Energy Resources Limited

Raven 2D Seismic Survey Section 38 Referral – *Environmental Protection Act 1986*

24 April 2020

57059/128067 Rev 0

JBS&G Australia Pty Ltd T/A Strategen-JBS&G

www.jbsg.com.au

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Abbreviations

Term	Definition
AH Act	*Aboriginal Heritage Act 1972*
ASS	Acid Sulfate Soil
BAM Act	*Biosecurity and Agriculture Management Act 2007*
CAMBA	China Australia Migratory Bird Agreement
DAWE	Department of Agriculture, Water and Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DMIRS	Department of Mines, Industry Safety and Regulation
DTA	Defence Training Area
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EP Act	*Environmental Protection Act WA 1986*
EPA	Environmental Protection Authority
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
ERL	Energy Resources Limited
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
JAMBA	Japan Australia Migratory Bird Agreement
MRWA	Main Roads Western Australia
PASS	Potential Acid Sulfate Soil
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
ROKAMBA	Republic of Korea Australia Migratory Bird Agreement
SWALSC	South West Aboriginal Land and Sea Council
TEC	Threatened Ecological Community
UCL	Unallocated Crown Land
VT	Vegetation Type

1. Introduction

1.1 Purpose of this Document

This document has been prepared to provide supporting information and evidence for referral of the Raven 2D seismic survey proposed by Energy Resources Limited (ERL) (the Proposal).

This supporting document should be read in conjunction with the completed 'Form for the referral of a proposal to the Environmental Protection Authority under section 38 of the *Environmental Protection Act 1986*'.

1.2 Proponent Details

ERL is a subsidiary of Mineral Resources Limited (MRL) an Australian-based, ASX listed (ASX:MIN) and New Zealand incorporated mining services company with assets in Western Australia. ERL is the holder of nine exploration permits and two production licences across five locations in the onshore Perth Basin, which extends from south of the Perth Metropolitan area to the Shire of Mingenew in the north. Proponent contact details are provided in Table 1.1.

Table 1.1: Proponent details

Proponent	Energy Resources Limited (ABN 63 009 475 423)
Contact person	Sean Daniels Operations Manager sean.daniels@enres.com.au 1 Sleat Road, Applecross, Western Australia, 6153 +61 8 9329 3487

2. The Proposal

2.1 Background

ERL is proposing to undertake the Raven 2D seismic acquisition survey in the Shire of Dandaragan in the Swan Coastal Plain region in the South-West of Western Australia within Petroleum Exploration Permit EP 432 (the Proposal) (Figure 2.1).

The Proposal comprises a total of 125 line kilometres (Lkm) of 2D seismic lines within an area of approximately 122.6 km^2 within the Perth Basin (the Development Envelope). The Proposal will require temporary disturbance of up to 40 ha of native vegetation to create access lanes for the vibroseis trucks and light vehicles. Previously cleared areas will be utilised where possible to undertake the Proposal.

The Proposal is proposed to be undertaken over a total activity period of twelve (12) weeks (including mobilisation and demobilisation).

2.2 Justification

The Proposed Raven 2D Seismic Survey is being acquired to further understand the structure and stratigraphy of the Raven Lead that lies within a complexly faulted area between the Cataby-1 and Mullering-1 wells of EP432 and the Walyering Gas Field of EP447. The survey will infill the existing multi-vintage 2D seismic grid (which was mostly acquired in 1989) and tie into the Mullering-3D and both the Cataby-1 and Mullering-1 wells.

The purpose of the Proposal is to map the subsurface geology of the area to enable identification of petroleum reservoir rocks for potential future conventional resource extraction. The Proposal involves only the completion of a 2D seismic acquisition survey only. It does not include any drilling, hydraulic fracturing or extraction activities.

2.3 Proposal Location

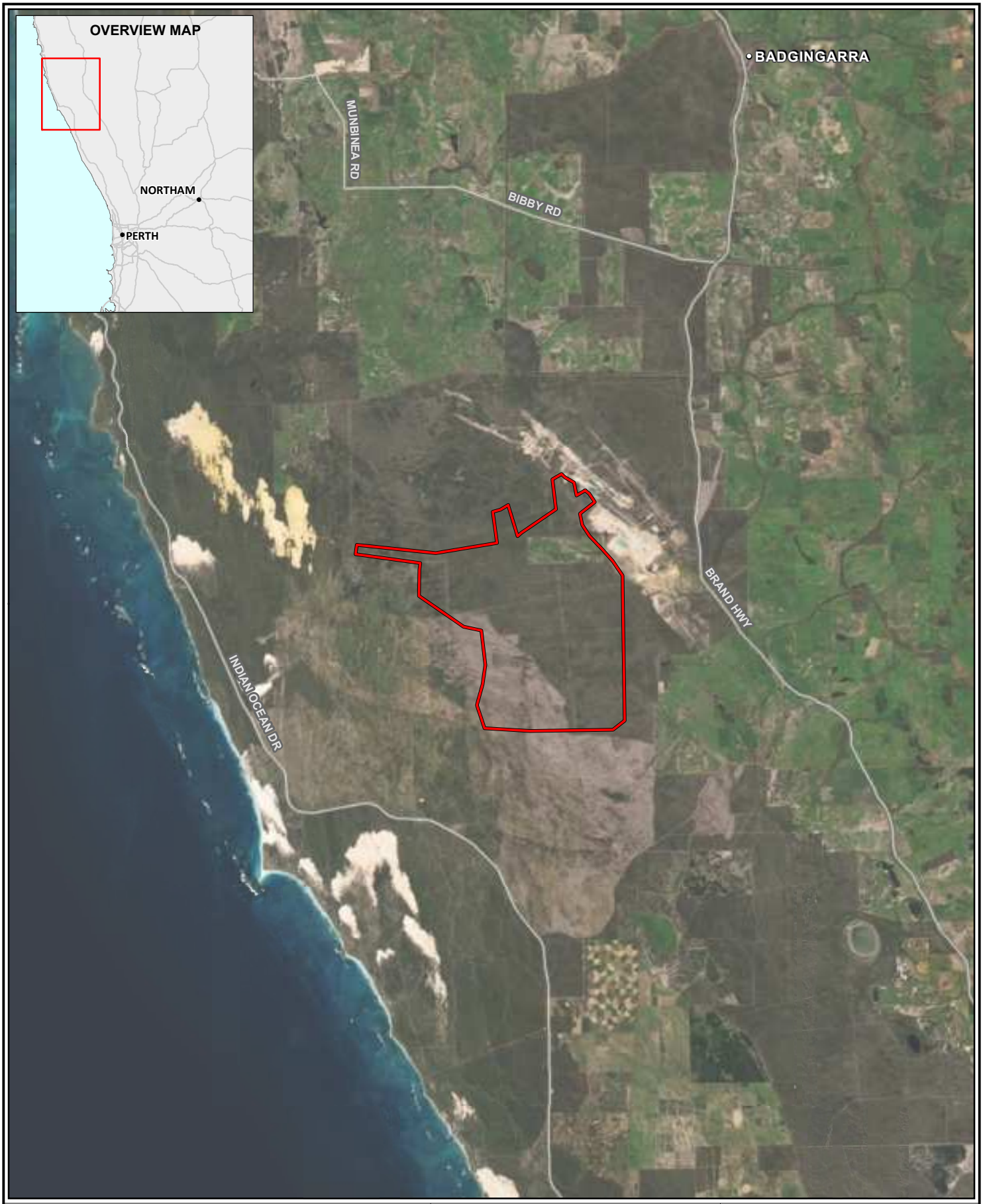
The area defined as the 'Development Envelope' is the physical area used to conduct the Proposal, including laydown facilities. The Development Envelope is located within the Shire of Dandaragan in the Wheatbelt region of Western Australia. The majority of the population resides in Jurien Bay, located approximately 55 km northwest of the Development Envelope.

2.4 Proposal Description

The Proposal comprises a total of 125 Lkm of 2D onshore seismic acquisition across a 122.6 km^2 area within Petroleum Exploration Permit EP 432. The cadastral boundary for this permit is shown in Figure 2.2.

The Proposal comprises the following key elements:

- preparation of vehicle access lands by cutting up to 40 ha of vegetation above ground level and mulching greenstock with immediate replacement of mulch in-situ;
- laying receiver nodes along access lanes (width 3.5m) to a maximum depth of 200 mm;
- undertaking seismic acquisition (generation of an acoustic signal) using vibroseis trucks; and
- demobilising, rehabilitation and closing vehicular access to seismic lines, monitoring and as required, remedial rehabilitation works.



Legend:

- Project Area
- Major road

Scale 1:300,000 at A4

0 2.5 5
Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 57624

Client: Energy Resources Limited

Version: A | Date: 06-Mar-2020

Drawn By: cthatcher | Checked By: TS

REGIONAL LOCATION

FIGURE 2.1

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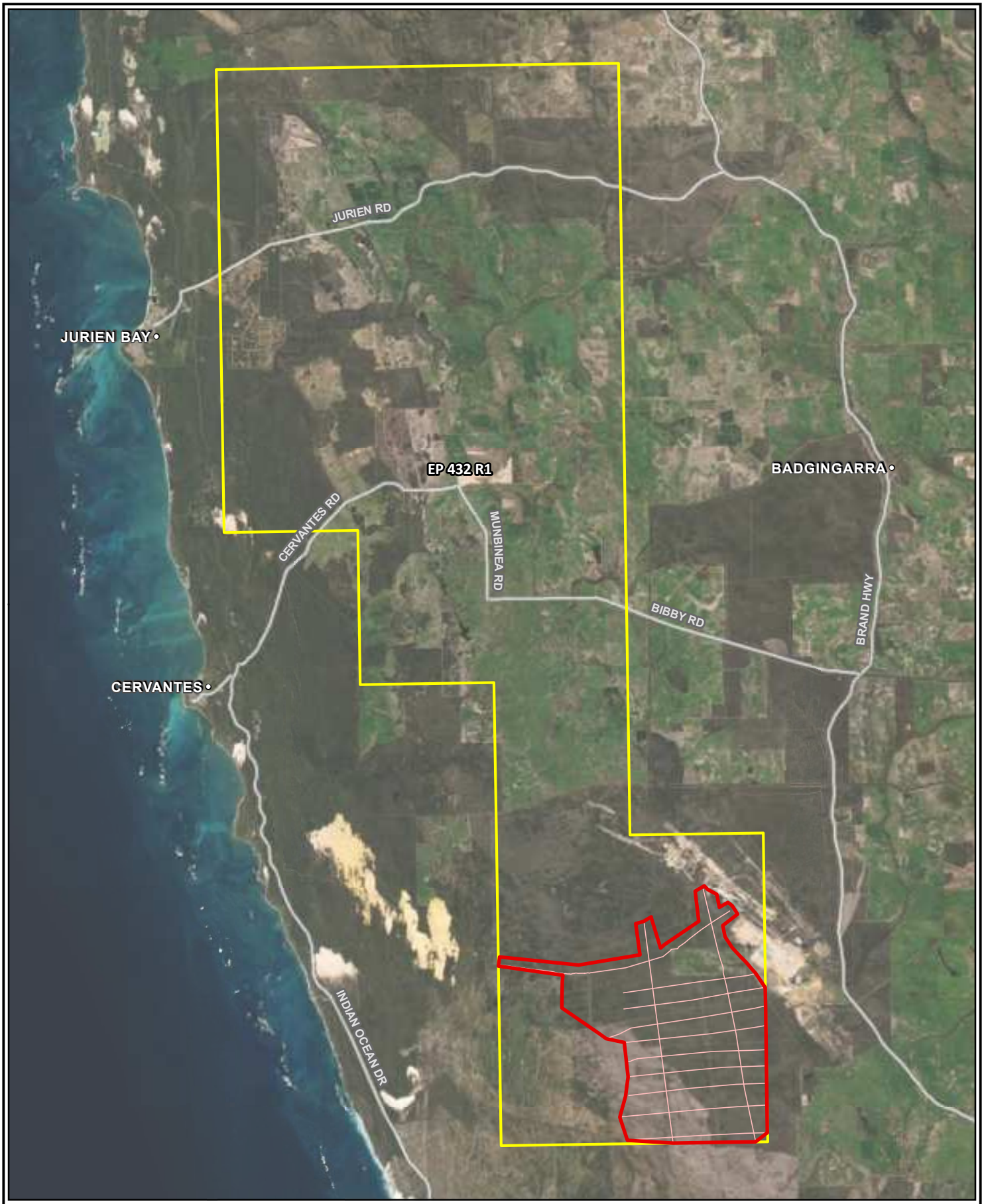
File Name: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_01_1_RegLocn.mxd
Image Reference: Energy Resources Limited; Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend:

- Raven project area
- Permit area
- Seismic lines
- Major road

Scale 1:300,000 at A4	0 2.5 5 Kilometres
Coord. Sys. GDA 1994 MGA Zone 50	
Job No: 57059	
Client: Energy Resources Limited	
Version: A	Date: 20-Apr-2020
Drawn By: cthatcher	Checked By: AL

RAVEN PERMIT BOUNDARY AND 2D SEISMIC LINES

FIGURE 2.2

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Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

2.4.1 Proposal Description

Seismic acquisition

The Proposal involves laying out nodes and conducting a seismic survey using vibroseis technology. Nodal receivers (Figure 2.3) are placed at regular intervals along seismic lines (source and receiver), laid using light vehicles or by hand-carrying equipment. The nodes are planted into the ground to approximately 100 mm depth (between 75 mm and 200 mm) so that about 50 mm sits above the ground surface. For areas of hard ground, a hand-held drill and auger will be used for placement.

Figure 2.3: Nodal receiver

Acquisition is the process by which a seismic source is generated to enable the collection of data on the subsurface structure and characteristics. The acquisition area is located entirely within the Development Envelope.

Vibroseis trucks traverse seismic lines, creating acoustic waves at regular intervals; reflected acoustic waves are received by the nodes. Data is processed then interpreted to create subsurface imaging.

Seismic survey line preparation

To enable vehicle access along the source and receiver lines, access lanes of maximum 3.5 m width are needed. As a result, the Proposal will temporarily disturb up to 40 ha of native vegetation, which represents 0.33%% of the Development Envelope (12 266 ha). The line preparation machinery will be fitted with a real-time sub-1 m accuracy positioning solution to allow the line clearing equipment to accurately follow the path of the line data provided (which incorporates botanical survey work already undertaken).

Where native vegetation must be cleared for the creation of tracks, this will occur through 'single-pass' cutting vegetation above ground level using cutting and mulching, as close to the ground surface as possible, leaving topsoil and root-stock undisturbed. One tractor-mounted 'fixed hammer' mulcher will be used for line preparation. Fixed Hammer mulchers provide minimal ground disturbance and safe vehicle access. The mulcher follows a fixed distance above the natural ground contours rather than digging into the ground surface, which avoids disturbance to soil and roots of vegetation. The 'single pass' technique also minimises overall traffic along the seismic lines, reducing additional potential soil compaction and vegetation disturbance. Seismic survey lines can be deviated from the nominal mapped alignments by up to 50 m without losing definition in survey results.

Cut vegetation will be mulched and returned to its place of origin along lanes. This will facilitate return of seed-stock and biomass to the soil and provide cover to minimise the risk of soil erosion. The vibroseis vehicle has a ground clearance of 46 cm, sufficient to leave the mulched vegetation intact along the seismic lines. No stockpiling of mulch will be needed.

This method of vegetation clearing ensures optimal conditions for successful rehabilitation within a minimised footprint, as follows:

- disturbance created by cutting and mulching vegetation is of a lower order and scale than conventional clearing (i.e. complete removal of vegetation and rootstock);
- there is no topsoil disturbance, reducing the risks of erosion and impacts on water filtration into the thin topsoil layer containing the seed resource. In turn, this minimises the potential to leave the area prone to weed invasion; and
- return of the mulched material to its source location will ensure a maximum rate of humus production and includes facilitation of recolonisation by microfauna (particularly burrowing invertebrates) and an increase in nutrient cycling within the topsoil.

Rehabilitation and monitoring

All equipment will be removed at the completion of the Proposed Action.

As the proposed mulching method does not require extensive rehabilitation at the cessation of the activity, the majority of disturbed areas will be rehabilitated immediately following completion of the survey. The mulching method of clearing will leave root and seed stock in-situ and natural regeneration of native vegetation is expected.

ERL will monitor rehabilitation following completion of the Proposed Action to ensure native vegetation along seismic lines returns to a composition and structure that is comparable to its pre-disturbance state.

Monitoring will commence one month after completion of the Project with a focus on third party access issues. The program will then continue annually between September and November for two years or until monitoring demonstrates rehabilitation completion criteria have been met. A paired transect design will be implemented to enable comparison of vegetation recovery with undisturbed vegetation. Rehabilitation progress will be reported to the WA Department of Mines, Industry Regulation and Safety (DMIRS) in the form of an annual report.

Supporting infrastructure and services

Due to the isolated nature of the Project Area, it will be self-sufficient with respect to utilities and services. An existing cleared area will be identified and used as a laydown location for unused equipment by the contractor over the duration of the Proposed Action as required. Bulk

hydrocarbon and chemical (i.e. drums and bulky containers) will be stored in accordance with AS1940 (The Storage and Handling of Flammable and Combustible Liquids) at the laydown area.

2.4.2 Timing and Proposal Staging

Pending receipt of all relevant approvals, ERL plans to commence the Proposal Quarter 2, 2020.

2.5 Local and regional context

2.5.1 Regional context

The Proposal is located within the Swan Coastal Plain 2 (SWA02 –Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Proposal is located between Grey Road and the Brand Highway, approximately 7 km east of Nambung National Park and 4 km east of Wanagarren Nature Reserve at its closest point [1]. Immediately east of the Development Envelope is the Tronox Cooljarloo Mineral Sands Mine. The Development Envelope overlaps Nature Reserve 40916 (un-named), located approximately 600 metres west of Brand Highway.

2.5.2 Climate

The Midwest Region has a Mediterranean climate consisting of hot, dry summers and cool, wet winters. The nearest weather station which records both temperature and rainfall data is the Badgingarra (station 009037), approximately 32 km from the Development Envelope. The average rainfall from 1965-2020 was 534.6 mm with the highest monthly rainfall occurring from May to September (Figure 2.4). The wettest year on record was 1963, with an annual rainfall of 785.2 mm, 607 mm of which fell during the May to August period (BOM, 2020).

The average maximum temperatures range from 17.6°C in July to 34.7°C in January/February. The average minimum temperatures range from 7.1°C in August to 17.8°C in February.

