis* (pixie mops), *Philotheca spicata* (pepper and salt), *Stirlingia latifolia* (blueboy),

Phlebocarya ciliata, Hypolaena exsulca and *Xanthorrhoea preissii* (balga). Key species in the herbaceous ground layer include members of the families Cyperaceae, Droseraceae, Haemodoraceae, Orchidaceae, Restionaceae and "lilies" from various families. Widespread species include *Amphipogon turbinatus* (tufted beard grass), *Burchardia congesta* (milkmaids), *Caladenia* spp. (spider orchids), *Dasypogon bromeliifolius* (pineapple bush), *Desmocladus flexuosus, Drosera erythrorhiza* (red ink sun dew), *Lepidosperma squamatum* (a tufted sedge), *Lomandra hermaphrodita, Lyginia barbata* (southern rush), *Lyginia imberbis, Mesomelaena pseudostygia* (semaphore sedge), *Patersonia occidentalis* (purple flag), *Podolepis* spp., *Stylidium brunonianum* (pink fountain trigger plant), *Stylidium piliferum* (common butterfly trigger plant), *Trachymene pilosa* (dwarf parsnip), and *Xanthosia huegelii* (heath xanthosia).

Appendix I Fauna likelihood of occurrence assessment

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
Calidris ferruginea	CR	S1, S5	PMST	Curlew Sandpipers mainly occur on 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 also recorded inland, though 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. Occasionally they are recorded around floodwaters.	Potential*	Marginally suitable habitat Nearest record 3.4km south south-east of the survey area.
Numenius madagascariensis	CR	S1, S5	PMST	During the non-breeding season in Australia, 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 (*Zosteraceae*).	Potential*	Marginally suitable habitat Nearest record 3.4km south south-east of the survey area.
Pseudocheirus occidentalis	CR	S1	NatureMap, PMST	Vegetation communities critical to the species include long unburnt mature remnants of peppermint (*Agonis flexuosa*) woodlands with high canopy continuity and high foliage nutrients (high in nitrogen and low toxin levels); jarrah (*Eucalyptus marginata*)/marri (*Corymbia calophylla*) forests and woodlands with limited anthropogenic disturbance (unlogged or lightly logged, and a low intensity and low frequency fire history), that are intensively fox-baited and have low indices of fragmentation; coastal heath, jarrah/marri woodland and forest,	Unlikely	No suitable habitat – minimal canopy connectivity in *Agonis flexuosa* woodlands and limited midstorey Nearest record 6.2km to the south of the survey area.

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
				peppermint woodlands, myrtaceous heaths and shrublands, Bullich (*Eucalyptus megacarpa*) dominated riparian zones and karri forest.		
Botaurus poiciloptilus	EN		PMST	In Western Australia, Australasian bitterns feed and breed in generally large, fresh to moderately brackish wetlands with pH levels ranging from 5.5 to 8.5. Extensive areas of water plants, especially rushes, reeds and sedges, provide habitat for the bitterns and support abundant prey. Shallow water, less than 30cm deep with a low to medium density of water plants mixed with, or near short fine sedges are favoured for foraging while higher density emergent vegetation is preferred for nesting.	Potential*	Marginally suitable habitat Nearest record 5km to the north-east to the survey area.
Calidris canutus	EN		PMST	In Australasia the Red Knot mainly inhabit 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.	Potential*	Marginally suitable habitat Nearest record 3.7km to the south of the survey area.
Calyptorhynchus baudinii	EN	S2	NatureMap, PMST	Mainly occurs in eucalypt forests, especially jarrah, marri and karri forest. The species is less frequently in woodlands of wandoo (*E. wandoo*), blackbutt (*Eucalyptus patens*), flooded gum (*Eucalyptus rudis*), yate (*Eucalyptus cornuta*), partly cleared farmlands and urban areas, including roadside trees and house gardens. This cockatoo forages at all levels of the	Likely	In the species range and habitat present. Nearest record 3.7km to the south of the survey area.

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
				forest, from the canopy to the ground, often feeding in the understorey on proteaceous trees and shrubs, especially banksias, and in orchards (both in trees and on dropped or fallen fruit on the ground).		
Calyptorhynchus latirostris	EN	S2	NatureMap, PMST	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum and wandoo, and in shrubland or kwongan heathland dominated by hakea, dryandra, banksia and grevillea species. It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture.	Likely	In the species range and habitat present Nearest record 0.3km to the north of the survey area.
Galaxiella nigrostriata	EN		PMST	The Blackstriped Dwarf Galaxias inhabits coastal wetlands from acidic, black-water temporary pools of south-west Western Australia.	Potential	In the species range and habitat present Nearest record 7km to the north of the survey area.
Rostratula australis	EN	S2	PMST	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.	Potential*	Marginally suitable habitat
Dasyurus geoffroii	VU	S3	NatureMap, PMST	The major portion of the remaining natural populations occur in varying densities in *Eucalyptus marginata* forests and woodlands in the south-west corner of WA, and in woodlands, mallee shrublands and heaths along the south coast, east to the Ravensthorpe area. There are also occasional records	Potential	In the species range and habitat present Nearest record 3.7km to the south-west of the survey area.

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
				from drier woodland and mallee shrubland in the Wheatbelt and Goldfield Regions.		
Calyptorhynchus banksii subsp. *naso*	VU	S3	NatureMap, PMST	The Forest Red-tailed Black Cockatoo inhabits the dense jarrah, karri (*Eucalyptus diversicolor*) and marri forests receiving more than 600 mm average rainfall annually, mainly in the hilly interior.	Recorded	In the species range and habitat present Nearest record 1.3km to the south-west of the survey area.
Nannatherina balstoni	VU		PMST	Balston's Pygmy Perch inhabits acidic, tannin-stained freshwater pools, streams and lakes in peat flats within 30 km of the coast of south-west Western Australia, preferring shallow water, and commonly associated with tall sedge thickets and inundated riparian vegetation. Balston's Pygmy Perch is typically found in freshwater with a pH range of 3.0–6.5 and seasonally fluctuating temperatures of 11–30 °C. It is typically found amongst inundated riparian vegetation where it is thought to feed and spawn, though adults are also found in open water. Larvae tend to be confined to shallow water < 10 cm deep amongst the flooded riparian vegetation, and as the larvae increase in size they gradually move to deeper waters.	Potential	Marginally suitable habitat
Westralunio carteri	VU	S3	NatureMap, PMST	Perennial streams, rivers, lakes and reservoirs, occasionally swamps.	Likely	In the species range and habitat present Nearest record 8.4km to the south-east of the survey area.

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
Leipoa ocellata	VU	S3	PMST	The Malleefowl is found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias. A sandy substrate and abundance of leaf litter are required for breeding.	Unlikely	No suitable habitat
Setonix brachyurus	VU	S3	NatureMap, PMST	Comprises *Taxandria linearifolia* swamps. Habitat critical to survival includes areas of natural vegetation where the understorey is sufficiently thick and complex to provide a predation refuge close to more open, recently burnt vegetation which is used as a food source.	Unlikely	No suitable habitat, no nearby records
Sternula nereis nereis	VU		PMST	The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night.	Unlikely	No suitable habitat
Falco peregrinus		S7	Naturemap	The Peregrine Falcon is found in most habitats, from rainforests to the arid zone, and at most altitudes, from the coast to alpine areas. It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water, and may even be found nesting on high city buildings.	Potential	Species utilises a broad range of habitats Nearest record 2.4km to the south-east of the survey area.
Tringa nebularia	IA		Naturemap	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh,	Potential*	Species utilises a broad range of habitats

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
				mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded 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 salt flats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees. It was once recorded with Black-winged Stilts (*Himantopus himantopus*) in pasture, but are generally not found in dry grassland.		Nearest record 3.6km to the south-east of the survey area.
Phascogale tapoatafa subsp. *wambenger*	-	S7	NatureMap	Formerly widespread in eastern and south-western Australia and presumed abundant in appropriate habitat of woodland and open forest. Occurs at low densities in the northern Jarrah forest.	Likely	Suitable habitat present. Nearest record 0.8km to the south-east of the survey area.
Isoodon obesulus fusciventer	-	P4	NatureMap	Scrubby, often swampy, vegetation with dense cover up to 1 m high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quenda will thrive in more open habitat subject to introduced	Likely	Suitable habitat present. Nearest record 0.12km to the south-east of the survey area.

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
				predator control. On the Swan Coastal Plain, Quenda are often associated with wetlands.		
Oxyura australis	-	P4	NatureMap	The Blue-billed Duck is almost wholly aquatic and is seldom seen on land. Non-breeding flocks, often with several hundred individuals, congregate on large, deep open freshwater dams and lakes in autumn. The daylight hours are spent alone in small concealed bays within vegetation or communally in large exposed rafts far from the shore.	Potential*	Marginally suitable habitat Nearest record 3.7km to the south of the survey area.

*The suitability of habitat within the survey area is marginal for this species however the permanent wetlands on site may results in the species visiting on a vagrant basis.

Appendix J Potentially significant black cockatoo habitat trees within the survey area.

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
387123	6325435	CC1	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	No other evidence
387136	6325436	CC2	*Corymbia calophylla*	No	No	NA	Dying tree, open area but not useable
387186	6325423	CC3	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot and Forest Red-tailed Black Cockatoo	Small nest poor condition
387207	6325418	CC4	*Corymbia calophylla*	No	No	Old evidence of Butler's Corella and Red-capped parrot	No hollows
387211	6325410	CC5	*Corymbia calophylla*	No	No	No	Thin branches
387209	6325411	CC6	*Corymbia calophylla*	No	No	No	Tree in poor condition
387215	6325406	CC7	*Corymbia calophylla*	No	No	No	Tree in poor condition
387215	6325404	CC8	*Corymbia calophylla*	No	No	No	Tree in poor condition
387225	6325470	CC9	*Corymbia calophylla*	No	No	No recent evidence	Thin branches, tree in poor condition
387229	6325517	CC10	*Corymbia calophylla*	No	No	No recent evidence	Thin branches, tree in poor condition
387229	6325518	CC11	*Corymbia calophylla*	No	No	No recent evidence	Thin branches, tree in poor condition
387238	6325517	CC12	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
387219	6325534	CC13	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition
387220	6325537	CC14	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition
387205	6325491	CC15	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition
387197	6325495	CC16	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition
387189	6325492	CC17	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition
387183	6325488	CC18	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition
387160	6325483	CC19	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	Thin branches, tree in poor condition
386910	6325518	CC20	*Corymbia calophylla*	Spout branch	10, 20, 10	No recent evidence	Looks to be chewing, beehive
386913	6325514	CC21	*Corymbia calophylla*	Branch	10	No recent evidence	Thin branches
386898	6325518	CC22	*Corymbia calophylla*	No	No	No recent evidence	Thin branches
386923	6325525	CC23	*Corymbia calophylla*	No	No	No recent evidence	Thin branches
386903	6325512	CC24	*Corymbia calophylla*	No	No	No recent evidence	Thin branches
386896	6325513	EM0	*Eucalyptus marginata*	No	No	No recent evidence	On large lean

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
386868	6325499	CC25	*Corymbia calophylla*	No	No	No recent evidence	Thin branches
386863	6325479	CC26	*Corymbia calophylla*	Spout	35 to 40	No recent evidence	Can't see if it has back
386859	6325420	CC27	*Corymbia calophylla*	No	No	No recent evidence	Tall thin branches
386866	6325399	CC28	*Corymbia calophylla*	No	No	No recent evidence	Tall thin branches
386833	6325489	EM1	*Eucalyptus marginata*	No	No	No recent evidence	Tall thin branches, poor condition
386847	6325489	EM2	*Eucalyptus marginata*	No	No	No recent evidence	Tall thin branches, poor condition
386866	6325564	CC29	*Corymbia calophylla*	No	No	Old evidence of Australian Ringneck	None
386736	6325439	EM3	*Eucalyptus marginata*	No	No	No	Poor condition
386706	6325378	EM4	*Eucalyptus marginata*	No	No	No	Dead stay, broken branch but no true hollow
386685	6325389	EM5	*Eucalyptus marginata*	No	No	No	Stag with epicormic
386681	6325403	EM6	*Eucalyptus marginata*	Spout	20	No	Stag with epicormic, broken off branch forming hollow
386672	6325390	CC30	*Corymbia calophylla*	No	No	Old evidence of Australian Ringneck and Red-capped parrot	None
386669	6325390	CC31	*Corymbia calophylla*	No	No	Butler's Corella	None