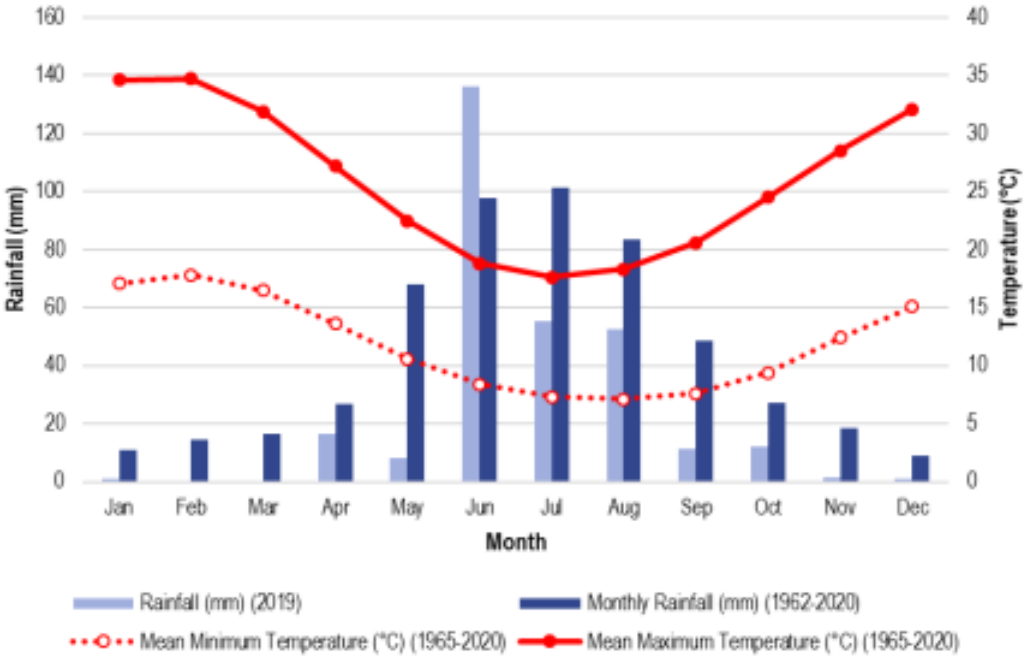


Figure 2.4: Monthly average rainfall and temperature at Badgingarra (Station 009037)

[1] National parks are established for wildlife and landscape conservation, scientific study, preservation of features of archaeological, historic or scientific interest, but are also able to be used for enjoyment by the public. They have national or international significance for scenic, biological or cultural values (DBCA).

2.5.3 Landform

The Proposal is located within the Swan Coastal Plain geomorphologic division of Western Australia and is situated on the Bassendean sand complex. This complex is characterised as a gently undulating landscape consisting of sand dunes, inter-dune basins and swales (Blandford 2004). Refer to Figure 2.5

2.5.4 Geology and Soils

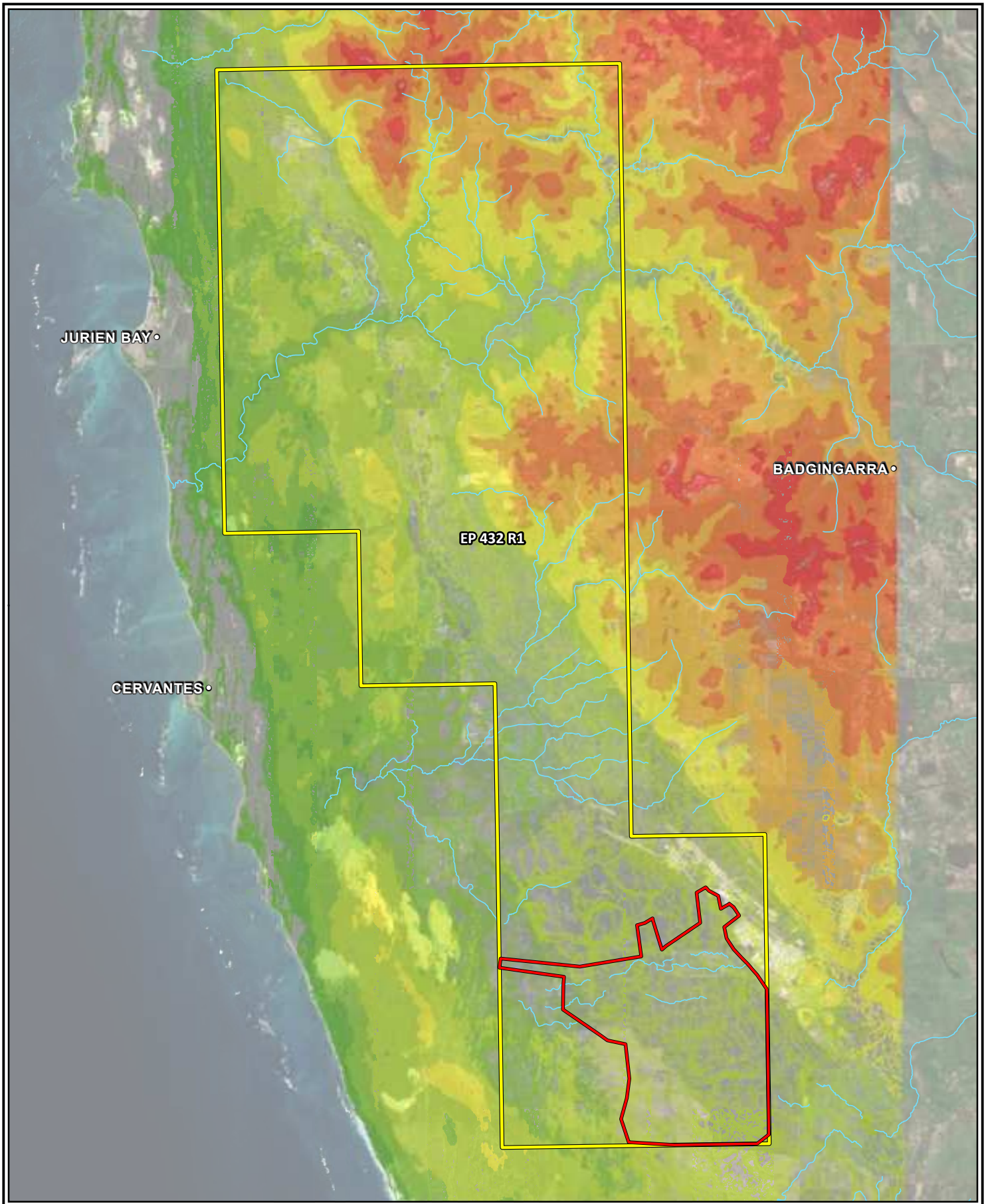
The Proposal is located within the Perth Basin, which extends from the Murchison River to the south coast of Western Australia. It is defined on the eastern boundary by the Darling Fault, with the western boundary lying under the continental slope. The Perth Basin contains a Silurian to Pleistocene sedimentary succession. According to Mory and Iasky (1996), the onshore Perth Basin is divided into 13 structural units, with the Proposal occurring on the Cadda Terrace and the Coomallo Trough units, which lie to the west of the Eneabba Fault.

Much of the Perth Basin is overlain by Quaternary deposits, up to 75 m in thickness, comprising mainly laterite and associated eluvial sand, coastal limestones, associated dune sands, lake and swamp deposits, alluvium and colluvium (Playford et al. 1975).

Specifically, the Proposal is located on the Swan Coastal Plain physiographic unit, which is comprised of four north-south oriented systems. The Proposal is located on the Bassendean Dune System (Mory and Iasky 1996).

The majority of the Development Envelope consists of Bassendean Sand comprising ancient coastal quartz-sand dunes, scattered with areas of swamp and lacustrine deposits of sand, clay and diatomite. The Bassendean Dunes represents a belt of coastal dunes and other associated shoreline deposits with local concentrations of heavy-mineral sands, the identification of which from surface features is virtually impossible (Mory and Iasky (1996). Bassendean Sands, which are almost completely leached of calcium carbonate, are represented by subdued hummocks of quartz sand with intervening swamps (Playford et al. 1975).

The Bassendean Sands have a maximum thickness of 80 m (Playford and Low 1972) and consist of very fine to coarse grained, well sorted quartz sand with some organic material; seasonal wetting and perching occurs in the sandy horizons as well as the presence of mottled clays at the base of this unit. This layer is underlain by the Guildford Formation, which consists of blue-grey to brown silty to slightly sandy clay, which can be separated into an upper clayey facies (maximum thickness 27 m) and a lower sandier facies (nominally to 22 m thickness). The upper clay facies acts as an aquitard, with a perched water table above this unit; however, although the permeability of the clay facies is generally low, there are areas with significantly higher hydraulic conductivity where sandier portions of the Guildford Formation occur (Worley Parsons 2013).



Legend:

- Raven project area
- Permit area
- Watercourse line

Elevation contours (m)

- 5 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300

Scale 1:300,000 at A4 (0 2.5 5 Kilometres)	
Coord. Sys. GDA 1994 MGA Zone 50	**TOPOGRAPHY**
Job No: 57059	
Client: Energy Resources Limited	**FIGURE 2.5**
Version: A	Date: 20-Apr-2020
Drawn By: cthatcher	Checked By: AL

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Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

2.5.5 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring, iron-sulphide rich soils, sediments or organic substrates, formed under waterlogged conditions. If exposed to air, these sulphides can oxidise and release sulphuric acid and heavy metals. This process can occur due to drainage or where dewatering is undertaken to facilitate excavation (below the water table).

A review of the Australian Soil Resources Inquiry System database indicated that the presence of Potential Acid Sulfate Soils (PASS) within the Development Envelope.

There are no planned activities associated with the Proposal that would result in ASS materials being exposed to air.

2.5.6 Regional Hydrology

2.5.6.1 Surface water

The Development Envelope includes 135 wetlands comprising a total area of 3,477 ha. These wetlands may be described as being creeks, damplands, floodplains, palusplains and sumplands.

The Development Envelope is drained by watercourses originating on the Dandaragan Plateau and the Arrowsmith Region. All watercourses, including Mullering Brook in the Development Envelope and Minyulo Brook to the south, are seasonal streams, with highly variable flows, terminating in large swamps or lakes within the Bassendean dunes. Both brooks form part of the Minyulo suite, which is a group of wetlands that have local and regional significance as a result of stratigraphy and presence of endemic flora (Semeniuk Research Group 1994).

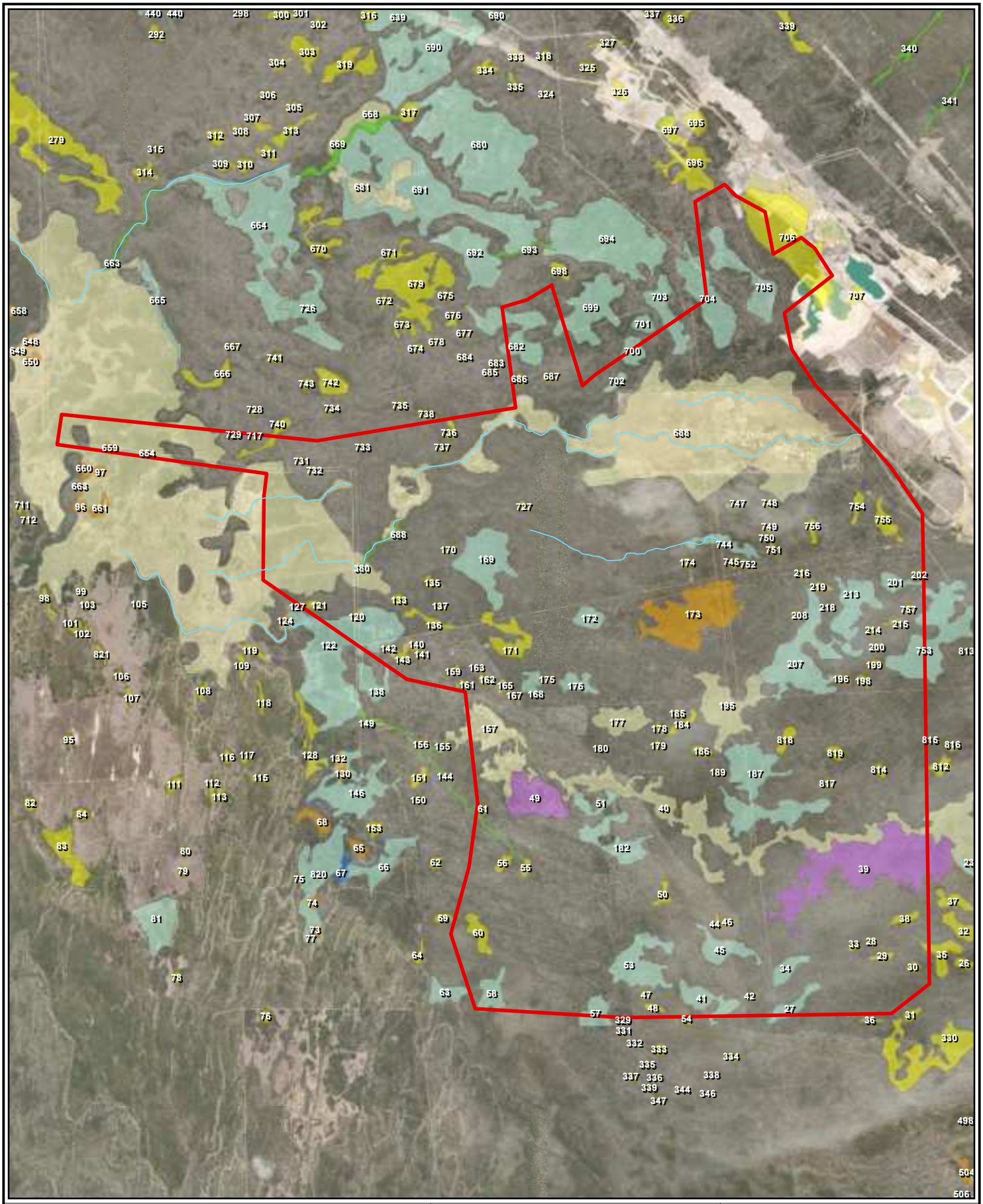
The southern portion of the Development Envelope includes the Nammings wetlands system which is comprised of a series of ovoid microscale lakes, sumplands and creeks located in the vicinity of Caro Brook in the Bassendean dunes (Seminiuk 1994). The system also includes permanent and seasonal lakes and swamps that occur in interdunal depressions in the Bassendean Dunes, for example the Douaraba Swamp, Lake Walyengarra and Emu Lakes to the south east of the Development Envelope (Kern 1989) (Figure 2.6). The wetlands are typically fresh to saline (ie. poililohaline) with water levels being maintained from groundwater rise and surface flow from watercourses that traverse the area, for example Minyulo Brook.

2.5.6.2 Groundwater

There are two main regional aquifer systems in the vicinity of the Proposal: the Superficial Formations and the Yarragadee Formation.

The Superficial Formations comprise alternating layers of sands and clays, which form an unconfined to semi-confined anisotropic groundwater flow system. This aquifer extends from ground surface to depths of between 18m to 50 m. Fluvial deposits derived from Mullering Brook and other watercourses are associated with this formation, which is recharged via direct infiltration of rainfall and upward leakage of groundwater from the Yarragadee Formation (Tronox 2017).

The Yarragadee Formation is predominantly comprised of sandstone and forms both the thickest and most extensive aquifer system within the region (Parsons Brinckerhoff 2011). This aquifer is overlain in part by the Superficial Formations and is recharged via direct infiltration of rainfall through the Superficial Formations (Tronox 2017).



Legend:

- Raven project area

Geomorphic Wetlands (DBCA)

- Barlkarra
- Creek
- Dampland
- Floodplain
- Lake
- Palusplain
- Sumpland
- Watercourse line

Scale 1:92,500 at A4

0 1 2 Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 57059

Client: Energy Resources Limited

Version: A | Date: 20-Apr-2020

Drawn By: cthatcher | Checked By: AL

SURFACE WATER FEATURES

FIGURE 2.6

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File Name: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\R01 Rev A\57059_0x_SurfaceWater.mxd
Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

2.5.7 Vegetation

2.5.7.1 Desktop assessment

Database searches were undertaken to generate a list of vascular flora and Threatened and Priority Ecological Communities previously recorded within, and nearby the Development Envelope. Database searches were conducted within a 10 km buffer of the Development Envelope. These are provided in Appendix A.

Table 2.1: Database searches conducted for the flora and vegetation desktop assessment (Strategen-JBSG 2019)

Custodian	Database	Taxonomic group	Buffer
Department of Biodiversity, Conservation and Attractions (DBCA)	NatureMap (*https://naturemap.dbca.wa.gov.au*)	Flora and Fauna	10km
DBCA	TPFL (*https://catalogue.data.wa.gov.au/dataset/threatened-and-priority-fauna*	Flora	5km
DBCA	Communities (*https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/*	Flora	5km
DBCA	Protected Matters Search Tool (PMST) *(environment.gov.au/epbc/protected-matters-search-tool)*	Ecological Communities	5km
Department of Agriculture, Water and Environment (DAWE)	NatureMap (*https://naturemap.dbca.wa.gov.au*)	Flora, Fauna and Communities	10km
DBCA	WA Herbrium (*https://florabase.dpaw.wa.gov.au/)*	Flora	5km

A number of previous surveys have been conducted within or adjacent to the Development Envelope (Table 2.2). These reports were also reviewed as part of the desktop assessment for flora and vegetation.