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
386621	6325405	CC32	*Corymbia calophylla*	No	No		Stag with epicormic, broken off branch forming hollow
386622	6325402	CC33	*Corymbia calophylla*	No	No	Red-capped parrot, Australian Ringneck	None
386618	6325378	CC34	*Corymbia calophylla*	Spout	15		Thin branch poor condition
386624	6325385	EM7	*Eucalyptus marginata*	No	No	No	Stag with epicormic, no intact hollow
386603	6325434	EM8	*Eucalyptus marginata*	No	No	No	Stag with epicormic, no intact hollow
386615	6325430	EM9	*Eucalyptus marginata*	No	No	No	Thin branches
386608	6325473	EM10	*Eucalyptus marginata*	No	No	No	Thin branches
386603	6325478	EM11	*Eucalyptus marginata*	No	No	No	Thin branches
386632	6325515	EM12	*Eucalyptus marginata*	No	No	No	Thin branches
386659	6325491	EM13	*Eucalyptus marginata*	No	No	No	Thin branches
386494	6325405	CC35	*Corymbia calophylla*	No	No	No recent evidence	Thin branches
386487	6325365	EM14	*Eucalyptus marginata*	No	No	No	Stag with epicormic
386479	6325411	CC36	*Corymbia calophylla*	No	No	No recent evidence	Broken thin

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
386477	6325439	CC37	*Corymbia calophylla*	No	No	No recent evidence	Roadside, thin
386438	6325523	CC38	*Corymbia calophylla*	No	No	No recent evidence	Thin
386430	6325527	CC39	*Corymbia calophylla*	No	No	No recent evidence	Thin
386421	6325539	CC40	*Corymbia calophylla*	No	No	No recent evidence	Thin
386361	6325515	CC41	*Corymbia calophylla*	No	No	Old evidence of Australian Ringneck and Red-capped parrot	Thin
386335	6325524	CC42	*Corymbia calophylla*	No	No	No recent evidence	Thin
386348	6325509	EM15	*Eucalyptus marginata*	No	No	No recent evidence	Thin
386340	6325509	CC43	*Corymbia calophylla*	No	No	No recent evidence	Thin
386334	6325510	CC44	*Corymbia calophylla*	No	No	No recent evidence	Thin
386389	6325486	EM16	*Eucalyptus marginata*	No	No	No recent evidence	Poor condition, broken branches
386398	6325484	EM17	*Eucalyptus marginata*	No	No	No recent evidence	Poor condition, broken branches
386452	6325459	CC45	*Corymbia calophylla*	No	No	No recent evidence	Roadside, thin
386418	6325394	EM18	*Eucalyptus marginata*	No	No	No recent evidence	Poor condition

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
386392	6325419	EM19	*Eucalyptus marginata*	Spouts	15, 20	No recent evidence	Poor condition, beehive in hollow
386360	6325403	CC46	*Corymbia calophylla*	Spout	10	Old evidence of Australian Ringneck, Red-capped parrot and Butler's Corella	Thin
386348	6325385	CC47	*Corymbia calophylla*	No	No	No recent evidence	Thin
386344	6325383	EM20	*Eucalyptus marginata*	No	No	No recent evidence	Thin
386331	6325409	EM21	*Eucalyptus marginata*	No	No	No recent evidence	Thin
386344	6325433	EM22	*Eucalyptus marginata*	No	No	No recent evidence	Thin, poor condition
386212	6325425	CC48	*Corymbia calophylla*	No	No	Old evidence of Australian Ringneck and Red-capped parrot	Thin gnarled
386232	6325391	CC49	*Corymbia calophylla*	No	No	Old evidence of Australian Ringneck and Red-capped parrot	Thin gnarled
386259	6325365	CC50	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot and recent evidence of Forest Red-tailed Black Cockatoo foraging	Thin gnarled, thin no hollows, Heavy residue, close to swamp water
386238	6325360	CC51	*Corymbia calophylla*	No	No	Recent evidence of Forest Red-tailed Black Cockatoo foraging	Feeding, thin no hollows, close to swamp water
386230	6325361	CC52	*Corymbia calophylla*	No	No	Recent evidence of Forest Red-tailed Black Cockatoo foraging	Feeding, thin no hollows, close to swamp water
386204	6325392	CC53	*Corymbia calophylla*	No	No	No recent evidence	Thin
386190	6325400	CC54	*Corymbia calophylla*	No	No	No recent evidence	Thin

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
386077	6325486	EM23	*Eucalyptus marginata*	No	No	No recent evidence	Poor condition, broken branches, no true hollow
386108	6325468	EM24	*Eucalyptus marginata*	Spout	20	No recent evidence	Poor condition, broken branches, no true hollow
386122	6325487	EM25	*Eucalyptus marginata*	Spout upright	40	No recent evidence	Poor condition, broken large open spout, probably no base to it
385718	6325456	EM26	*Eucalyptus marginata*	No	No	No recent evidence	Stunted
385619	6325470	EM27	*Eucalyptus marginata*	No	No	No recent evidence	None
385616	6325519	EM28	*Eucalyptus marginata*	No	No	No recent evidence	Red tails in area, visual and noise
385593	6325516	EM29	*Eucalyptus marginata*	No	No	No recent evidence	Thin, poor condition
385576	6325536	EM30	*Eucalyptus marginata*	No	No	No recent evidence	Stag centre with large epicormic stems
385570	6325536	EM31	*Eucalyptus marginata*	No	No	No recent evidence	Old stag
385558	6325500	EM32	*Eucalyptus marginata*	No	No	No recent evidence	None
385556	6325490	EM33	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385541	6325485	EM34	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385534	6325461	EM35	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
385530	6325449	EM36	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385516	6325437	EM37	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385512	6325445	EM38	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385499	6325453	EM39	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385460	6325441	EM40	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385460	6325431	EM41	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385449	6325435	EM42	*Eucalyptus marginata*	No	No	No recent evidence	Thin branches, poor condition, narrow crown
385426	6325427	EM43	*Eucalyptus marginata*	No	No	No recent evidence	Dead stag, thin branches
385465	6325395	EM44	*Eucalyptus marginata*	No	No	No recent evidence	Old stag, fractured stems
385507	6325367	EM45	*Eucalyptus marginata*	No	No	No recent evidence	Flowering, thin crown structure
385547	6325409	EM46	*Eucalyptus marginata*	No	No	No recent evidence	Flowering, thin crown structure, epicormic flowering
385579	6325445	EM47	*Eucalyptus marginata*	No	No	No recent evidence	Flowering, thin crown structure, epicormic flowering
385617	6325433	EM48	*Eucalyptus marginata*	No	No	No recent evidence	Flowering, thin crown structure, epicormic flowering, poor condition

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
385643	6325503	EM49	*Eucalyptus marginata*	No	No	No recent evidence	3 Forest Red-tailed Black Cockatoo perched in tree
385634	6325505	EM50	*Eucalyptus marginata*	No	No	No recent evidence	None
385630	6325500	EM51	*Eucalyptus marginata*	No	No	No recent evidence	None
385156	6324902	CC55	*Corymbia calophylla*	No	No	Old evidence of Red-capped parrot	None
385163	6324880	CC56	*Corymbia calophylla*	No	No	Old evidence of Australian Ringneck and Red-capped parrot	None
385157	6324881	CC57	*Corymbia calophylla*	No	No	Forest Red-tailed Black Cockatoo foraging, possibly Carnaby's Cockatoos, feeding in pines	Heavy residue
385199	6324901	CC58	*Corymbia calophylla*	No	No	Old evidence of Australian Ringneck, Red-capped parrot and Butler's Corella	Poor condition
385112	6324610	CC59	*Corymbia calophylla*	No	No	No recent evidence	None
385132	6324593	EM52	*Eucalyptus marginata*	No	No	No recent evidence	Old stag, broken branches
385145	6324625	EM53	*Eucalyptus marginata*	No	No	No recent evidence	Poor crown development
385030	6324483	EM54	*Eucalyptus marginata*	No	No	No recent evidence	Poor crown development
384554	6324191	EM55	*Eucalyptus marginata*	No	No	No recent evidence	Poor crown development
384575	6324066	EM56	*Eucalyptus marginata*	No	No	No recent evidence	Poor crown development

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
384628	6324028	EM57	*Eucalyptus marginata*	No	No	No recent evidence	Poor crown development
384450	6324217	EM58	*Eucalyptus marginata*	No	No	No recent evidence	Poor crown development
387166	6325423	ER1	*Eucalyptus rudis*	No	No	No recent evidence	None
387148	6325507	ER2	*Eucalyptus rudis*	No	No	No recent evidence	None
387053	6325480	ER3	*Eucalyptus rudis*	No	No	No recent evidence	None
387063	6325532	ER4	*Eucalyptus rudis*	No	No	No recent evidence	None
387040	6325522	ER5	*Eucalyptus rudis*	No	No	No recent evidence	None
387034	6325520	ER6	*Eucalyptus rudis*	No	No	No recent evidence	None
387033	6325500	ER7	*Eucalyptus rudis*	No	No	No recent evidence	None
387023	6325531	ER8	*Eucalyptus rudis*	No	No	No recent evidence	None
387025	6325541	ER9	*Eucalyptus rudis*	No	No	No recent evidence	None
387029	6325555	ER10	*Eucalyptus rudis*	No	No	No recent evidence	None
387019	6325565	ER11	*Eucalyptus rudis*	No	No	No recent evidence	None
386812	6325439	ER12	*Eucalyptus rudis*	No	No	No recent evidence	None
386801	6325446	ER13	*Eucalyptus rudis*	No	No	No recent evidence	None
386496	6325423	ER14	*Eucalyptus rudis*	No	No	No recent evidence	None
386474	6325455	ER15	*Eucalyptus rudis*	No	No	No recent evidence	None
386486	6325477	ER16	*Eucalyptus rudis*	No	No	No recent evidence	None
386393	6325543	ER17	*Eucalyptus rudis*	No	No	No recent evidence	None
386387	6325551	ER18	*Eucalyptus rudis*	No	No	No recent evidence	None
387007	6325395	ER19	*Eucalyptus rudis*	No	No	No recent evidence	None

Easting	Northing	WPT	Species	Hollow type	Hollow size(cm)	Foraging/roosting/breeding evidence	Other comments
387051	6325404	ER20	*Eucalyptus rudis*	No	No	No recent evidence	None
387081	6325426	ER21	*Eucalyptus rudis*	No	No	No recent evidence	None
387240	6325396	ER22	*Eucalyptus rudis*	No	No	No recent evidence	None
387039	6325473	ER23	*Eucalyptus rudis*	No	No	No recent evidence	None
387034	6325496	ER24	*Eucalyptus rudis*	No	No	No recent evidence	None
386920	6325497	ER25	*Eucalyptus rudis*	No	No	No recent evidence	None
386924	6325497	ER26	*Eucalyptus rudis*	No	No	No recent evidence	None
387233	6325398	ER27	*Eucalyptus rudis*	No	No	No recent evidence	None