Table 2.2: Past flora and vegetation surveys and investigations over the Development Envelope

Description of survey and reference	Field work timing
Vegetation Survey – Vacant Crown Land, Cooljarloo (Mattiske 1996)	
Vegetation Survey – 27000 South Area, Cooljarloo (Mattiske 1997)	
Major Habitat Mapping – Cooljarloo Minesite North Mine Region, July 2002 (Western Botanical 2002)	July 2002
Mullering Onshore 3D Seismic Survey – Flora Vegetation and Dieback (*Phytophthora cinnamomi*) Survey (Woodman 2006a)	
Cooljarloo North (Falcon) Tenements, Flora, Vegetation and *Phytophthora cinnamomi* Assessment (Woodman 2006b)	
Tiwest Joint Venture – Cooljarloo West Phase 1 Drilling – Flora and Vegetation Assessment (Woodman 2007a)	
Falcon Mineral Sands Project: Flora and Vegetation, Local and Regional Conservation Significance (Woodman 2007b)	
Cooljarloo West Project – Flora and Vegetation Assessment (Woodman 2009a)	November 2008
Northern Operations – Cooljarloo Assessment of the Impacts of Mulch Harvesting on Floristic Composition of Native Vegetation (Woodman 2011)	
Cooljarloo West Drilling Program 2012 – Significant Flora Assessment (Woodman 2009b)	September –December 2009
Flora and Vegetation Survey of Exploration Access and Drill Lines in Cooljarloo West and Cooljarloo North West (Mattiske 2010)	September – December 2010
Tiwest 2011 Drill Program – *Phytophthora cinnamomi* Occurrence Assessment occurrence assessment (Glevan 2010)	October 2010
Cooljarloo West Mineral Sands Project – Regional Search for Restricted Wetland Communities (Woodman 2012)	February – March 2012

Description of survey and reference	Field work timing
Targeted Flora Search of Additional Exploration Access Lines – Cooljarloo West (Astron 2012)	December 2012
Conservation Assessment of Threatened and Priority Flora from the Cooljarloo Area	Woodman 2013
Cooljarloo West Titanium Minerals Project – Flora and Vegetation Assessment (Woodman 2014a)	September – November 2012 May 2013
Paracaleana dixonii review of conservation status and revised impact assessment (Woodman 2014b)	
Paracaleana dixonii Targeted Regional Surveys (Western Botanical 2014a)	December 2013, Jan 2014
Assessment of Conservation Significant Species, Cooljarloo (Western Botanical 2014b)	February 2014
Botanical Survey of 2015 Drill and Access Lines (Woodman 2015)	October 2015
Cooljarloo Survey Intensity Assessment (Astron 2015)	N/A
Cooljarloo West conservation significant flora risk assessment (Woodman 2015a)	N/A
Conservation significant flora survey and impact assessment, Tronox Cooljarloo West Project (Mattiske 2017)	July – December 2016

Regional vegetation

Beard (1990) Botanical Subdistrict

The Proposal occurs within the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

Australia's Interim Biogeographic Regionalisation for Australia subregion

IBRA describes a system of 89 'biogeographic regions' (bioregions) and 419 subregions covering the entirety of the Australian continent (Department of the Environment and Energy, 2019). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The Proposal occurs within the Swan Coastal Plain 2 (SWA2) IBRA subregion which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

Vegetation system association and System 6 mapping

Vegetation occurring within the region was initially mapped at a broad scale (1: 1 000 000) by Beard during the 1970s. This dataset formed the basis of several regional mapping systems, including the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia) for Western Australia (DEE 2017), physiographic regions defined by Beard (1981), and System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980).

The Development Envelope comprises four Beard (1981) vegetation associations (Figure 2.8). Percentage remaining of each vegetation association is provided in Table 2.3(GoWA 2019a). Heddle et.al. (1980) mapping does not extend to the Development Envelope.

Table 2.3: Beard (1981) vegetation associations within the Development Envelope (Strategen-JBSG 2019)

Vegetation Association	Description	Percent remaining in IBRA Region (%)	Clearing extent within Development Envelope	% impact
1026	Mosaic: Shrublands; *Acacia rostellifera, A. cyclops* (in the south) & *Melaleuca cardiophylla* (in the north) thicket / Shrublands; *Acacia lasiocarpa* & *Melaleuca acerosa* heath	93.84	0.07	<0.001
1029	Shrublands; scrub-heath dryandra-calothamnus assocication with *Banksia prionotes* on limestone in the northern Swan Region	71.84	0.68	<0.001
1030	Low woodland; *Banksia attenuata* & *B. menziesii*	63.81	38.60	0.029
1031	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath	19.30	No clearing	No clearing

Vegetation types

Woodman (2014a) defined 18 vegetation types (VTs) across the greater Cooljarloo West Study Area, which was based on three hundred and seventy (370) 10 x 10 m quadrats. The Cooljarloo West Study Area included the Development Envelope. Mapped boundaries of the vegetation communities within this area were subsequently reviewed during field survey in 2016 by Mattiske Consulting which resulted in minor modifications (Mattiske 2017).

Vegetation within these VTs range from the low open forests over species rich low shrublands (which occupy majority of the area) to areas of greater water availability (which include sedgelands, samphire shrublands and heathlands or woodlands on drainage lines).

Legend:

- Project Area

Pre-European vegetation (DPIRD)

- Bassendean_1030
- Bassendean_1031
- Guilderton_1026
- Guilderton_129
- Jurien_1029
- Jurien_125
- Le Sueur_1030
- Le Sueur_1031
- Le Sueur_7

strategen JBS&G

0 2
Kilometres

REGIONAL VEGETATION

Job No: 57624		Scale 1:100,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 06-Mar-2020

FIGURE: 2.7

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Image Reference:SLIP Public Services Imagery 2020.

Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the Development Envelope was undertaken using:

- NatureMap (Parks and Wildlife 2007)
- the Western Australian Herbarium (Western Australian Herbarium 1998)
- Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (DEE 2017).

The desktop assessment identified four Threatened flora and 49 Priority flora species that have been recorded in the local area. Of these, based on general habitat requirements, four (4) Threatened and 40 Priority flora species were considered to have potential to occur within the Development Envelope (Strategen-JBS&G 2020).

A field survey assessed whether these potential species actually occur in the areas to be cleared (refer to Section 2.5.7.2).

Threatened and Priority Ecological Communities

Based on the desktop assessment, one Threatened Ecological Community (TECs) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), and one Priority Ecological Community (PEC) listed by Department of Biodiversity Conservation and Attractions (DBCA), were considered to be potentially present within the Development Envelope (Table 2.4).

Table 2.4: TECs and PECs identified within and near the Development Envelope (Strategen-JBSG 2019)

Community	Conservation Status	
	EPBC Act	BC Act
Banksia Woodlands of the Swan Coastal Plain	TEC	PEC

2.5.7.2 Field survey

In addition to a detailed desktop assessment of the Development Envelope, a field assessment was undertaken in November 2019 (Ecological Survey). The Ecological Survey was conducted in accordance with the EPA *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

The Ecological Survey comprised:

- a reconnaissance survey to confirm previous vegetation mapping undertaken across the Development Envelope;
- a targeted survey of 15 m corridors along each seismic lines with a total length of 86.5 km. The total area surveyed was 129.77 ha (Ecological Survey Area); and
- for occurrences of taxa thought to be conservation significant, a GPS location and a count of the individuals present for a given area for the species, were recorded. The extent of the populations were also recorded to enable mapping of populations.

Threatened and Priority flora

Three (3) Threatened flora and 15 Priority flora species as listed under section 178 of the EPBC Act or section 19(1) of the *Biodiversity Conservation Act 2016* (WA) Act (BC Act) were recorded within the Development Envelope (Strategen-JBSG 2019; Appendix A: Table 5.1), as shown in Figure 2.9.

The Ecological Survey was conducted during the main flowering season for flora of the southwest botanical region (i.e. Spring), including the Threatened and Priority species identified as having the

potential to occur in the Development Envelope. As such, the Ecological Survey was undertaken during the optimal time to detect the majority of species present (Strategen-JBSG 2019).

The taxon *Macarthuria keigheryi* was recorded in very large numbers in the north-western portion of the Development Envelope. This area was burned in a 2015-2016 fire and this taxon is likely to be stimulated by fire, causing a flush of growth which will eventually senesce and numbers will gradually reduce.

Project Area

Conservation significant flora

- Andersonia gracilis
- Anigozanthos humilis subsp. chrysanthus
- Anigozanthos viridis subsp. terraspectans
- Anigozanthos viridus subsp. terraspectans
- Babingtonia urbana
- Banksia dallanneyi subsp. pollosta
- Chordifex chaunocoleus
- Chordifex reseminans
- Conospermum scaposum
- Conostephium magnum
- Desmocladus nodatus
- Guichenotia alba
- Hakea longiflora
- Isopogon panduratus subsp. palustris
- Isotropis cuneifolia subsp. glabra
- Macarthuria keigheryi
- Stylidium hymenocraspedum
- Verticordia huegelii var. tridens
- Verticordia lindleyi subsp. lindleyi

strategen JBS&G

0 2 Kilometers

Job No: 57624		Scale 1:65,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 06-Mar-2020

CONSERVATION SIGNIFICANT FLORA RECORDED DURING 2019 SURVEYS

FIGURE: 2.8

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_04_1_ConSigFlora.mxd

Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

Weeds

A total of 16 introduced (exotic) species have been recorded within the Development Envelope. None of these species are Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM ACT) according to the Western Australian Department of Agriculture and Food (Strategen JBS&G 2019).

Freehold farmland and existing roads (Woolka and Cooljarloo Roads), together with introduction of vehicles, machinery material from external areas are the primary existing sources of weed propagules.

Dieback

Glevan Consulting undertook a dieback occurrence assessment over an area which encompassed the Development Envelope in 2012 (Glevan 2012). *Phytophthora cinnamomi* has been recorded from several places adjacent to Cooljarloo near the Cooljarloo West; however, the area overlapping Development Envelope was determined as uninfested. All areas of native vegetation are therefore designated protectable areas. Strict hygiene measures will be implemented to ensure there is no spread of the disease.

Vegetation types

As a result of the flora and vegetation survey, a total of 13 Vegetation Types (VT) identified in Woodman (2014) and revised by Mattiske (2017) was mapped within the Development Envelope (Table 2.5) (Figure 2.10). Of these, 10 VTs will be impacted by clearing (Strategen-JBS&G 2019). The creation of access lanes requires the clearing of 40 ha of native vegetation. .

Vegetation within these VTs range from the low open forests over species rich low shrublands (which occupy majority of the area) to areas of greater water availability (which include sedgelands, samphire shrublands and heathlands or woodlands on drainage lines).

Table 2.5: Vegetation types within the Development Envelope

Vegetation Type (VT)	Description	Area in Development Envelope (ha)	% of Development Envelope	Area to be cleared (Ha)[1]	% of Development Envelope
1	Low Open Heathland to Mid Closed Heathland of *Acacia lasiocarpa* var. *lasiocarpa*, *Banksia telmatiaea*, *Melaleuca seriata*, *Hakea obliqua* subsp. *parviflora*, *Regelia ciliata* and/or *Verticordia densiflora* var. *densiflora*, often with Mid Isolated Clumps of Shrubs to Mid Sparse Shrubland of *Melaleuca rhaphiophylla* on white grey to grey brown sand, sandy loam or sandy clay in broad damp depressions on flat to gently undulating plains	1,489.48	12.15	5.13	0.04
2	Mid Sparse Shrubland to Mid Closed Shrubland of *Melaleuca acutifolia*, *Melaleuca brevifolia*, *Melaleuca rhaphiophylla* and/or *Melaleuca viminea* subsp. *viminea* over Low Isolated Clumps of Shrubs to Low Shrubland of *Calothamnus hirsutus*, *Calothamnus sanguineus* and *Grevillea* ?*thelemanniana* subsp. Cooljarloo (B.J. Keighery 28 B) on grey to grey brown sand, sandy loam or sandy clay in broad damp to wet depressions and drainage lines on flat to gently undulating plains	215.79	1.76	0.47	0.004

Vegetation Type (VT)	Description	Area in Development Envelope (ha)	% of Development Envelope	Area to be cleared (Ha)[1]	% of Development Envelope
3	Low Isolated Clumps of Shrubs of *Regelia ciliata* and *Kunzea glabrescens* or Mid Shrubland of *Verticordia densiflora* subsp. *densiflora* over Low Isolated Clumps of Forbs of **Hypochaeris glabra* and *Trachymene pilosa* on white grey sandy clay or grey brown sand on the periphery of claypans	3.46	0.03	0.00	0.00
5	Low Heathland to Mid Closed Heathland of *Banksia telmatiaea*, *Hakea obliqua* subsp. *parviflora*, *Melaleuca seriata* and/or *Regelia ciliata* on white grey to grey brown sand, sandy loam, sandy clay or clay loam in broad damp depressions on flat to gently undulating plains	358.45	2.92	0.69	0.005
6	Low Isolated Clumps of Trees to Low Woodland of *Banksia attenuata*, *Banksia menziesii* and/or *Banksia ilicifolia* over Low Sparse Shrubland to Mid Closed Shrubland of *Adenanthos cygnorum* subsp. *cygnorum*, *Banksia telmatiaea*, *Beaufortia squarrosa*, *Hypocalymma angustifolium*, *Jacksonia nutans* and/or Melaleuca seriata over Low Isolated Clumps of Sedges to *Melaleuca seriata* Mid Sedgeland of *Anarthria laevis* and/or Low Isolated Clumps of Rushes of *Chordifex sinuosus* on white grey to grey brown sand in damp depressions	84.47	0.69	0.51	0.004
7	Low Sparse Heathland to Low Closed Heathland of *Allocasuarina* spp., *Calothamnus quadrifidus*, *Calothamnus sanguineus*, *Hakea incrassata*, *Hakea lissocarpha*, *Hibbertia crassifolia* and/or *Melaleuca seriata* over Low Isolated Clumps of Sedges to Mid Sparse Sedgeland of *Mesomelaena pseudostygia* and *Schoenus clandestinus* on white grey to grey sand or white grey sandy loam to yellow brown clay loam with lateritic surface stones in broad dry depressions or gently undulating plains	114.65	0.93	0.31	0.002
8	Mid Open Shrubland to Mid Shrubland of *Banksia leptophylla*, *Banksia sessilis* var. *cygnorum* and *Hakea trifurcata* over Low Open Shrubland to Low Shrubland of *Bossiaea eriocarpa*, *Calothamnus quadrifidus* subsp. *quadrifidus*, *Grevillea preissii* subsp. *preissii*, *Hibbertia racemosa*, *Melaleuca systena* and *Scholtzia leptantha* on yellow grey sand to yellow brown sandy loam on ridges and dunes with limestone outcropping	35.20	0.29	0.18	0.001
9a	Mid Open Shrubland to Tall Closed Shrubland of *Melaleuca teretifolia*, *Melaleuca rhaphiophylla* and *Melaleuca viminea* subsp. *viminea*, occasionally with Mid Shrubs of *Melaleuca lateritia* and Low to Tall Sedges and Rushes of *Baumea juncea*, *Chorizandra enodis*, *Leptocarpus*	178.76	1.46	0.57	0.004

Vegetation Type (VT)	Description	Area in Development Envelope (ha)	% of Development Envelope	Area to be cleared (Ha)[1]	% of Development Envelope
	coangustatus and *Schoenus subfascicularis* on grey to grey brown sandy loam or clay loam in broad shallow basins, wet flats and drainage lines				
9b	Low Woodland to Mid Open Forest of *Eucalyptus rudis* subsp. *rudis* over Low Isolated Clumps of Trees to Low Closed Forest of *Melaleuca rhaphiophylla*, often with Tall Sparse Shrubland to Tall Shrubland of *Acacia saligna* subsp. *lindleyi*, over Low Isolated Clumps of Forbs to Low Closed Forbland of **Galium murale*, **Hypochaeris glabra*, **Lysimachia arvensis* and *Trachymene pilosa* on grey to grey black sand, sandy loam, sandy clay or clayey sand in wetlands, broad shallow basins/depressions and drainage lines	178.94	1.46	1.08	0.009
13	Low Sparse Samphire Shrubland to Mid Samphire Shrubland of *Salicornia quinqueflora*, *Tecticornia* ?*halocnemoides* and/or *Tecticornia indica* subsp. *bidens* over Low Isolated Clumps of Shrubs to Low Open Shrubland of *Frankenia pauciflora* and/or *Lawrencia squamata* over Low Isolated Clumps of Forbs to Low Forbland of *Angianthus micropodioides*, *Angianthus pygmaeus* or *Angianthus preissianus*, **Hypochaeris glabra*, **Lysimachia arvensis*, **Polypogon monspeliensis* and/or **Vulpia bromoides* on white grey to grey brown sandy clay to clay on saline flats	10.19	0.08	0.00	0.00
16	Low Sedgeland of *Schoenus curvifolius* and/or Low Isolated Clumps of Forbs to Low Closed Forbland of **Dittrichia graveolens*, **Lysimachia arvensis*, *Pogonolepis stricta*, **Parentucellia viscosa*, *Brachyscome bellidioides*, *Calandrinia* sp. Kenwick (G.J. Keighery 10905), *Goodenia pulchella* subsp. Coastal Plain A (M. Hislop 634) and *Wurmbea* sp. on grey to grey brown sandy clay loam on non-saline flats	41.04	0.33	0.00	0.00
17	Low Isolated Clumps of Trees to Low Open Forest of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* over Mid Isolated Clumps of Shrubs to Mid Shrubland of *Adenanthos cygnorum* subsp. *cygnorum*, *Eremaea pauciflora*, *Jacksonia floribunda*, *Jacksonia nutans*, *Stirlingia latifolia* and *Xanthorrhoea preissii* over Low Isolated Clumps of Shrubs to Low Shrubland of *Bossiaea eriocarpa*, *Dasypogon obliquifolius*, *Eremaea asterocarpa* subsp. *asterocarpa*, *Eremaea pauciflora*, *Hibbertia crassifolia*, *Hibbertia hypericoides*, *Jacksonia nutans*, *Melaleuca clavifolia*, *Patersonia*	5,777.11	47.11	20.20	0.16

Vegetation Type (VT)	Description	Area in Development Envelope (ha)	% of Development Envelope	Area to be cleared (Ha)[1]	% of Development Envelope
	occidentalis var. ?*occidentalis* and *Petrophile linearis* over Low Isolated Clumps of Sedges to Mid Open Sedgeland of *Mesomelaena pseudostygia* on white or grey sand on undulating plains and low dunes				
18	Low Isolated Clumps of Trees to Low Open Forest of *Banksia attenuata* and *Banksia menziesii* over Mid Isolated Clumps of Shrubs to Mid Shrubland of *Allocasuarina humilis*, *Conospermum stoechadis* subsp. *stoechadis*, *Eremaea pauciflora*, *Hakea costata* and/or *Xanthorrhoea preissii* over Low Isolated Clumps of Shrubs to Low Closed Shrubland of *Bossiaea eriocarpa*, *Calothamnus sanguineus*, *Dasypogon obliquifolius*, *Eremaea pauciflora*, *Hibbertia hypericoides*, *Jacksonia nutans* and/or *Melaleuca clavifolia* over Low Isolated Clumps of Sedges to Mid Open Sedgeland of *Mesomelaena pseudostygia* on grey to yellow grey sand on undulating plains and low dunes or white grey to grey brown sand, sandy loam or sandy clay loam on simple slopes, open depressions or flats within undulating plains	3,080.98	25.13	10.15	0.08
C	Cleared Land	674.86	5.50	0.04	0.0003
R	Rehabilitation Area	18.38	0.15	0.00	0.00
		12,261.75	100.00	0.00	0.00
	Total	12,261.75	100%	39.32	0.32

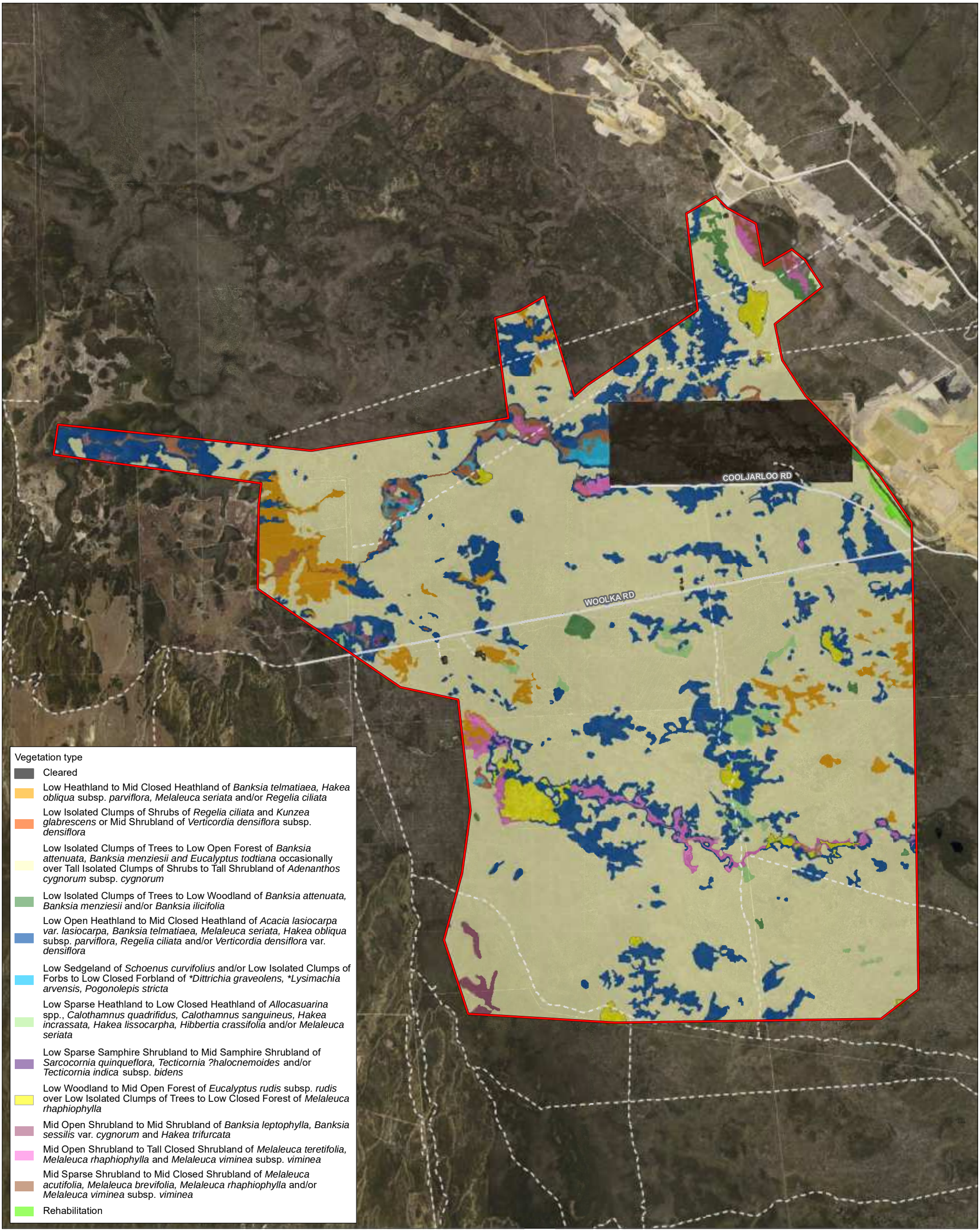
Vegetation condition

The majority of vegetation within the Development Envelope and surrounds is intact and has not been subjected to significant disturbance (Woodman 2014a). As such, vegetation condition within the Development Envelope is predominantly in Excellent condition (EPA 2016). Disturbance present with the Development Envelope includes historical access lines for exploration drilling and seismic surveys, firebreaks and vehicle tracks.

Threatened and Priority Ecological Communities

The EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community (TEC), was mapped in the Development Envelope (Figure 2.11). The community is also listed as a Priority 3 Priority Ecological Community (PEC) which are *"(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc."* (DBCA 2019).

This community is present in one large patch within the Development Envelope comprising an area of 8942.6 ha. However, this patch is not fully confined to the Development Envelope, with adjacent vegetation within the Development Envelope being considered part of the patch. This community also extends Development Envelope. Average vegetation condition ranged from Good to Very Good.



Legend:

- Project Area
- Minor road
- Tracks

strategen JBS&G

0 2 Kilometers

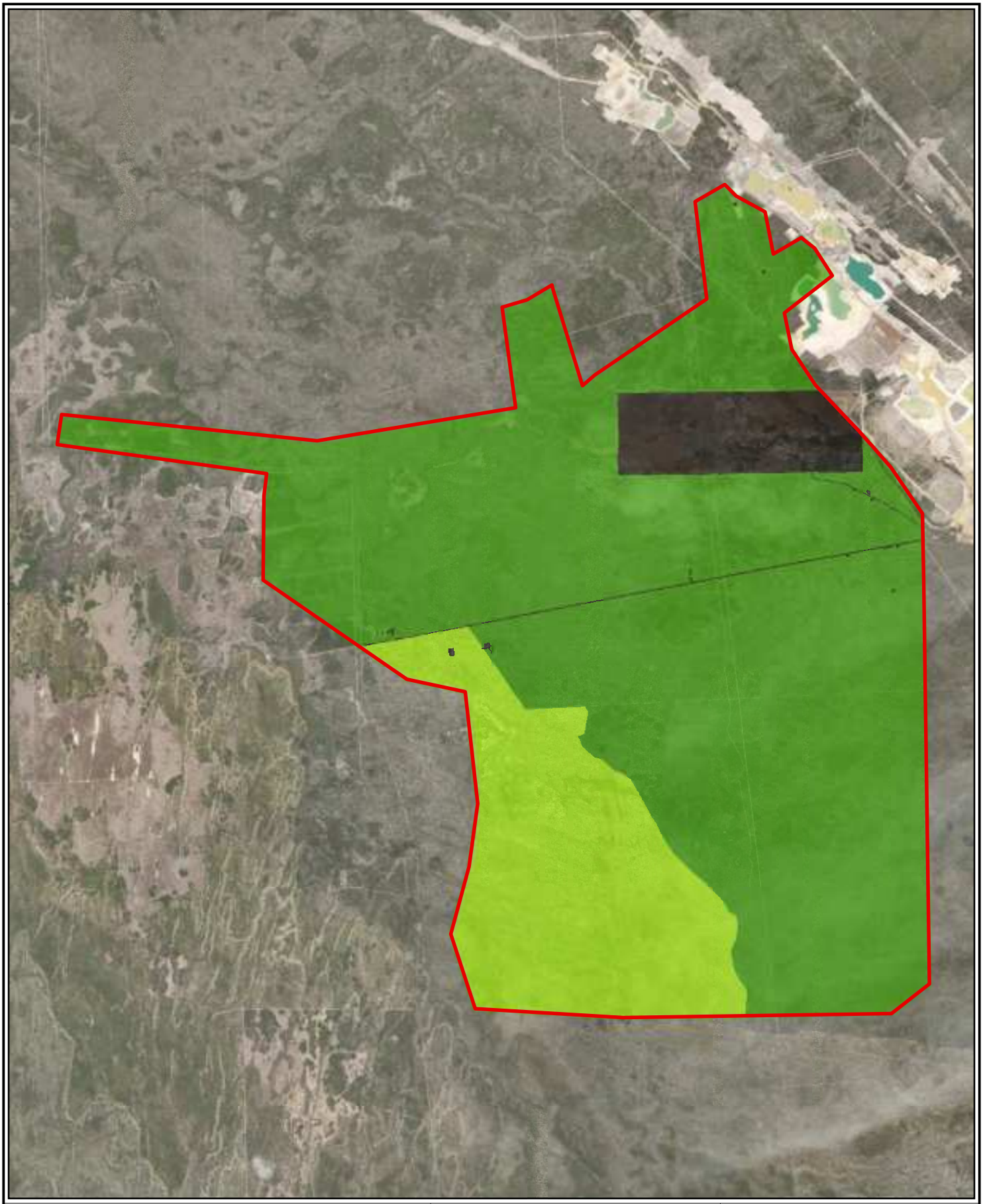
Job No: 57624		Scale 1:65,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 13-Mar-2020

VEGETATION TYPES MAPPED WITHIN THE PROJECT AREA

FIGURE: 2.9

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_02_4_VegTypes.mxd

Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Raven project area

Vegetation condition

- Excellent
- Very Good
- Completely Degraded

Scale 1:92,500 at A4

0 1 2
Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

VEGETATION CONDITION

Job No: 57059

Client: Energy Resources Limited

FIGURE 2.10

Version: A | Date: 20-Apr-2020

Drawn By: cthatcher | Checked By: AL

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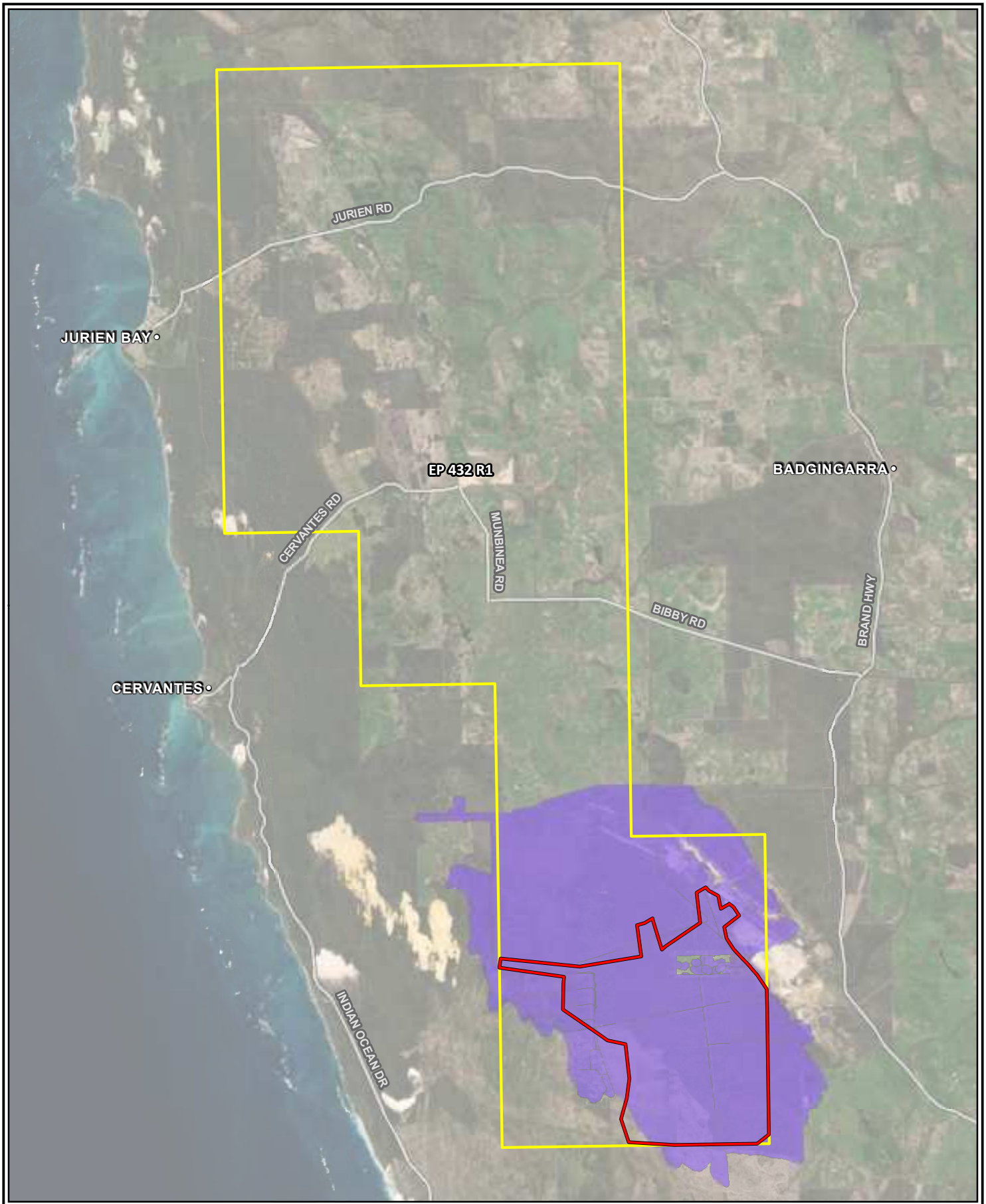
File Name: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\R01 Rev A\57059_0x_VegCond.mxd
Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend:

- Raven project area
- Permit area

TEC/PEC communities

- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region
- Major road

Scale 1:300,000 at A4

0 2.5 5
Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 57059

Client: Energy Resources Limited

Version: A | Date: 24-Apr-2020

Drawn By: cthatcher | Checked By: AL

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES MAPPED WITHIN THE DEVELOPMENT ENVELOPE

FIGURE 2.11

strategen JBS&G

File Name: W:\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\R01 Rev A\57059_0x_TECPEC.mxd
Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Project Area

Banksia woodlands of the Swan Coastal Plain TEC/PEC

strategen JBS&G

0 2
Kilometers

BANKSIA WOODLAND MAPPED WITHIN THE PROJECT AREA

Job No: 57624		Scale 1:65,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 13-Mar-2020	**FIGURE: 2.12**

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_04_2_Banksia.mxd

Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

2.5.8 Fauna

2.5.8.1 Desktop Assessment

Database searches were undertaken to generate a list of conservation significant vertebrate fauna, previously recorded within, and nearby the Development Envelope and are provided in Appendix A.

The EPBC Act also protects a range of shorebirds listed under the JAMBA and CAMBA Migratory Bird Agreements. Species may also be listed migratory or subject to international agreements including, the Convention on the Bonn, CAMBA, JAMBA, ROKAMBA and the IUCN.

Reports that document fauna within the surrounds of the Development Envelope were also reviewed prior to the field assessment.

Results of the databases searches identified a total of 25 conservation significant vertebrate species (including Priority species) as having the potential to occur within the Development Envelope (Appendix B). These were comprised of one (1) reptile, 17 birds, and seven (7) mammals.

The likelihood of these species being present within the Development Envelope was determined by considering the provision of suitable habitat and the proximity, frequency and currency of previous records. The majority of species are considered unlikely to occur within the Development Envelope due to the absence of suitable habitat, including a number of coastal and marine migratory birds.

Based on the likelihood assessment, nine (9) conservation significant species retrieved from the database searches were considered as either likely to occur or have the potential to occur in the Development Envelope (Strategen-JBSG 2019). Of these, three species were recorded within the Development Envelope by Bamford (2015).

Table 2.6: Conservation significant fauna potentially occurring in the Development Envelope

Fauna group	Species	Conservation status (EPBC Act)	Conservation status (BC Act/ DBCA 2019)	Occurrence within Development Envelope
Reptiles	Jewelled Ctenotus (*Ctenotus gemmula*)		P3	Potential to occur based on presence of habitat
	Woma (*Aspidites ramsayi*)		P1	Potential to occur based on presence of habitat
	Black-striped Snake (*Neelaps calonotos*)		P3	Potential to occur based on presence of habitat
Birds	Rainbow Bee-eater (*Merops ornatus*)	Marine		Recorded (Bamford 2015)
	Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered	Endangered	Recorded (Bamford 2015)
	Fork-tailed Swift (*Apus pacificus*)	Listed migratory (CAMBA, JAMBA, ROKAMBA)		Potential to occur based on presence of habitat
	Peregrine Falcon (*Falco peregrinus*)		OS	Potential to occur based on presence of habitat
	Western Ground Parrot (*Pezoporus flaviventris*)	Critically Endangered Listed migratory (JAMBA as *Pezoporus wallicus flaviventrus*)	Critically Endangered	Potential to occur based on presence of habitat
Mammals	Brush Wallaby (*Macropus irma*)		P4	Recorded (Bamford 2015)

CR = Listed as Critically Endangered under the EBPC Act and BC Act, EN = Listed as Endangered under the EBPC Act and BC Act, VU = Listed as Vulnerable under the EBPC Act and BC Act, Mi = Listed as Migratory under the EBPC Act, Ma = Listed as Marine under the EBPC Act, OS = Other specially protected fauna under the BC Act , and P = Listed as Priority by the DBCA.

Fauna habitat

A broad range of habitats exist across the Development Envelope which can be grouped into three Vegetation and Substrate Associations (VSAs) which support the fauna assemblages within the local area (Bamford 2015):

- VSA 1 Low Heath on flats;
- VSA 2 Banksia Woodland on low dunes; and
- VSA 3 Riparian and Riverine Woodland.