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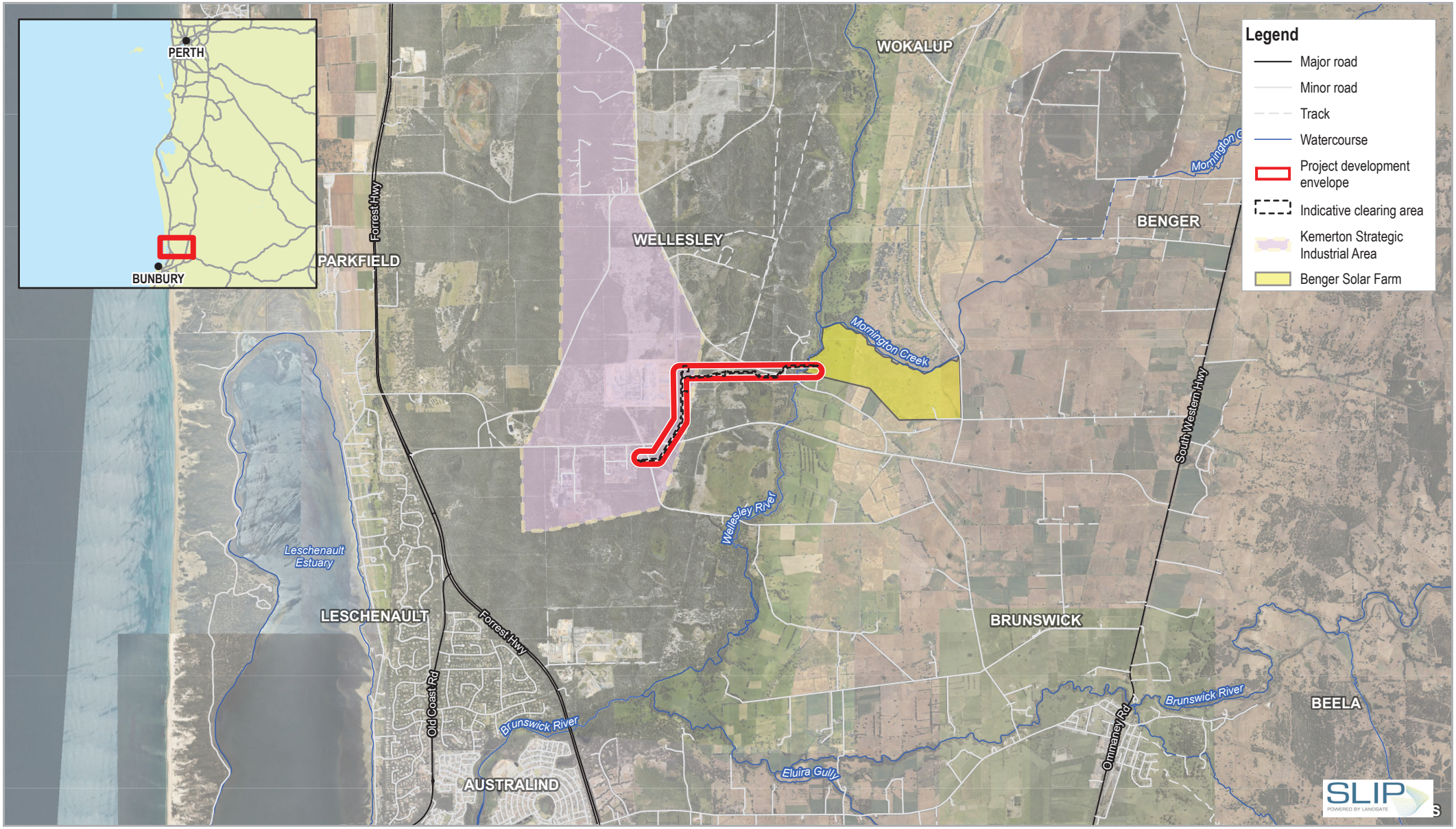
Appendix B - Figures



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

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South Energy
Benger Solar Farm Connection

Proposal Location

Project No. **61-12529778**
Revision No. **0**
Date **19 Apr 2021**

FIGURE 1

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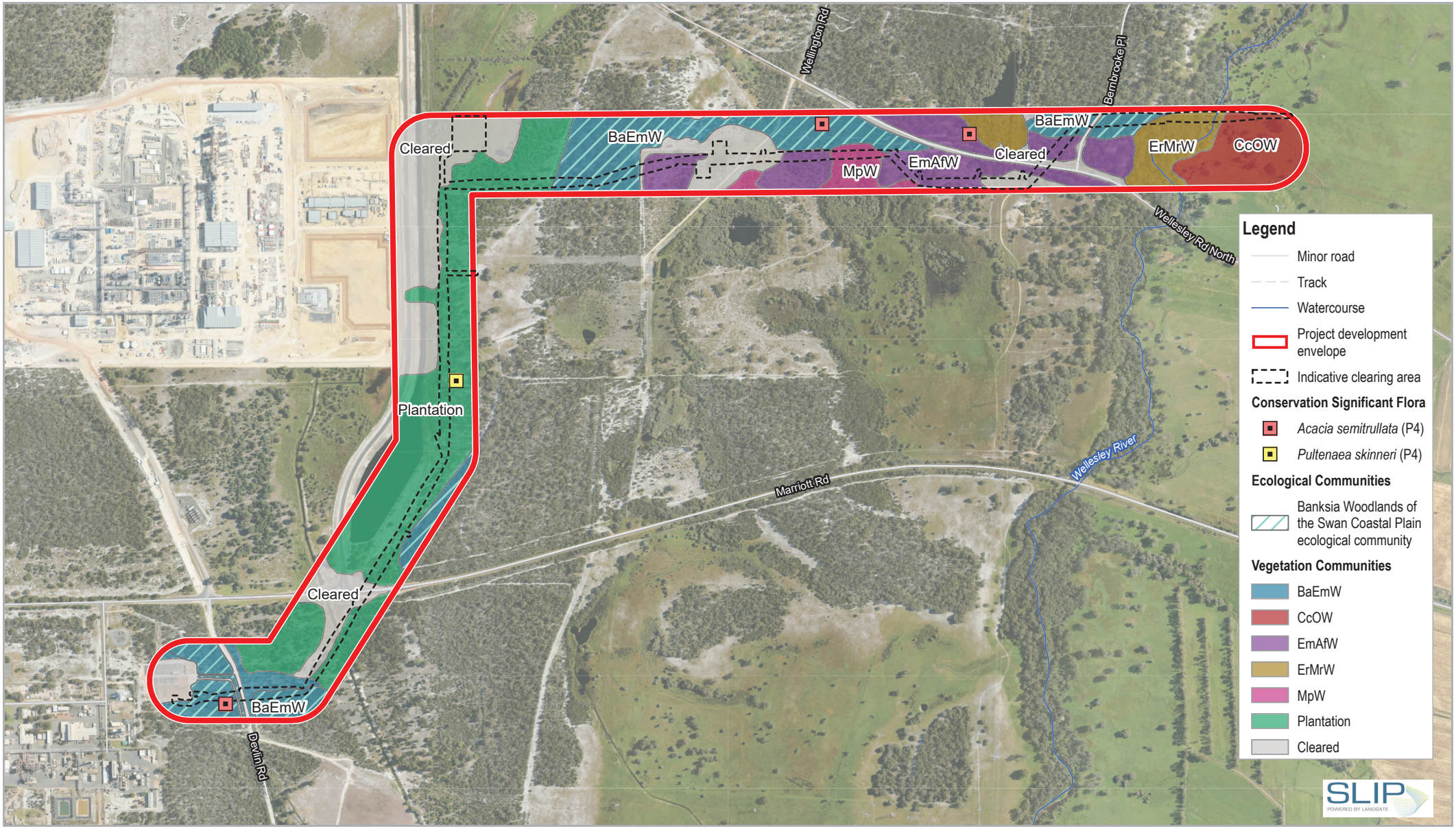
Print date: 19 Apr 2021 - 20:50