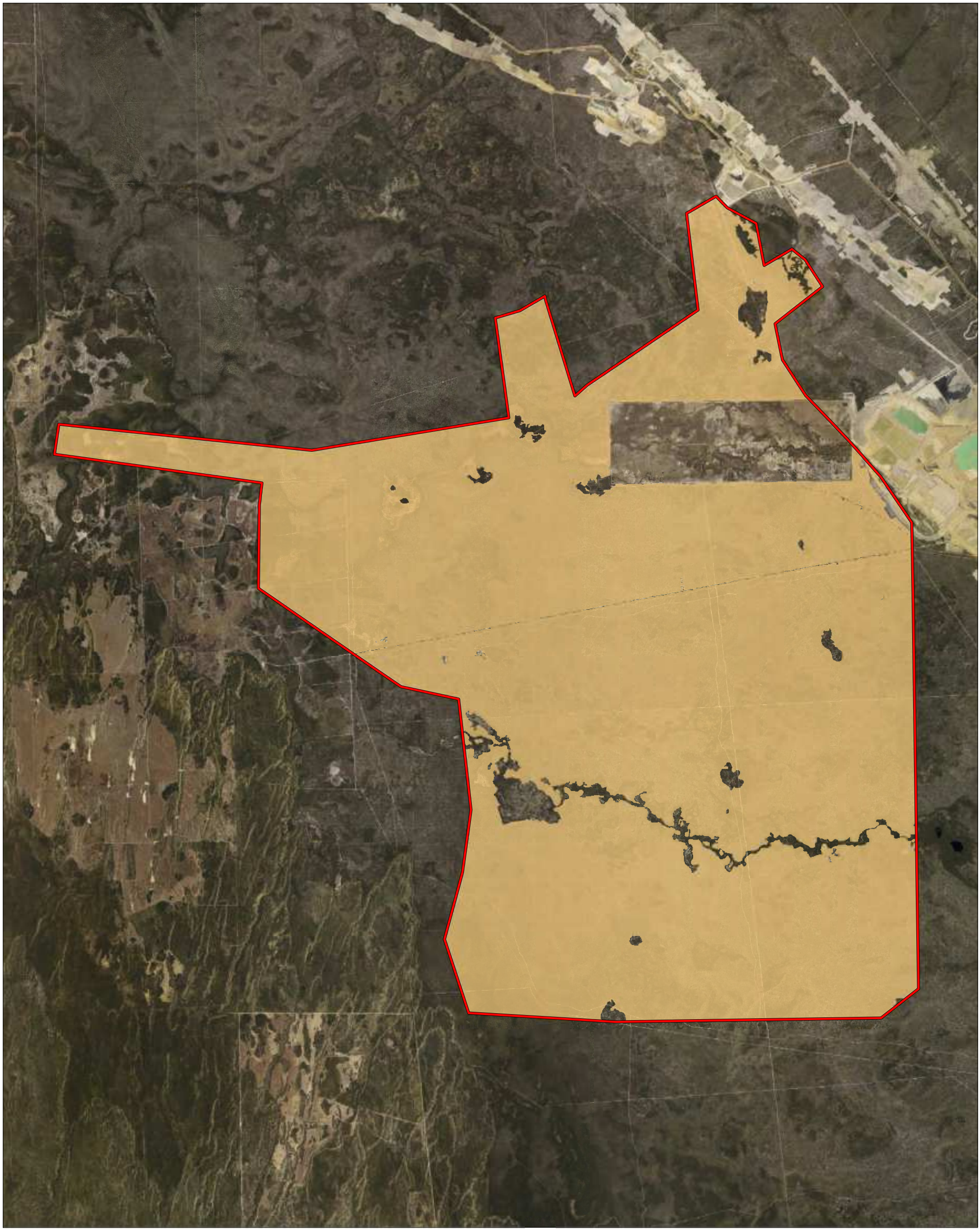
Bamford (2015) indicates that VSAs 1 and 2 area considered foraging habitat for Carnaby's black-cockatoos (approximately 11,211 ha occurs within the Development Envelope). Habitat identified is not confined to this area and suitable habitat for Carnaby's Cockatoo occurs throughout the region.

Black cockatoo habitat assessment

Approximately 11,211 ha of foraging habitat has been recorded within the Development Envelope (Bamford 2015; Figure 2.13) of which up to 37.6 ha will be disturbed as a result of the Proposal , that is 0.34% of the mapped habitat (Appendix A). Foraging species in the Development Envelope primarily consists of *Banksia attenuata*.

Foraging habitat present within the Development Envelope ranges between moderate quality (VSA1) and good quality (VSA2). All of the 37.6 ha of Black Cockatoo habitat that is to be cleared is considered to be of Excellent to Good quality.

Figure 2.13: Black cockatoo habitat within Development Envelope



Legend

- Project Area
- Black cockatoo foraging habitat

strategen JBS&G

0 2
Kilometers

BLACK COCKATOO FORAGING HABITAT

Job No: 57624		Scale 1:65,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 13-Mar-2020	**FIGURE: 2.13**

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_04_3_BCForaging.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

2.5.9 National Parks and Reserves

One DBCA managed reserve occurs within the Development Envelope and two (2) occur in close proximity (Table 2.7).

Table 2.7: DBCA managed lands within the Development Envelope

Type	Name	Identifier	Class	Area (ha)	Within Development Envelope (Y/N)?
Nature Reserve	Wanagarren Nature Reserve	R 31675	C	11 121	N – closest seismic line 6km
Nature Reserve	Nature Reserve – un-named	R 40916	A	1002	Y
Nature Reserve	Wongonderra Nature Reserve	R 26247	C	439	N – closest seismic line 4.3 km

The Proposal requires clearing of 1.92 ha within Nature Reserve 40916 to allow access for portions of three seismic lines. ERL will ensure the required access permissions are obtained for entry into the reserve. The Proposal is not anticipated to result in adverse impacts on any other reserves identified within proximity to the Development Envelope.

3. Land Use and Tenure

3.1 Location

Coordinates of the Development Envelope are provided in Table 3.1 projected in WGS 84 / UTM zone 50S. The area defined as the Development Envelope is the physical area used to conduct the Proposal, including laydown facilities. The acquisition area i.e. the area within which the seismic source will be generated to obtain data, occurs within the Development Envelope.

Table 3.1: Development Envelope Coordinates (UTM 50)

	Easting Coordinates	Northing Coordinates
1	380805	6569861
2	388757	6569950
3	388855	6560713
4	395542	6560781
5	395542	6554334
6	389577	6554332
7	389577	6553105
8	389062	6553095
9	389262	6544903
10	381083	6544907
11	381010	6551337
12	379171	6551311
13	379123	6555637
14	377214	6555487
15	377196	6557853
16	382973	6557927
17	380890	6561997

3.2 Land Use

Land use across the Development Envelope comprises:

- Unallocated Crown land – vacant open bush;
- Department of Defence (Lancelin DTA);
- Agriculture: cereal (wheat, oats, barley, lupins and canola); and
- Conservation estate including an un-named Reserve (R 40916).

The nearest townsites (with population greater than 500) include Jurien Bay to the north west, Lancelin to the south and Cervantes to the north west.

3.3 Tenure

The land tenure of the Development Envelope is mainly Unallocated Crown Land (UCL), which is managed by the DBCA, with two freehold properties (Lots 3933 and 980). The Development Envelope is located within the land parcels as identified in Table 3.2.

Table 3.2: Land tenure within the Development Envelope

Lot	Plan		Volume	Folio
2337	DP	089368	216	21A
980	DP	103269	375	78A
3933	DP	172467	1359	300
4116	DP	027506	LR3070	37
3001	DP	054549	LR3161	988
3002	DP	054549	LR3161	989
305	DP	054549	LR3161	985
306	DP	054549	LR3161	986
2487	DP	144558	LR3008	296
4112	DP	217423	LR3043	222

3.4 Native Title

The Development Envelope is located within the Yued and Whadjuk People registered Native Title Claim area. The South West Aboriginal Land and Sea Council (SWALSC) is the native title representative body.

3.5 Aboriginal Heritage Sites

In Western Australia, the *Aboriginal Heritage Act 1972* (AH Act) protects Aboriginal sites defined under section 5 of the Act. It is an offence under section 17 of the AH Act to excavate, destroy or damage a site unless the person is acting with the authorisation of the Registrar under section 16, or the consent of the Minister under section 18 of the AHA.

A place search for Aboriginal heritage was conducted in October 2019 on the Department of Planning, Lands and Heritage (DPLH) database.

There are seven registered Aboriginal heritage sites located wholly or partially within the Development Envelope, two of which have been assessed as meeting section 5 of the AH Act. A further three (3) lodged sites are located in close proximity to the Development Envelope.

Table 3.3: Aboriginal Heritage Sites within the Development Envelope

Title	Identifier	Type	Status	Within Development Envelope (Y/N)?
Cooljarloo Well	4639	Mythological, water source	Registered	Y
Mullering Brook	4640	Mythological	Registered	Y

Title	Identifier	Type	Status	Within Development Envelope (Y/N)?
Mududldu Myer	24662	Artefacts / scatter, camp, hunting place, water source	Lodged	Y
Yuccan Djooraly (Turtle Lake)	19735	Ceremonial, Meeting Place, Plant Resource, Water Source, Other: Food source, Medicinal Purposes	Lodged	Y
Dwert Djoorlay (Dog Hole)	19736	Ceremonial, Meeting Place, Plant Resource, Water Source, Other: Food source, Medicinal Purposes	Lodged	Y
Cooljarloo Swamp	20050	Camp, hunting place, water source	Lodged	Y
Tombstone Rocks	20048	Mythological, water source	Lodged	N
Coomado Swamp	20049	Man-Made Structure, Birth Place, Camp, Hunting Place	Lodged	Y
Karong (Carnega)	28324	Historical, Man-Made Structure, Camp, Hunting Place, Meeting Place, Water Source	Lodged	N
Kooyar	28325	Artefacts / Scatter, Man-Made Structure, Birth Place, Camp, Meeting Place, Natural Feature, Ochre, Plant Resource, Water Source	Lodged	N

ERL has been advised by the South West Aboriginal Land and Sea Council (SWALSC) that a meeting with the Yued Working Group is not required prior to the conduct of the Proposal.

4. Stakeholder Engagement

4.1 Stakeholder consultation

ERL is undertaking a consultation program with key stakeholders in relation to its exploration activities in the Perth Basin.

The key objectives of the consultation program is to:

- Identify relevant stakeholders;
- Initiate and maintain communication;
- Develop tools for ongoing communication;
- Provide for two-way communication on management/mitigation strategies to minimise impacts of the Proposal on the environment and potentially affected stakeholders; and
- Record consultation activity, key issues and outcomes.

4.2 Stakeholder engagement process

Relevant person(s) for the purpose of identifying stakeholders that should be consulted were identified based on the following:

- Government departments or agencies that administer the required approval(s) to implement the Proposal;
- Land owners / managers within the Development Envelope;
- Any person or organisation whose functions, interests or activities may be affected by the Proposal; and
- Any other person or organisation with a potential interest in the Proposal.

ERL will continue to identify new relevant stakeholders prior to the Proposal commencing and during the activity. New stakeholders may be identified during ongoing consultation with stakeholders identified to date or direct approach by persons that have become aware of the Proposal.

If additional stakeholders are identified, they will be contacted, provided with information in relation to the Proposal, and invited to make comment. These actions are considered sufficient for any new relevant stakeholders identified to allow them to make an informed assessment of the potential effects of the Proposal on their functions, interests and/or activities.

ERL will maintain and continue to update its stakeholder consultation register.

4.3 Key Stakeholders

The following key stakeholder groups have been identified:

- State and Commonwealth government agencies including:
    - Department of Mines, Industry Regulation and Safety (DMIRS Environmental and Petroleum Divisions);
    - Department of Planning, Lands and Heritage (DPLH);
    - Department of Biodiversity, Conservation, and Attractions (DBCA);
    - Department of Water and Environment Regulation (DWER EPA Services;
    - Department of Agriculture, Water and Environment (Commonwealth – DAWE);
    - Main Roads Western Australia (MRWA);

- Shire of Dandaragan and community stakeholders; and
- The Proposal is located within the Yued and Whadjuk People registered Native Title Claim area. The SWALSC is the native title representative body.

5. Principles of Environmental Protection

This section identifies the environmental factors relevant to the Proposal, outlines the overall assessment methodology presented in this document and the detailed environmental impact assessment undertaken for each preliminary key environmental factor.

Four preliminary key environmental factors relevant to the Proposal have been identified:

- Flora and vegetation;
- Terrestrial fauna;
- Inland waters; and
- Terrestrial environmental quality.

The Proposal is also being submitted to the Commonwealth Department of Agriculture, Water and Environment (DWAE) as a consequence of the potential impacts on Matters of National Environmental Significance (MNES) to satisfy the requirements of the EPBC Act.

The preliminary key environmental factors associated with the Proposal are addressed in this referral supporting document in the following format:

- Statement of Environmental Protection Authority (EPA) objective;
- Discussion of relevant policy and guidance, and summary of how this guidance has been addressed;
- Description of the receiving environment relevant to the factor;
- Definition of potential direct, indirect and cumulative impacts on the environmental values for this factor;
- Assessment of the extent and significance of impacts to the environmental values for this factor;
- Description of mitigation, including application of the mitigation hierarchy (avoid, minimise, rehabilitate); and
- Description of the predicted environmental outcome as assessed against the EPA objective for this factor.

ERL's consideration of the *Environmental Protection Act WA* 1986 principles of environmental protection in relation to the Proposal is shown in Table 5.1.

Table 5.1: Environmental Protection Principles

Principle	Consideration
1. The Precautionary Principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by: a. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b. an assessment of the risk-weighted consequences of various options.	The final seismic lines have been developed through a detailed process of review to ensure that impacts to the environment are minimised. The Proponent used existing environmental data for the region and has supplemented it with additional site specific studies (ecological assessment) to identify appropriate areas of vegetation for retention. Consultation has been undertaken with key stakeholders to identify potential environmental impacts and appropriate management for the Proposal, including project staging to minimise impacts to adjacent land uses.
2. The Principle of Intergenerational Equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	The Proposal meets the principle of intergenerational equity by ensuring the health of the environmental values, maintaining ecological functions for future generations, whilst minimising any impacts on the environment. The Proposal can be implemented without significant impacts on the health, diversity or productivity of the environment. Native vegetation impacted is expected to regenerate following completion of the seismic survey.
3. The Principle of the Conservation of Biological Diversity and Ecological Integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The conservation of biological diversity and ecological integrity was a fundamental consideration in the assessment of this proposal. Wherever possible: • clearing has been avoided or minimised to the extent possible whist achieving data level and quality requirements • seismic lines realigned to avoid sensitive environmental features.
4. Principles Relating to Improved Valuation, Pricing and Incentive Mechanisms c. Environmental factors should be included in the valuation of assets and services. d. The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. e. The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	Environmental constraint avoidance and management costs have been considered in the planning and design of the Proposal. The Proponent will be responsible for funding the cost of environmental avoidance and management measures and ongoing monitoring as detailed in the referral.
5. The Principle of Waste Minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Waste will be minimised by adopting the hierarchy of waste controls: avoid, minimise, reuse, recycle and safe disposal.

6. Assessment of Preliminary Key Environmental Factors

6.1 Flora and Vegetation

6.1.1 EPA Objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

Table 6.1: Flora and Terrestrial Vegetation

	Potential Environmental Impacts

EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	The following policy and guidance are relevant to this factor and has informed planning for the Proposal.
	
	Environmental Factor Guideline: Flora and Vegetation (EPA 2016b)
	
	This guideline provides an outline of how flora and vegetation is considered by the EPA in the environmental impact assessment (EIA) process. Relevant matters discussed in guideline include the following:
	• Description of environmental impact assessment (EIA) considerations, including:
	  o Application of the mitigation hierarchy;
	  o The flora and vegetation affected by the proposal;
	  o The potential impacts and the activities that will cause them;
	  o Surveys and analyses required;
	  o The significance of the flora and vegetation, and the risk to the flora and vegetation; and
	  o The current state of knowledge of flora and vegetation and the level of confidence underpinning the predicted residual impacts;
	• Describes issues commonly encountered by the EPA during EIA of this factor; and
	• Provides a summary of the type of information that may be required by the EPA to undertake EIA related to this factor.
	
	Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a)
	
	This guidance is intended to ensure adequate flora and vegetation data of an appropriate standard are obtained and used in EIA, specifically providing advice on:
	• Survey preparation and desktop study;
	• Determining the type of survey required;
	• Sampling techniques and survey design; and
	• Data analysis and reporting.

Consultation – Outline the outcomes of consultation in relation to the potential environmental impacts	Refer to Section 4.

Receiving environment – Describe the current condition of the receiving environment in relation to this factor.	The receiving environment in the Development Envelope has been subject to a number of flora and vegetation surveys and is generally well understood. The most recent survey completed in relation to the Proposal was undertaken in Spring 2019 (Strategen-JBS&G, 2020). **Vegetation** The Proposal is located in the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990). It is located in the Swan Coastal Plan 2 (SWA2) IBRA region. Vegetation systems as mapped by Beard that may be present within the Development Envelope include: • 1026 - Mosaic: Shrublands; *Acacia rostellifera, A. cyclops* (in the south) & *Melaleuca cardiophylla* (in the north) thicket / Shrublands; *Acacia lasiocarpa* & *Melaleuca acerosa* heath (93.84% remaining in the IBRA Region) • 1029 - Shrublands; scrub-heath dryandra-calothamnus assocication with *Banksia prionotes* on limestone in the northern Swan Region (71.84% remaining in the IBRA Region) • 1030 - Low woodland; *Banksia attenuata* & *B. menziesii* (63.81% remaining in the IBRA Region) • 1031 - Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath (19.30% remaining in the IBRA Region) With the exception of Vegetation Association 1031, the vegetation associations to be impacted exist at > 30% of their original extent. The current extent of 1031 is 19.30 %. No vegetation will be cleared within association 1031 as a result of the Proposal. The Development Envelope has been surveyed numerous times since 1996. Of these surveys work completed in 2015 (Woodman) identified 18 native vegetation types (VTs) across the greater Cooljarloo West Study Area. The 2019 ecological survey (Strategen-JBS&G) identified a total of 13 vegetation communities. Areas not classified as native vegetation included cleared areas and covered 5.5% of the Development Envelope. The Proposal will impact on 0.66 % or less of each of the mapped vegetation communities within the Development Envelope. The 2019 ecological survey identified that the vegetation within the Development Envelope and surrounding areas is intact and has not been subject to significant disturbance. Disturbance observed across the Development Envelope may be associated with freehold farmland activities, existing roads (Woolka and Cooljarloo Roads), formation of firebreaks and the introduction of vehicles/machinery material in relation to historical seismic surveys. Despite the historical disturbance, the vegetation may therefore be described as being in Excellent condition across the Development Envelope. The introduction of weeds may be associated with the limited vehicle traffic movements experienced across the Development Envelope. **Significant Vegetation** The Development Envelope partly comprises a large single patch of vegetation that is representative of the Priority 3 Priority Ecological Community (PEC) which is *"(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc."* (DBCA 2019). This PEC is also listed under the EPBC Act as 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community' (TEC). An assessment of VTs was made using the key diagnostic criteria as per the Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016). Vegetation within VT6, VT17 and VT18 met the key diagnostic criteria for the ecological community. This represents a total area within the Development Envelope of 8,942.6 ha across one patch. This patch is not fully confined to the Development Envelope, with vegetation adjacent being considered part

of the patch. Average vegetation condition ranged from Good to Very Good-Excellent. While the state level community Banksia Woodlands of the Swan Coastal Plain PEC is not subject to condition criteria areas mapped as Banksia Woodlands of the Swan Coastal Plain TEC are also considered to represent the PEC.