Data source: South Energy: Project development envelope, Benger Solar Farm - 20200313; DWER: Watercourses; DPLH: Kemerton Strategic Industrial Area; LGATE: Roads, Imagery - Nov 2017.WMS: .
Created by: htaniza



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Biological Constraints Flora and Vegetation

Project No. **61-12529778**
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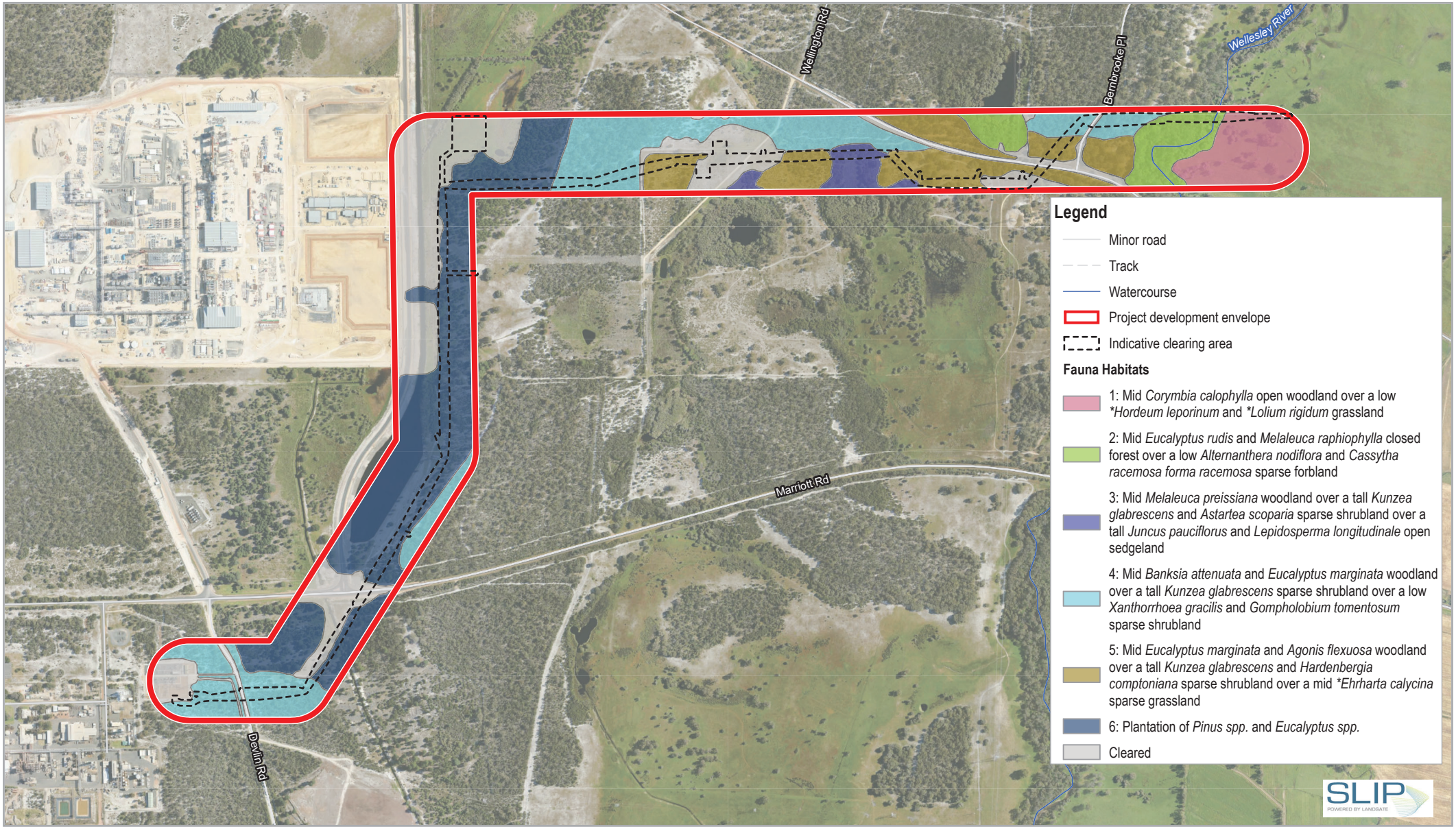
Date **19 Apr 2021**

FIGURE 2

\\ghdnet\ghd\AU\Perth\Projects\61\12529778\GIS\Maps\Working\12529778_Figures\12529778_Figures.aprx\12529778_002_BiologicalConstraints_Flora&Veg_Rev0
Print date: 19 Apr 2021 - 19:59

Data source: South Energy: Project development envelope, Conservation significant flora, Ecological communities, Vegetation communities - 20200313; GHD: Indicative clearing area; DWER: Watercourses; LGATE: Roads, Imagery - Nov 2017.WMS: . Created by: htaniza



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

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Biological Constraints Terrestrial Fauna