Of the 8,942.6 ha mapped within the Development Envelope, approximately 30.86 ha is expected to be cleared. This represents 0.35 % of the mapped extent within the Development Envelope and a smaller percentage of that present in surrounding area. The clearing is not considered permanent and will be allowed to regenerate once the seismic survey is completed.

Conservation significant flora

Three Threatened flora species and 15 Priority flora species (Table 6.2) were recorded within the Development Envelope during the 2019 field assessment.

The taxon, *Macarthuria keigheryi* was recorded in very large numbers in the north-western portion of the Development Envelope, in an area which was burned in the 2015-2016 fire. This taxa's regrowth is likely to be stimulated by fire, causing a flush of growth which will eventually senesce and then numbers will gradually reduce. The conservation significant flora mapped within the Development Envelope, estimated number and impacts from the Proposal are presented in the table below.

Table 6.2: Conservation significant flora identified in 2019

Taxon	Conservation Status	Number of individuals	Estimated impact from proposed clearing and percentage
Andersonia gracilis	T	1007	Avoidable
Anigozanthos viridis subsp. *terraspectans*	T	25	Avoidable
Macarthuria keigheryi	T	11500 (estimated)	2,990; 25%
Chordifex reseminans	P2	5000 (estimated)	1300: 25%
Isotropis cuneifolia subsp. *glabra*	P2	1	Avoidable
Babingtonia urbana	P3	855	222: 25%
Banksia dallanneyi subsp. *pollosta*	P3	244	63: 25%
Conospermum scaposum	P3	955	248: 25%
Desmocladus nodatus	P3	1	Avoidable
Guichenotia alba	P3	9	Avoidable
Hakea longiflora	P3	1	Avoidable
Isopogon panduratus subsp. *palustris*	P3	81	Avoidable
Stylidium hymenocraspedum	P3	497	129: 25%
Verticordia huegelii var. *tridens*	P3	209	54: 25%
Anigozanthos humilis subsp. *chrysanthus*	P4	17	avoidable
Chordifex chaunocoleus	P4	6	avoidable
Conostephium magnum	P4	19	avoidable
Verticordia lindleyi subsp. *lindleyi*	P4	552	143: 25%

	Potential Environmental Impacts
Proposal activities – Describe the proposal activities that have the potential to impact the environment	Proposal activities which have the potential to impact on flora and vegetation include: • clearing and mulching of vegetation along selected seismic survey lines • traversing of seismic lines by survey vehicles (light vehicles, vibroseis trucks) • unauthorised access to areas during works • unauthorised clearing in areas outside the planned seismic survey lines • unauthorised access and clearing in conservation areas • Third party use of access lanes post survey. The development of laydown areas is not anticipated to have an impact on flora and vegetation. These areas are to be established using an existing cleared area within the Development Envelope.
Potential Impacts – Define the potential impacts (direct, indirect and cumulative) on the environmental values for this factor – regional and local, including MNES	**Direct Impacts** Potential direct impacts resulting from the Proposal are: • Disturbance to up to 40 ha of native vegetation; • Loss of threatened and priority flora; • Loss of State-listed PEC; • Loss of habitat that supports black cockatoo; and • Impact to 1.92 ha of vegetation within Nature Reserve R 40916. **Indirect Impacts** Potential indirect impacts that may occur from implementation of the Proposal include: • Impacts from hydrocarbon and chemical storage and possible spills/leakage from fuels, chemicals and hydrocarbons required for the Proposal; • Waste materials – general waste, chemicals, containers for fuels, hydrocarbons; • Weeds and other pathogens introduced on vehicles and by site staff activities; • Dust – smothering of vegetation; and • Amenity impacts – noise, dust and light spill. **Cumulative Impacts** • Reduction (localised) in conservation significant flora species and PEC (also EPBC TEC) vegetation (that may also comprise habitat for conservation significant/listed threatened fauna species) and that adds to the cumulative impact being experienced across the region.

<table>
<tr><th></th><th>Potential Environmental Impacts</th></tr>
<tr><td>Impacts – Assess the impacts of the proposal and review the residual impacts against the EPA objective</td><td>
The Proposal will:

Temporarily disturb up to 40 ha of native vegetation to provide access for light vehicles to lay seismic survey nodes and the subsequent seismic survey which will be completed by vibroseis trucks.
Based on a 3.5 m wide clearing footprint, the initial clearing estimates for each vegetation type identified across the site in 2019 are presented in the following table:

Table 6.3: Vegetation clearing per vegetation types
<table>
<tr><th>Vegetation Type</th><th>Area of Impact (ha)</th></tr>
<tr><td>1</td><td>5.13</td></tr>
<tr><td>2</td><td>0.47</td></tr>
<tr><td>5</td><td>0.69</td></tr>
<tr><td>6</td><td>0.51</td></tr>
<tr><td>7</td><td>0.31</td></tr>
<tr><td>8</td><td>0.18</td></tr>
<tr><td>9a</td><td>0.57</td></tr>
<tr><td>9b</td><td>1.08</td></tr>
<tr><td>17</td><td>20.20</td></tr>
<tr><td>18</td><td>10.15</td></tr>
<tr><td>Cleared Areas</td><td>0.04</td></tr>
<tr><td>Rehabilitation</td><td>0.00</td></tr>
<tr><td>Total</td><td>39.32</td></tr>
</table>

Impact to 30.86 ha of Banksia Woodland PEC (EPBC TEC) or 0.35% of the total of 8,942.6 ha in the Development Envelope.
Impact seven (7) of the priority listed species and one listed threatened species, as a result of the presence and distribution of these species across the Development Envelope (refer Table 6.2 above).

One species, Macarthuria keigheryi, occurs in the north-western corner of the Development Envelope within Banksia Woodland areas and in high densities. As a result, it has not been possible to avoid impacts to this species. It is estimated that approximately 25% of the recorded numbers of this species will be impacted.
Seven species (Chordifex reseminans, Babingtonia urbana, Banksia dallanneyi subsp. pollosta, Conospermum scaposum, Stylidium hymenocraspedum, Verticordia huegelii var. tridens, Verticordia lindleyi subsp. lindleyi) occurred in large densities and the total extents were unable to be mapped. While impacts to these species are unlikely to be avoidable, their large population size and small area of impact on each population mean any impacts on the local populations of these species are unlikely to be significant. It is estimated that approximately 25% of the recorded numbers of these species will be impacted.

It is considered that residual impacts which may be experienced as a result of the Proposal should be localised and temporary. It is anticipated that there will be no long lasting residual impacts due to the adoption of an approach that focuses on the temporary disturbance of native vegetation at the site rather than the total clearing of vegetation (refer below).
</td></tr>
</table>

Mitigation – Describe the measures proposed to manage and mitigate the potential environmental impacts.	Mitigation measures have been separated into those implemented during the planning of the Proposal and those that are to be implemented during completion of the site works. **Pre-survey Seismic Line Planning** The final seismic plan has been developed following a detailed process of review to ensure the impacts to the environment can be and have been minimised as far as practicable. Seismic surveys are inherently flexible and the survey lines may be adjusted from the nominally mapped alignments by up to approximately 50 m without impacting of the definition in results. The steps outlined below were implemented to ensure the final seismic plan results in the lowest environmental impact through the avoidance of environmentally sensitive features and areas of conservation significant vegetation, as follows: • High level review of existing aerial imagery to ensure, where possible: o avoidance of areas of native vegetation; and o use of visible cleared tracks. • Desktop assessment of existing environmentally sensitive features including conservation areas, heritage areas, mapped listed species and communities, surface water features etc to identify lines that can be truncated or removed to minimise impacts on these features to the extent possible. • Bespoke further refinement of avoidance areas and move lines through: o collection of high-resolution imagery; o identification of existing cleared tracks and areas with no understorey vegetation that would not require additional clearing; and o movement of lines into nearby areas which would not require clearing. • On-ground site survey was undertaken in Spring 2019 along the proposed seismic lines. This survey assessed a 15 m wide corridor to identify and delineate where lines could be deviated around flora populations or individual listed species and communities, significant trees and riparian zones for surface water bodies. Through this process these features and the associated impacts have been avoided through line deviation or truncation of seismic lines, where possible. **Survey Mitigation Measures** • Vegetation clearing will be undertaken by a team comprising the operator, line surveyor, and cultural anthropologist using single pass clearing and mulching techniques and fixed hammer mulchers. In areas with significant risk of Unexploded Ordnance (UXO), UXO experts will first assess risk before clearing, and further survey the mulched areas for UXO. If UXO are found, they will be safely disposed of appropriately with consultation to local police. • This equipment operates in a manner that retains topsoil, leaves root-stock undisturbed and follows the natural ground contours which reduces the impact on soils and root material • The use of a single pass approach to mulching will reduce the overall traffic on the access lanes and hence soil compaction and vegetation disturbance. • This method of vegetation clearing ensures optimal conditions for successful rehabilitation within a minimised footprint, as follows: o disturbance created by cutting and mulching vegetation is of a lower order and scale than conventional clearing (i.e. complete removal of vegetation); o there is no topsoil disturbance, reducing the risks of erosion and impacts on water filtration into the thin topsoil layer containing the seed resource. In turn, this minimises the potential to leave the area prone to weed invasion; and

	Potential Environmental Impacts
	○ return of the mulched material to its source location will ensure a maximum rate of humus production and includes facilitation of recolonisation by microfauna (particularly burrowing invertebrates) and an increase in nutrient cycling within the topsoil. • Restriction of the number of vehicle passes per survey line in combination with site hygiene measures should reduce the potential spread of weeds and plant pathogens • Avoidance areas have been identified and will be input into GPS guidance tablets with audible alarms to enable on-ground identification and avoidance during implementation of the Proposal • The following species will be avoided through the use of this approach and equipment: ○ two threatened flora species *Andersonia gracilis* and *Anigozanthos viridis* subsp. *Terraspectans* occur in lower densities and disturbance to these species will be avoided by deviating planned access lanes around known populations. These populations will be demarcated and input into the GPS navigation system; and ○ eight priority species (I*sotropis cuneifolia subsp. glabra, Desmocladus nodatus, Guichenotia alba, Hakea longiflora, Isopogon panduratus subsp. palustris, Anigozanthos humilis subsp. chrysanthus, Chordifex chaunocoleus, Conostephium magnum*) will be avoided by deviating planned access lanes around known populations. These populations will be demarcated and input into the GPS navigation system. • Seismic lines have been revised to reduce the anticipated impacts on the seven priority listed species and one listed threatened species (refer Table 6.2 above) • Access line clearing width restricted to 3.5 m • Seismic survey to be completed using vehicles with high clearance (0.46 m) which will reduce disturbance of mulch vegetative material replaced on the access lanes and topsoil disturbance • Access lines to be dog legged at road and tracks crossings, weaved smoothly around sensitive areas • All vehicles to be cleaned (brushed down) prior to mobilisation to site and all cleaning activities to recorded in register/log • Vehicles, machinery and footwear to be clean on entry prior to entering area of native vegetation • Avoidance of work during wet soil conditions • Restriction of all vehicle movements to existing tracks and gazetted roads, where and as far as possible • Speed of vehicles when off road to be reduced to 40 km/hr to minimise the risk of dust generation • All Proposal tracks and access lanes to be closed and rehabilitated as soon as possible after completion of the survey works to prevent future unauthorised access.
Predicted Outcome – Describe the predicted outcome against the environmental objective	The Proposal will result in a temporary impact on up to 40 ha of native flora and vegetation. Through the implementation of an iterative planning development process and on ground mitigation measures to be adopted through the duration of the site works, potential impacts to State or Commonwealth listed TECs, conservation significant or listed threatened species have been avoided or reduced to the extent possible. Accordingly, it is expected that the EPA's objective for flora and vegetation will be met.
Assumptions - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions	Not applicable.

6.2 Terrestrial Fauna

6.2.1 EPA Objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

Table 6.4: Terrestrial Fauna

	Potential Environmental Impacts
EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	The following policy and guidance are relevant to this factor and has informed planning for the Proposal. **Environmental Factor Guideline: Terrestrial Fauna** (EPA, 2016c) This guideline provides an outline of how Terrestrial Fauna is considered by the EPA in the EIA process. Relevant matters discussed in the Guideline include the following: • Description of EIA considerations, including: o Application of the mitigation hierarchy; o The terrestrial fauna affected by the proposal; o The potential impacts and the activities that will cause them; o Surveys and analyses required; o The significance of and risks to the fauna; o The current state of knowledge of terrestrial fauna and the level of confidence underpinning the predicted residual impacts; o Describes issues commonly encountered by the EPA during EIA of this factor; and o Provides a summary of the type of information that may be required by the EPA to undertake EIA related to this factor. The Proponent has specifically considered this guidance in the following ways: • Surveys and analyses undertaken and planned to describe the receiving environment and its significance; • Identification of activities which may lead to impacts to terrestrial fauna; and • Application of the mitigation hierarchy in elements of Proposal design. **Technical Guidance – Terrestrial Fauna Surveys** (EPA, 2016d) This guidance is intended to provide information on standards and protocols for terrestrial fauna surveys to ensure adequate data of an appropriate standard are obtained and used in EIA, specifically providing advice on: • Survey preparation and planning; • Determining the type of survey required; and • Presentation and reporting. **Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna** (EPA, 2016e) This guidance is intended to provide information on standards and protocols for terrestrial fauna surveys to ensure adequate data of an appropriate standard are obtained and used in EIA, specifically providing advice on: • Pre-survey protocols;

<table>
<tr><th></th><th>Potential Environmental Impacts</th></tr>
<tr><td></td><td>

Determining the level of survey required;
Sampling techniques for specific fauna;
Survey design; and
Data analysis and reporting.

</td></tr>
<tr><td>Consultation – Outline the outcomes of consultation in relation to the potential environmental impacts</td><td>Refer to Section 4.</td></tr>
<tr><td>Receiving environment – Describe the current condition of the receiving environment in relation to this factor.</td><td>
A broad range of fauna habitats are known to be present across the Development Envelope. These may be grouped into three Vegetation and Substrate Associations (VSAs) which are able to support fauna assemblages within the local area and Development Envelope. These are:

VSA 1 Low Heath on flats
VSA 2 Banksia Woodland on low dunes
VSA 3 Riparian and Riverine Woodland.

Approximately 11,211 ha of foraging habitat recorded within the Development Envelope by Bamford (2015) with foraging species primarily consisting of Banksia attenuata. The vegetation in the Development Envelope ranges between moderate quality (VSA1) and good quality (VSA2) with regard to Black Cockatoo foraging habitat quality. These VSAs and habitat are not confined to the Development Envelope. Suitable foraging habitat for Carnaby's Black Cockatoo is known to occur throughout the region.

A desktop study indicates that a total of 25 conservation significant vertebrate species may occur across the Development Envelope. Of these it is considered likely that nine State conservation significant and/or listed threatened species may occur or have the potential to occur in the Development Envelope (Strategen-JBS&G 2020). This is based on assessment of the suitability of habitat and the proximity, frequency and currency of previous records.

The remaining 16 species, which including a number of coastal and marine migratory birds, are considered unlikely to occur within the Development Envelope principally due to the absence of suitable habitat.

The nine conservation significant and/or listed threatened species are presented in the following table.
<table>
<tr><th>Fauna group</th><th>Species</th><th>Conservation status (EPBC Act)</th><th>Conservation status (BC Act/ DBCA 2019)</th><th>Occurrence within Survey area</th><th>Predicted impact</th></tr>
<tr><td>Reptiles</td><td>Jewelled Ctenotus (Ctenotus gemmula)</td><td></td><td>P3</td><td>Potential to occur based on presence of habitat</td><td>The impact of the Proposal is unlikely to be significant to the species given the amount of similar habitat available in the region and the low level of impact to habitat within the Project Area.</td></tr>
</table>
</td></tr>
</table>

	Potential Environmental Impacts					
		Woma (*Aspidites ramsayi*)		P1	Potential to occur based on presence of habitat	The impact of the Proposal is unlikely to be significant to the species given the amount of similar habitat available in the region and the low level of impact to habitat within the Project Area.
		Black-striped Snake (*Neelaps calonotos*)		P3	Potential to occur based on presence of habitat	The impact of the Proposal is unlikely to be significant to the species given the amount of similar habitat available in the region and the low level of impact to habitat within the Project Area.
	Birds	Rainbow Bee-eater (*Merops ornatus*)	Marine		Recorded (Bamford 2015)	The impact of the Proposal is unlikely to be significant to the species given the amount of similar habitat available in the region. While the species is of conservation significance, it is widespread and often favours disturbed environments.
		Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered	Endangered	Recorded (Bamford 2015)	The impact of the Proposal is unlikely to be significant to the species given the amount of foraging habitat available within the Development Envelope surrounds and that 37.6 ha (0.335 %) of foraging habitat for this species within the Development Envelope will be cleared.

	Potential Environmental Impacts					
		Fork-tailed Swift (*Apus pacificus*)	Listed migratory (CAMBA, JAMBA, ROKAMBA)		Potential to occur based on presence of habitat	There are no significant threats to the Fork-tailed Swift in Australia. Potential threats include habitat destruction and predation by feral animals; however, due to the wide range of the species and its aerial nature, the species is unlikely to be reliant on habitat within the Development Envelope and the potential impacts from this proposed action are unlikely to be significant.
		Peregrine Falcon (*Falco peregrinus*)		OS	Potential to occur based on presence of habitat	This species has a widespread distribution and therefore it is unlikely that the Proposal will adversely affect the species' regional population.
		Western Ground Parrot (*Pezoporus flaviventris*)	Critically Endangered Listed migratory (JAMBA as *Pezoporus wallicus flaviventrus*)	Critically Endangered	Potential to occur based on presence of habitat	The Proposal will not have a significant impact on this species as it is considered locally extinct.
	Mammals	Brush Wallaby (*Macropus irma*)		P4	Recorded (Bamford 2015)	Potential impacts to the species resulting from the Proposal include habitat loss, road mortalities and increased predation. However, given the amount of similar habitat available in the region and the low level of impact to

<table>
<tr><th></th><th>Potential Environmental Impacts</th></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td>habitat within the Project Area impacts from habitat loss are unlikely to be significant. Given the temporary nature of the Project, impacts from road mortalities and increased predation can be minimised through management measures and are therefore unlikely to be significant.</td></tr>
</table>
Of the above nine species, Rainbow Bee-eater, Carnaby's Cockatoo and Brush Wallaby have been recorded within the Development Envelope.
</td></tr>
<tr><td>Proposal activities – Describe the proposal activities that have the potential to impact the environment</td><td>Proposal activities which have the potential to impact on terrestrial fauna include:
Clearing and mulching of vegetation to create access lanes
Vehicle movements including equipment mobilisation, seismic line survey, seismic survey works (vibroseis truck use) and demobilisation on completion of the work
Support vehicle and supply vehicle use
Noise and vibrations from all machinery and vehicles, notably from the vibroseis trucks.</td></tr>
<tr><td>Potential Impacts – Define the potential impacts (direct, indirect and cumulative) on the environmental values for this factor – regional and local, including MNES</td><td>Direct Impacts
Potential direct impacts that may be experienced are:
Injury or mortality due to vehicle strike during implementation of the Proposal;
Injury or mortality due to vehicle strike during mobilisation/demobilisation;
Injury or mortality due to vehicle strike during line access lane preparation (clearing) and seismic acquisition;
Noise and vibration from all machinery and vehicles; and
Loss of habitat, including habitat for conservation significant fauna.
Indirect Impacts
Potential indirect impacts that may be experienced are
Impacts to habitat due to erosion along access tracks leading to degradation of adjacent areas;
Impacts to habitat from storage and possible leakage from fuels, chemicals and hydrocarbons required for the completion of the seismic programme;
Waste materials – general waste, chemicals, containers for fuels, hydrocarbons if not removed from site (as per operating procedures);
Noise and vibration; and
Dust from vehicle movements.</td></tr>
</table>

	Potential Environmental Impacts
	Cumulative Impacts • Reduction (localised) in habitat for conservation significant fauna/listed threatened species that adds to the cumulative impact being experienced across the region.
Impacts – Assess the impacts of the proposal and review the residual impacts against the EPA objective	Approximately 11,211 ha of foraging habitat for the Carnaby's Black Cockatoo has been recorded with Development Envelope of which approximately up to 37.6 ha or 0.34% will be disturbed as a result of the Proposal. It is considered that residual impacts which may be experienced as a result of the Proposal are localised and temporary impacts habitat for conservation significant/listed threatened terrestrial fauna species. It is anticipated that there will be no long-lasting residual impacts due to the adoption of an approach that requires only the temporary disturbance of native vegetation rather than the total clearing of vegetation (refer below). As the Proposal is to be completed with limited/restricted use of the access tracks, there should be no long-term impacts across the Proposal Area.
Mitigation – Describe the measures proposed to manage and mitigate the potential environmental impacts.	Mitigation measures have been separated into those implemented during the planning of the Proposal and those that are to be implemented during completion of the site works. **Pre-survey Seismic Line Planning** The final seismic plan has been developed following a detailed process of review to ensure the impacts to the environment can be and have been minimised as far as practicable. Seismic surveys are inherently flexible and the survey lines may be adjusted from the nominally mapped alignments by up to approximately 50 m without impacting of the definition in results. The steps outlined below were implemented to ensure the final seismic plan results in the lowest environmental impact through the avoidance of environmentally sensitive features and areas of conservation significant vegetation, as follows: • High level review of existing aerial imagery to ensure, where possible: o avoidance of areas of native vegetation; o use of visible cleared tracks; • Desktop assessment of existing environmentally sensitive features including conservation areas, heritage areas, mapped listed species and communities, surface water features etc to identify lines that can be truncated or removed to minimise impacts on these features to the extent possible; • Bespoke further refinement of avoidance areas and move lines through: o collection of high-resolution imagery; o identification of existing cleared tracks and areas with no understorey vegetation that would not require additional clearing; o movement of lines into nearby areas which would not require clearing; and • On ground site survey was undertaken in Spring 2019 along the proposed seismic lines. This survey assessed a 15 m wide corridor to identify significant trees. **Survey Mitigation Measures** • Vegetation clearing will be undertaken by a team comprising the operator, line surveyor and cultural anthropologist using single pass clearing and mulching techniques and fixed hammer mulchers. In areas with significant risk of Unexploded Ordnance (UXO), UXO experts will first assess risk

	Potential Environmental Impacts
	before clearing, and further survey the mulched areas for UXO. If UXO are found, they will be safely disposed of appropriately with consultation to local police. • This equipment operates in a manner that retains topsoil, leaves root-stock undisturbed and follows the natural ground contours which reduces the impact on soils and root material. • The use of a single pass approach for mulching will reduce the overall traffic on the access lanes. • This method of vegetation clearing ensures optimal conditions for successful rehabilitation. • Avoidance areas have been identified and will be input into GPS guidance tablets with audible alarms to enable on-ground identification and avoidance during implementation of the Proposal. • Access line clearing width restricted to 3.5 m. • Restriction of all vehicle movements to existing tracks and gazetted roads, where and as far as possible. • Speed of vehicles when off road to be reduced to 40km/hr to minimise the risk of dust generation. All Proposal tracks and access lanes to be closed and rehabilitated as soon as possible after completion of the survey works to prevent future unauthorised access.
Predicted Outcome – Describe the predicted outcome against the environmental objective	The Proposal will have a temporary impact on 40 ha of habitat that may support nine conservation significant fauna species and listed threatened species which are likely to occur or have the potential to occur across the Development Envelope. Through the implementation of an iterative planning development process and on ground mitigation measures to be adopted through the duration of the site works, the impact on State listed conservation significant or threatened species is expected to be avoided, reduced or minimised and may therefore be considered not significant. Accordingly, it is expected that the EPA's objective for terrestrial fauna will be met.
Assumptions - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions	Not applicable.

6.3 Inland Waters

6.3.1 EPA Objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

Table 6.5: Inland Waters

	Potential Environmental Impacts
EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	The following policy and guidance are relevant to this factor and has informed planning for the Proposal. **Environmental Factor Guideline: Inland Waters (EPA 2016f)** This guideline provides an outline of how inland waters are considered by the EPA in the EIA process. Relevant matters discussed in guideline include the following: • Description of EIA considerations, including: o Application of the mitigation hierarchy; o The environmental values associated with inland waters affected may be affected by the proposal; o The potential impacts and the activities that will cause them; o Surveys and analyses required; and o The current state of knowledge of inland waters and the level of confidence underpinning the predicted residual impacts; • Describes issues commonly encountered by the EPA during EIA of this factor; and • Provides a summary of the type of information that may be required by the EPA to undertake EIA related to this factor.
Consultation – Outline the outcomes of consultation in relation to the potential environmental impacts	Refer to Section 4.

	Potential Environmental Impacts
Receiving environment – Describe the current condition of the receiving environment in relation to this factor.	The Development Envelope may be described with respect to surface water and groundwater environments. **Surface Water** The Proposal is located within the Swan Coastal Plain geomorphologic division of the Western Australia and specifically in the Dandaragan Plateau in an area comprising 135 wetlands and drained by ephemeral water courses including Mullering Brook and Minyulo Brook. Both brooks form part of the Minyulo suite which comprises a series of wetlands with local and regional significance (Semeniuk Research Group 1994). Water draining along these brooks flows into permanent and seasonal lakes and swamps located in the interdunal depressions in the Bassendean Dunes. The southern portion of the Development Envelope includes the Nammings wetlands system which is comprised of a series of ovoid microscale lakes, sumplands and creeks located in the vicinity of Caro Brook in the Bassendean dunes (Seminiuk 1994). The system also includes permanent and seasonal lakes and swamps that occur in interdunal depressions in the Bassendean Dunes, for example the Douaraba Swamp, Lake Walyengarra and Emu Lakes to the south east of the Development Envelope (Kern 1989) (Figure 2.7). Surface water regimes (flow, storage) are controlled and characterised by the north south orientated Bassendean Dunes which are coastal dune structures. There are no Conservation Category Wetlands (CCW) mapped within the Development Envelope. **Groundwater** The Development Envelope is underlain by two main regional aquifers. The first comprises the Quaternary age superficial unconfined to semi-confined aquifers located within the more recent alluvial, aeolian and marine sediments typical of the Perth coastal plain. These aquifers are typically encountered at depths of between 18 m and 50 m below existing ground level and are recharged by direct infiltration and upward leakage from the underlying second aquifer system, the Yarragadee Formation. The second aquifer comprises the Yarragadee Formation which is the largest (thickest, most extensive) aquifer in the Perth Basin.
Proposal activities – Describe the proposal activities that have the potential to impact the environment	Proposal activities which have the potential to impact on inland waters include: • Clearing and mulching of vegetation along selected access lanes; and • Spills or leaks from the operation and servicing of vehicles required to undertake the Proposal.

	Potential Environmental Impacts
Potential Impacts – Define the potential impacts (direct, indirect and cumulative) on the environmental values for this factor – regional and local, including MNES	**Direct Impacts** Potential direct impacts that may result from the Proposal are: • Disturbance of surface water flows by track construction/clearing; and • Direct contamination of surface water courses and/or local lakes/swamps/wetlands by vehicle use, spills and leaks from vehicles. **Indirect Impacts** Potential indirect impacts that may be experienced are • Contamination of surface water and groundwater through possible leakage from stored fuels, chemicals and hydrocarbons required for the completion of the seismic programme; and • Contamination of surface water and groundwater from waste materials – general waste, chemicals, hydrocarbons if not removed from site (as per operating procedures). **Cumulative Impacts** No cumulative impacts are anticipated with the Proposal with respect to Inland Waters.
Impacts – Assess the impacts of the proposal and review the residual impacts against the EPA objective	The Development Envelope is approximately 122.6 km^2. The Proposal will require the temporary disturbance of up to 40 ha of land comprising native vegetation across the surface water and groundwater regimes of the area. The formation and use of temporary access tracks may result in the: • Localised disturbance of surface water flows and the formation of drainage shadows; and • Localised erosion of soils along access tracks, where soils may be exposed. It is considered that residual impacts which may be experienced as a result of the Proposal should be limited as a result of the very localised impacts on surface water and groundwater regimes and associated vegetation. It is anticipated that there will be no long lasting residual impacts due to the adoption of an approach that focuses on the temporary disturbance of native vegetation at the site rather than the total clearing of vegetation (refer below).

	Potential Environmental Impacts
Mitigation – Describe the measures proposed to manage and mitigate the potential environmental impacts.	Mitigation measures may be separated into those implemented during the planning of the Proposal and those that are to be implemented during completion of the site works. **Seismic Line Planning** The final seismic plan has been developed following a detailed process of review to ensure the impacts to the environment can be and have been minimise to the extent possible. Seismic surveys are inherently flexible and the survey lines may be adjusted from the nominally mapped alignments by up to approximately 50 m without impacting of the definition in results. The steps outlined below were implemented to ensure the final seismic plan may be considered to have the lowest environmental impact through the avoidance of environmentally sensitive features and areas of conservation significant vegetation. • High level review of existing aerial imagery to ensure, where possible: o avoiding creek lines; o avoidance of areas of riparian vegetation; o use of visible cleared tracks ; • Desktop assessment of existing environmentally sensitive features to identify lines that can be truncated or removed to minimise impacts on these features to the extent possible; • Bespoke further refinement of avoidance areas and move lines through: o collection of high-resolution imagery; o identification of existing cleared tracks and areas within no understorey vegetation that would not require additional clearing; o movement of lines into nearby areas which would not require clearing; and • On ground site survey was undertaken in Spring 2019 along the proposed seismic lines. This survey assessed a 15 m wide corridor (ie. 3-4 m either side of the proposed seismic line alignment). **On ground Mitigation Measures** • Seismic tracks to be located away from water courses and surface water bodies. • Seismic line clearing width restricted to 3.5 m. • Access tracks to be formed using clearing techniques that retain low vegetation and root stock to minimise erosion and promote rapid recovery of vegetation post survey. • Lines to be dog legged at road and tracks crossings, weaved smoothly around sensitive areas. • Access track construction to avoid or minimise the formation of road edges/windrows which may impact surface water flows during and after rainfall. • Restriction of all vehicle movements to existing tracks and gazetted roads, where possible. • All fuels, hydrocarbons and chemicals to be stored in a controlled environment in accordance with relevant Australian Standards to minimise the risk of spills and contamination of inland waters – surface waters and ground waters. • Servicing and refuelling of vehicles to undertaken off site in laydown area where spill control equipment is available. • All Proposal tracks and access lanes to be closed and rehabilitated as soon as possible after completion of the survey works. All windrows to be removed to minimise the impact to overland flow and other surface water movement post survey and the formation of surface water shadows.

	Potential Environmental Impacts
Predicted Outcome – Describe the predicted outcome against the environmental objective	The Proposal will have a temporary impact on up to 40 ha of land across a total Proposal Area of 122.6 km^2. Through the implementation of an iterative planning development process and on ground mitigation measures to be adopted through the duration of the site works, the impact on Inland Waters is expected to be avoided, reduced or minimised and are not considered to be not significant. Accordingly, it is expected that the EPA's objective for inland waters will be met.
Assumptions - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions	Not applicable.

6.4 Terrestrial Environmental Quality

6.4.1 EPA Objective

To maintain the quality of land and soils so that environmental values are protected.

Table 6.6: Terrestrial Environmental Quality

	Potential Environmental Impacts
EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	The following policy and guidance are relevant to this factor and has informed planning for the Proposal. **Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016g)** This guideline provides an outline of how terrestrial environmental quality is considered by the EPA in the EIA process. Relevant matters discussed in guideline include the following: • Description of EIA considerations, including: o Application of the mitigation hierarchy; o The environmental values associated with terrestrial environmental quality may be affected by the proposal; o The potential impacts and the activities that will cause them; o Surveys and analyses required; and o The current state of knowledge of flora and vegetation and the level of confidence underpinning the predicted residual impacts; • Describes issues commonly encountered by the EPA during EIA of this factor; and • Provides a summary of the type of information that may be required by the EPA to undertake EIA related to this factor.
Consultation – Outline the outcomes of consultation in relation to the potential environmental impacts	Refer to Section 4.

	Potential Environmental Impacts
Receiving environment – Describe the current condition of the receiving environment in relation to this factor.	The Proposal is located within the Perth Basin which extends from the Murchison River in the north to the south coast of Western Australia. The eastern boundary of the basin is delineated by the Darling Fault and the associated Darling Escarpment. The western boundary is located offshore on the continental slope. Specifically, the Development Envelope is located within the Swan Coastal Plain geomorphologic division of Western Australia and is situated on the Bassendean sand complex, one of four north south orientated dune systems characteristic of the Perth Basin. The Bassendean dune complex is characterised as a gently undulating landscape consisting of sand dunes, inter-dune basins and swales (Blandford 2004). The Bassendean Dunes represents a belt of coastal dunes and other associated shoreline deposits with local concentrations of heavy-mineral sands, the identification of which from surface features is virtually impossible (Mory and Iasky (1996). The topography may be described as gently undulating with high areas of fine to coarse well sorted quartz sand dunes, typically highly to completely leached, interspersed with low areas characterized by swamps and lacustrine deposits (clays, silts, fine sands). The sands are underlain by the silty to sandy clays of the Guildford Formation. The waterlogged soils typically found in the low areas between the dunes may be considered, locally, to be potentially acid sulfate soils (PASS) with higher levels of naturally occurring sulphide rich material. The Australian Soil Resources Inquiry System database indicated that Potential Acid Sulfate Soils (PASS) may be located within the Development Envelope.
Proposal activities – Describe the proposal activities that have the potential to impact the environment	Proposal activities which have the potential to impact on terrestrial environmental quality include: • Clearing and mulching of vegetation along selected seismic access lanes and seismic acquisition; • Soil compaction due to vehicle use of tracks and use of seismic equipment, notably the acquisition equipment and when soils are moist and sand; and • Operation and servicing of vehicles required to undertake the Proposal resulting in localised contamination of soils.
Potential Impacts – Define the potential impacts (direct, indirect and cumulative) on the environmental values for tis factor – regional and local, including MNES	**Direct Impacts** Potential direct impacts that may occur as a result of the Proposal are: • Compaction of soils by use of tracks by survey vehicles – light vehicles and vibroseis trucks; • Compaction of soils by acquisition equipment – vibration plates or tyres, especially when soils are moist and sandy; and • Contamination of soils by vehicle use, spills and leaks from vehicles. **Indirect Impacts** Potential indirect impacts that may occur as a result of the Proposal are: • Contamination of soils from waste materials – general waste, chemicals, containers for fuels, hydrocarbons. **Cumulative Impacts** No cumulative impacts are anticipated or may be associated with the Proposal with respect to Terrestrial Environmental Quality.
Impacts – Assess the impacts of the proposal and review the residual impacts against the EPA objective	The Development Envelope is approximately 122.6 km^2. The Proposal will require the temporary disturbance of up to 40 ha of land to create access lanes to undertake the Proposal. The formation of temporary access lanes may result in the: • Localised disturbance of soils; and • Localised erosion of soils along access tracks, where and if soils may be exposed. Typically, soils will be most susceptible to erosion on completion of the mulching and prior to the reestablishment of vegetation cover. It is considered that residual impacts that may be experienced as a result of the Proposal should be limited to very localised impacts associated with access track preparation works and the actual seismic survey.