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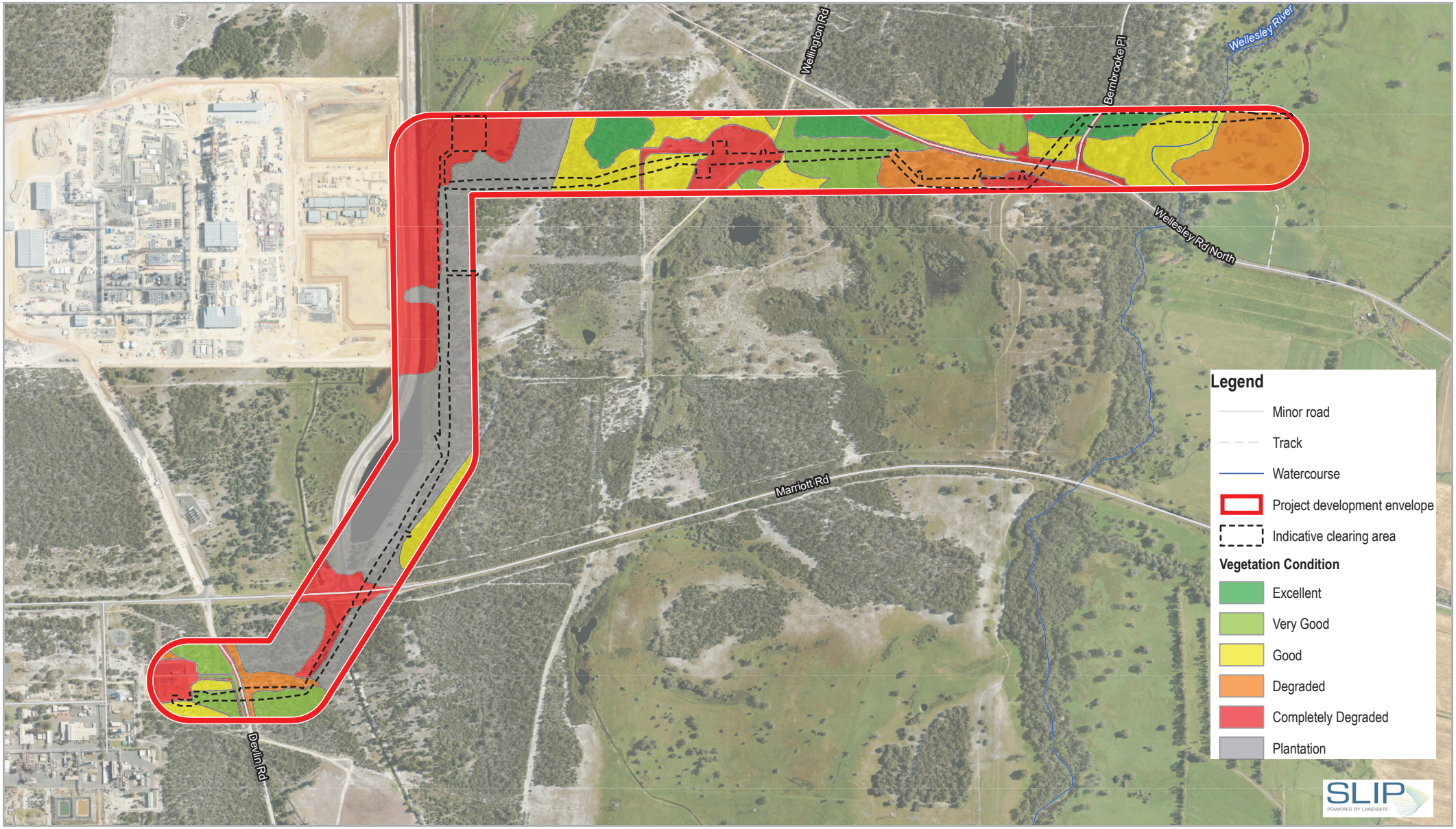
Date **19 Apr 2021**

FIGURE 3

\\ghdnet\ghd\AU\Perth\Projects\61\12529778\GIS\Maps\Working\12529778_Figures\12529778_Figures.aprx\12529778_003_BiologicalConstraints_TerrestrialFauna_Rev0
Print date: 19 Apr 2021 - 20:08

Data source: South Energy: Project development envelope, Fauna habitats - 20200313; GHD: Indicative clearing area; DWER: Watercourses; LGATE: Roads, Imagery - Nov 2017.WMS: . Created by: htaniza



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Metres

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

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Vegetation Condition

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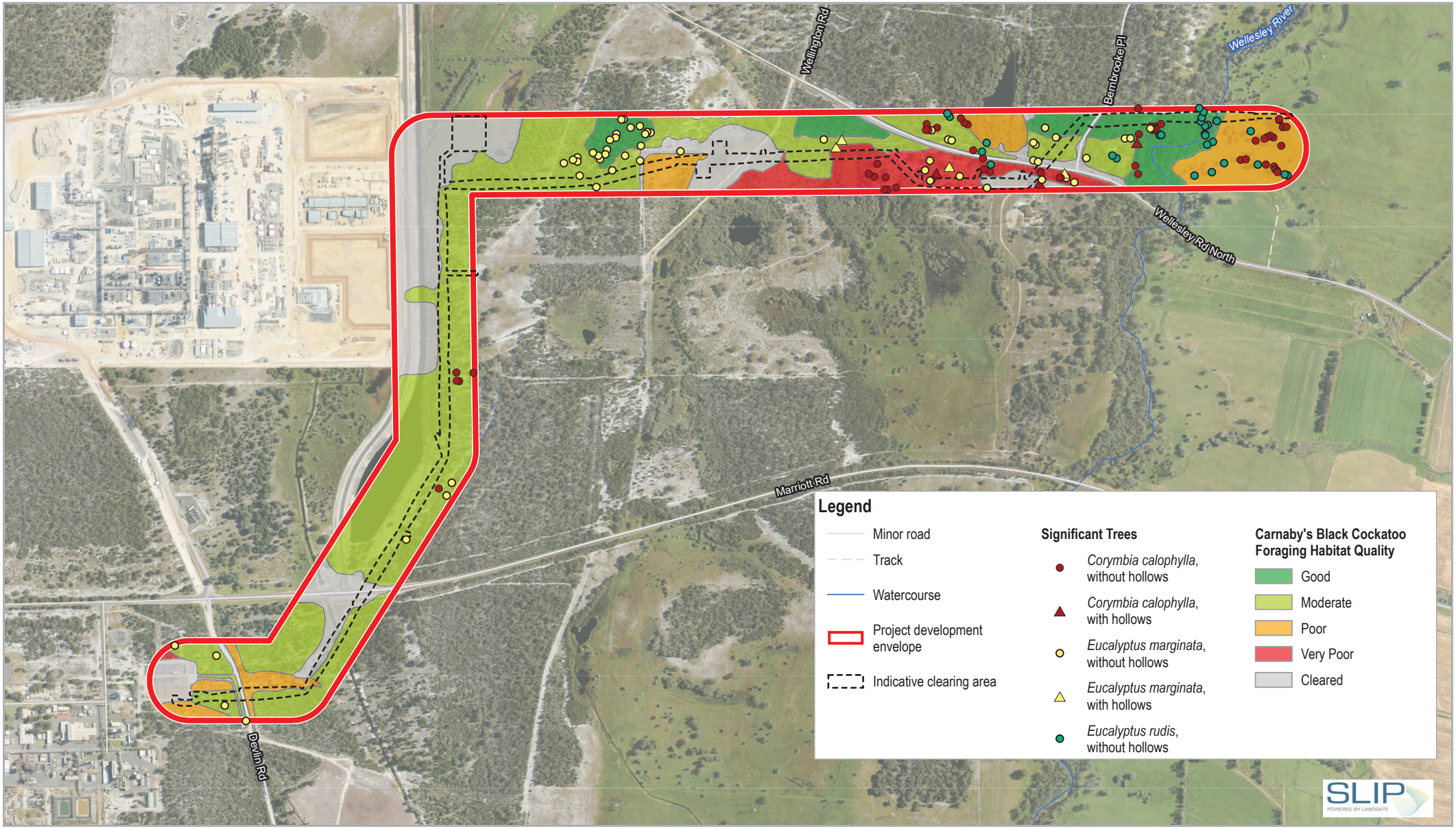
FIGURE 4

\\ghdnet\ghd\AU\Perth\Projects\61\12529778\GIS\Maps\Working\12529778_Figures\12529778_Figures_Amendments.aprx\12529778_004_VegetationCondition_Rev0
Print date: 20 Apr 2021 - 08:46

Data source: South Energy: Project development envelope, Vegetation condition- 20200313; GHD: Indicative clearing area; DWER: Watercourses; LGATE: Roads, Imagery - Nov 2017.WMS: . Created by: htaniza



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Metres

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

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Black Cockatoo Foraging Habitat and Significant Trees

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FIGURE 5

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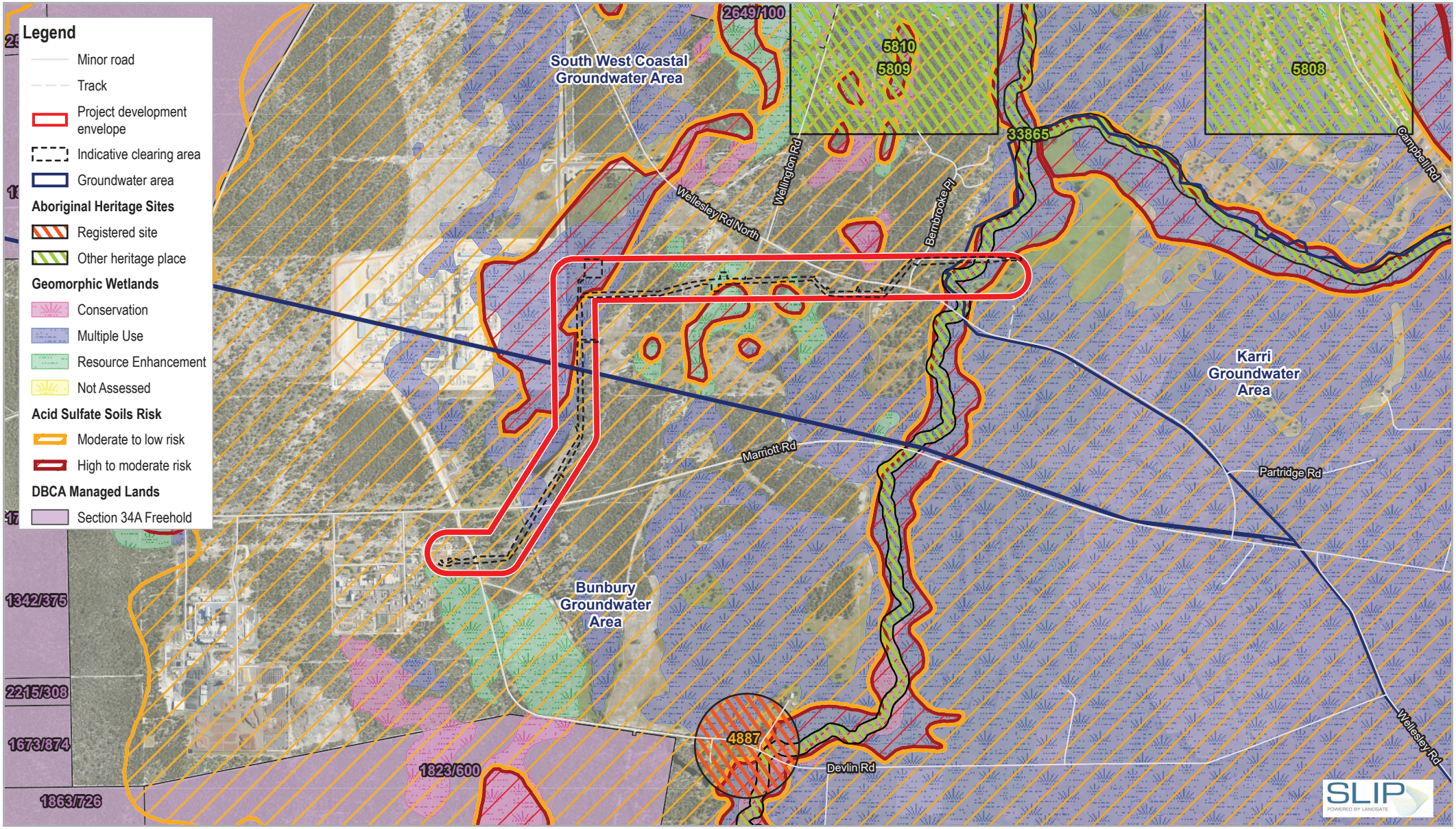
Print date: 19 Apr 2021 - 20:18

Data source: South Energy: Project development envelope, Significant trees - 20200313; GHD: Indicative clearing area; DWER: Watercourses; LGATE: Roads, Imagery - Nov 2017.WMS: . Created by: htaniza



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

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Environmental Constraints

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Date **19 Apr 2021**

FIGURE 6

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Print date: 19 Apr 2021 - 20:21

Data source: South Energy: Project development envelope - 20200313; GHD: Indicative clearing area; DWER: Groundwater areas; DPLH: Aboriginal heritage sites; DBCA: Geomorphic wetlands, Managed lands; LGATE: Roads, Imagery - Nov 2017.WMS: . Created by: htaniza

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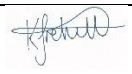
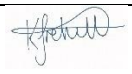
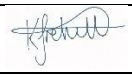
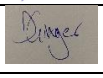
12529778-44346-29/https://projectsportal.ghd.com/sites/pp18_04/bengersolarfarmconne/ProjectDocs/12529778_Rev-1_NVCP-Supporting-Document.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	S. Isbister	K Frehill		M Brook		07/08/2020
0	S. Isbister	K Frehill		M Brook		13/08/2020
1	S. Goldsworthy	K. Frehill		D. Ginger		25/05/2021

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