	Potential Environmental Impacts
	It is anticipated that there will be no long lasting residual impacts due to the adoption of an approach that requires on the temporary disturbance of native vegetation at the site rather than the total clearing of vegetation (refer below).
Mitigation – Describe the measures proposed to manage and mitigate the potential environmental impacts.	Mitigation measures may be separated into those implemented during the planning of the Proposal and those that are to be implemented during completion of the site works. **Seismic Line Planning** The final seismic plan has been developed following a detailed process of review to ensure the impacts to the environment can be and have been minimised to the extent possible. The steps outlined below were implemented to ensure the final seismic plan may be considered to have the lowest environmental impact through the avoidance of environmentally sensitive features and areas of conservation significant vegetation. • High level review of existing aerial imagery to ensure, where possible: o avoidance of areas of native vegetation; and o use of visible cleared tracks. • Desktop assessment of existing environmentally sensitive features. • Bespoke further refinement of avoidance areas and move lines through: o collection of high-resolution imagery; o identification of existing cleared tracks and areas within no understorey vegetation that would not require additional clearing o movement of lines into nearby areas which would not require clearing; and • On ground site survey was undertaken in Spring 2019 along the proposed seismic lines. **On ground Mitigation Measures** • Seismic tracks to be located away from sensitive features including water courses and surface water bodies. • Seismic line clearing width restricted to 3.5 m. • Access tracks to be formed using clearing techniques that minimise disturbance to the ground surface and retain topsoil, low vegetation and root stock to minimise erosion and promote rapid recovery of vegetation • Lines to be dog legged at road and tracks crossings, weaved smoothly around sensitive areas • Access track construction to avoid or minimise the formation of road edges/windrows which may impact surface water flows during and after rainfall • Restriction of all vehicle movements to existing tracks and gazetted roads, where possible • All fuels, hydrocarbons and chemicals to be stored in a controlled environment in accordance with relevant Australian Standards to minimise the risk of spills and contamination of inland waters – surface waters and ground waters • Servicing and refuelling of vehicles to undertaken off site in laydown area where spill control equipment is available • All Proposal tracks and access lanes to be closed and rehabilitated as soon as possible after completion of the survey works. • Any windrows to be removed to minimise the impact to overland flow and other surface water movement post survey and the formation of surface water shadows.
Predicted Outcome – Describe the predicted outcome against the environmental objective	The Proposal will have a temporary impact on up to 40 ha of land across a total Proposal Area of 122.6 km^2. Through the implementation of an iterative planning development process and on ground mitigation measures to be adopted through the duration of the site works, the impact on Terrestrial Environmental Quality is expected to be avoided, reduced or minimised and may therefore be considered not significant.

	Potential Environmental Impacts
	Accordingly, it is expected that the EPA's objective for Terrestrial Environmental Quality will be met.
Assumptions - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions	Not applicable.

7. Other Environmental Factors

No other environmental factors established by the EPA for the purposes of environmental impact assessment were considered significant for the Proposal, as presented in Table 7.1.

Table 7.1: Assessment of other environmental factors

Environmental factor	Significance of impact
Benthic Communities and Habitat	The Proposal is not located adjacent or nearby coastal areas.
Coastal Processes	The Proposal is not located adjacent or nearby coastal areas.
Marine Environmental Quality	The Proposal is not located adjacent or nearby marine areas.
Marine Fauna	The Proposal is not located adjacent or nearby marine areas.
Landforms	The Proposal will not require disturbance of the ground surface. . No large scale excavation of in-situ materials will be required the survey to proceed.
Subterranean Fauna	There is no subsurface invasive work required (i.e. drilling). The proposal will have an impact on subterranean fauna.
Social Surroundings	The nearest population to the Development Area lives in the town of Cataby which is located approximately 11 km to the northwest. The Proposal is not expected to have an impact on the aesthetic, cultural, economic and/or social values of the location or the region in which it is located.
Human Health	The nearest population to the Development Area lives in the town of Cataby which is located approximately 11 km to the northwest. At this distance noise and vibration generated by the Proposal are not expected to have an impact on human health.
Air Quality	The will be limited disturbance of soils and vegetation during the preparation and survey phases of the Proposal. Some dust may be generated during the vegetation clearing phase however it is anticipated that the impacts should be minor and contained within the immediate work area.

8. Matters of National Environmental Significance

8.1 Matters of National Environmental Significance

The Commonwealth EPBC Act provides a legal framework for the protection of Matters of National Environmental Significance (MNES). The EPBC Act requires that all actions that will or may have a significant impact on a MNES must be referred to the Minister for the Environment via the DWAE. Protected matters under the EPBC Act include:

- World heritage properties;
- National heritage places (including Commonwealth Heritage Places);
- Wetlands of international importance;
- Listed threatened species and ecological communities;
- Migratory species protected under international agreements;
- Commonwealth marine areas;
- A water resource, in relation to coal seam gas activities and large coal mining activities;
- The Great Barrier Reef Marine Park; and
- Nuclear Actions including uranium mining.

In addition, protected matters include the environment where actions proposed will affect Commonwealth land or proposed actions are being undertaken by a Commonwealth agency.

For consistency with the EPBC Act, the Proposal is referred to as the "Proposed Action" in this section of the referral.

8.2 Proposed Action and assessment

The Proposed Action will involve the temporary clearing of up to 40 ha of native vegetation of which 30.86 ha may be considered to the Banksia Woodland TEC and 37.6 ha black cockatoo foraging habitat. Approximately 5.19 ha of temporary clearing associated with the Proposed Action will be undertaken on Commonwealth land that is part of the Lancelin Defence Training Area (LDTA). This land is listed on the National Heritage Place list and Commonwealth Heritage Place List.

Further information regarding the proposed action is presented in Section 2.

A summary of existing environmental values relating to MNES is provided in the following sections:

- Section 2.5.7: Vegetation
- Section 2.5.8: Fauna
- Section 2.5.2: Regional hydrology.

Based on the outcomes of the environmental assessments completed to date, one MNES will be impacted by the proposed action:

- Listed threatened species and ecological communities
- Commonwealth Heritage Places.

The following sections provide an overview of the MNES to be impacted by the proposed action, including specific diagnostic criteria and key threats associated with the species and ecological communities.

8.3 Controlled action provisions

The proposed action is being referred to DAWE in parallel to this referral to the EPA.

The environmental values of the Proposed Action are as it relates to the EPBC Act have been determined with reference to:

- previous and project related environmental assessments, including flora and vegetation and fauna surveys and investigations; and
- known and available scientific information on relevant EPBC Act listed species in relation to their habitat needs and requirements.

The potential impacts of the Proposed Action were considered with reference to the following policy documents:

- EPBC Act referral guidelines for three threatened black cockatoo species (DSEWPAC 2012a); and
- Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (Significant Impact Guidelines) (DoE 2013).

The Proposed Action has the potential to have a significant impact on the following matters:

- Listed threatened species and communities (sections 18 and 18A of the EPBC Act):
  - Banksia Woodlands of the Swan Coastal Plain TEC (Endangered); and
  - Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered).
- National Heritage Places (Commonwealth Heritage Places) – Lancelin Defence Training Area (LDTA) (section 15B and 15C of the EPBC Act)

The LDTA is Commonwealth land, and the Proposed Action involves clearing of approximately 5.19 ha of native vegetation within the area identified as the LDTA. This is discussed further in Section 8.5.

8.4 Listed threatened species and communities

8.4.1 Ecological Communities

One TEC has been identified with the potential to occur within the area of the proposed action. This is the 'Banksia Woodland of the Swan Coastal Plain' TEC of which 30.86 ha is considered to be present within the maximum area to impacted on 47 ha of native vegetation within the Development Envelope.

The results of an assessment completed with reference to the EPBC significance criteria are presented in Table 8.1.

Table 8.1: Significant impact criteria for Banksia Woodlands of the Swan Coastal Plain TEC

Significance criteria	Response
Will the action reduce the extent of an ecological community?	Vegetation within VT6, VT17 and VT18 met the key diagnostic criteria for the Banksia Woodlands of the Swan Coastal Plain ecological community. This represents a total area within the Development Envelope of 8942.6 ha across one patch. The most dominant vegetation type within the Development Envelope was VT17 with 47% of this native vegetation within the Development Envelope. Within VT17 there is 23.09 ha of native vegetation proposed to be cleared. At a local context the Proposed Action occurs within the range of the TEC with extensive areas of potential TEC in the Development Envelope and surrounds. The proposed clearing will result in removal of up to 30.86 ha of TEC, leaving a contiguous area of TEC of viable size (approximately 8 942.6 ha within the Development Envelope). The Proposed Action will not significantly reduce the extent of the Banksia woodlands TEC as 99.6% of the Banksia Woodland TEC patch will remain.

Significance criteria	Response
Will the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?	The Proposed Action is unlikely to increase fragmentation of the TEC. The proposed clearing will result in removal of up to 30.86 ha of TEC, leaving 99.6 % contiguous area of TEC to be retained in the Patch. The Proposed Action is unlikely to fragment patches of existing Banksia Woodland TEC due to the low impact nature of clearing associated with the proposed action (3.5 m-wide tracks). Rehabilitation of the access lanes following completion of the proposed action will be undertaken with appropriate monitoring in place to ensure native vegetation along access lanes return to a composition and structure that is comparable to their pre-disturbance state and edge effects to adjacent native vegetation will be minimised
Will the action adversely affect habitat critical to the survival of an ecological community?	The Proposed Action is not expected to adversely affect habitat critical to the survival of the TEC. The Proposed Action will directly impact no more than 30.86 ha of Banksia Woodland TEC. The Banksia Woodland TEC extends beyond the Development Envelope. Rehabilitation of the access lanes following completion of the proposed action will be undertaken with appropriate monitoring in place to ensure native vegetation along access lanes return to a composition and structure that is comparable to their pre-disturbance state.
Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?	The Proposed Action is not expected to modify abiotic factors necessary for the survival of the TEC. The Proposed Action will not substantially modify or destroy abiotic factors necessary for the survival of the Banksia Woodland TEC including hydrology, nutrients or soil resources. Due to the low impact nature of the proposed action, it is not expected to result in significant Impacts to groundwater levels, or substantial alteration of surface water drainage patterns.
Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?	The Proposed Action is not expected to cause substantial change in species composition or cause a decline or loss of functionally important species. Given the small scale of the proposed clearing footprint (40 ha), and the low impact nature of clearing (3.5 m wide access tracks) within the larger contiguous TEC patch, the proposed action will not result in an action that may cause a substantial change in the species composition of the occurrence of the TEC.
Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to? • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?	The Proposed Action is not expected to result in a substantial reduction in the quality or integrity of Banksia Woodland TEC. The Proposed Action will incorporate mitigation measures that will minimise spread of weeds and dieback including weed treatment and hygiene. ERL will monitor rehabilitation of the Development Envelope following completion of the Proposed Action to ensure native vegetation along access lanes return to a composition and structure that is comparable to their pre-disturbance state.
Will the action interfere with the recovery of an ecological community?	It is not anticipated that the Proposed Action will impact or interfere in the recovery of an ecological community.

8.4.2 Fauna

The EPBC Act referral guidelines for three threatened black cockatoo species (DSEWPAC 2012a) state that an action is regarded as having a high risk of significant impact on habitat for black cockatoos if it involves:

- Clearing of any known nesting tree;

- Clearing or degradation of any part of a vegetation community known to contain breeding habitat (namely trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are a suitable diameter to develop a nest hollow);
- Creation of a new gap of more than 4 km between patches of habitat suitable for breeding, foraging or roosting; and
- Clearing of more than 1 ha of quality foraging habitat.

For the purpose of assessing the significance of a site as potential habitat for black cockatoos, the guidelines specify that the threshold for significance will only be met if there is a "real chance or possibility" that an action will:

- Lead to a long term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of the species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that that species is likely to decline;
- Result in an invasive species that are harmful to a critically endangered or an endangered species becoming established in the endangered or critically endangered species' habitat;
- Introduce a disease that may cause a species to decline; and
- Interfere with the recovery of the species.

The impacts of the Proposed Action on black cockatoos have been broadly assessed against the Commonwealth Significant Impact Guidelines 1.1 (DotE 2013) (refer **Table 8.2**)

Table 8.2: Significant impact criteria for three species of Black Cockatoo

Significance criteria	Response
Lead to a long-term decrease in the size of a population	The Proposed Action is not expected to lead to a long-term decrease in the size of Carnaby's black cockatoo populations. Carnaby's black cockatoos feed on the seeds, nuts and flowers, of a variety of native and introduced plant species and insect larvae (DEE 2019b). Food plants generally occur within proteaceous genera such as Banksia, Hakea and Grevillea, though are known to forage on eucalypt species in woodland areas. Carnaby's black cockatoos have also adapted to feeding on exotic species such as pines and cape lilac and weeds such as wild radish and wild geranium (DEE 2019b). The highest quality Carnaby's black cockatoo foraging habitat was present in areas of Banksia woodland (VSA2) where multiple species suitable for foraging were present in two or more strata. This vegetation is widespread locally. Based on a 3.5 m wide clearing footprint, initial clearing estimates for black cockatoo foraging habitat is 37.6 ha (0.33 %) of the total available potential foraging habitat within the Project Area. Bamford (2015) recorded no evidence of Carnaby's black cockatoos nesting and/or breeding and there are no suitable nesting sites within the Project Area. Suitable Carnaby's black cockatoo foraging and breeding habitat occurs within the Project Area surrounds. This species has been known to breed in the hollows of large trees outside the Project Area, specifically along Cataby Brook and in the upper catchment of Mullering Brook, approximately 5 km east of the Project Area (Strategen JBS&G 2020).

Significance criteria	Response
	On this basis it is unlikely that the Proposal will lead to a long-term decrease in the size of the population.
Reduce the area of occupancy of the species	The Proposed Action is not expected to reduce the area of occupancy of black cockatoos. The Proposed Action is located within the mapped distribution of Carnaby's Cockatoo (DSEWPaC, 2012; DoEE, 2017). There is approximately 11,221 ha of mapped potential foraging habitat within the Project Area which ranges between moderate quality (VSA1) and good quality (VSA2) (Strategen-JBSG 2020). This vegetation is widespread locally and the removal of 37.6 ha (0.33%) of potential foraging habitat within the Project Area is unlikely reduce the area of occupancy of the species.
Fragment an existing population into two or more populations	The Proposed Action is not expected to fragment populations of Carnaby's black cockatoos. Carnaby's black cockatoos are highly mobile species, and as suitable foraging habitat is widespread locally outside of the Project Area, the species is not likely to be dependent on a particular patch of foraging habitat within the Project Area. Carnaby's black cockatoo are expected to forage outside the Project Area amongst large patches of suitable foraging habitat within the local area. Based on a 3.5 m wide clearing footprint, 37.6 ha of low impact clearing for tracks created by the Proposed Action is unlikely to fragment an existing population into two or more populations. Rehabilitation will be undertaken following completion of the Proposed Action to ensure native vegetation along seismic lines return to a composition and structure that is comparable to their pre-disturbance state.
Adversely affect habitat critical to the survival of a species	The Proposed Action is not expected to directly or indirectly impact habitat critical to the survival of the Carnaby's black cockatoo. Carnaby's black cockatoos usually breed between July and December in the hollows of live or dead eucalypts; primarily in Salmon Gum and Wandoo, but also within Jarrah, Marri and other eucalypt species (Johnstone 2010a). The Project Area comprises 11,211 ha suitable foraging habitat and Bamford (2015) recorded no evidence of Carnaby's Cockatoos nesting and/or breeding sites within the Project Area. Suitable foraging and breeding habitat occur outside of the Project Area in the local and regional area which would be considered more likely to be critical habitat to the species. Carnaby's black cockatoo has been known to breed in the hollows of large trees outside the Project Area, specifically along Cataby Brook and in the upper catchment of Mullering Brook, approximately 5 km east (Strategen JBS&G 2020). The Project EP will also implement mitigation measures to reduce indirect impacts that may reduce the quality of adjacent / retained habitat.
Disrupt the breeding cycle of a population	The Proposed Action is not expected to disrupt the breeding cycle of a population of Carnaby's black cockatoos as Bamford (2015) recorded no evidence of Carnaby's black cockatoos nesting and/or breeding and there are no suitable nesting sites within the Project Area. This species has been known to breed in the hollows of large trees outside the Project Area, specifically along Cataby Brook and in the upper catchment of Mullering Brook, approximately 5 km east (Strategen JBS&G 2020).
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Proposed Action is not expected to impact the availability or quality of habitat to the extent that Carnaby's black cockatoos are likely to decline. The clearing of approximately 37.6 ha of potential habitat represents a 0.33 % reduction in potential foraging habitat for Carnaby's black cockatoos within the local area. The majority of the vegetation within the Project Area and surrounds is intact and has not been subjected to any significant disturbance (Woodman 2014a). The reduction in foraging habitat for Carnaby's black cockatoos may result in a minor residual impact associated with the Proposed Action, however it is

Significance criteria	Response
	unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline. Rehabilitation will be undertaken following completion of the Proposed Action to ensure native vegetation along seismic lines return to a composition and structure that is comparable to their pre-disturbance state.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The Proposed Action is unlikely to introduce harmful or invasive species that reduce the extent or quality of suitable foraging habitat to the Carnaby's black cockatoo within the Project Area and surrounds. The majority of the vegetation within the Project Area and surrounds is intact and has not been subjected to any significant disturbance (Woodman 2014a). Freehold farmland and existing roads (Woolka and Cooljarloo Roads), together with introduction of vehicles, machinery material from external areas are the primary existing sources of weed propagules. The Proposed Action EP will include measures to manage the potential spread of weeds, dieback and feral animals into adjacent retained vegetation that could comprise habitat for the species.
Introduce disease that may cause the species to decline	The Proposed Action is unlikely to introduce a disease (e.g. beak and feather disease virus) that may cause the species to decline. There are no known diseases that may be introduced to the area that may cause the population to decline and it is unlikely that any disease already exists in the Project Area that may be spread by activities associated with the Proposed Action. The Proposed Action EP will include measures to manage dieback within the Project Area and adjacent vegetation to reduce potential decline in vegetation health that could comprise remaining habitat for the species.
Interfere with the recovery of the species	The Recovery Plans (DBCA, 2013 and DEC, 2008) provide measures for the species recovery. These measures include identifying, protecting and managing important habitat. The Proposed Action is not inconsistent with the recovery plans for the Carnaby's black cockatoo.

8.5 National Heritage (Commonwealth) Places

The EPBC Significant Impact guidelines 1.1 (DotE 2013) state that an action is likely to have a significant impact on the National Heritage values of a National Heritage place if there is a real chance or possibility that it will cause:

- One or more of the National Heritage values to be lost
- One or more of the National Heritage values to be degraded or damaged, or
- One or more of the National Heritage values to be notably altered, modified, obscured or diminished.

Where the values include natural heritage (geology, landscape, biological, ecological, wilderness and aesthetic), cultural (historic) and Indigenous heritage.

The LDTA (ID 105578) is situated at the northern end of the Swan Coastal Plain biogeographic region, an area of exceptionally diverse flora and fauna many of which are endemic to the region. Wetland vegetation types within the study area are highly diverse, particularly the wet heaths, that often occur as a mosaic with the Banksia woodlands, particularly in the Bassendean system. (DAWE, 2020).

The area is therefore an area of high natural heritage value as a result of the presence of geological, landscape, ecological, biological and wilderness values.

The impacts of the Proposed Action on these natural values have been broadly assessed against the Commonwealth Significant Impact Guidelines 1.1 (DotE 2013) (refer **Table 8.3**).

Table 8.3: Significant impact criteria for Natural Heritage values

Values	Response
Geology or landscape Biological or ecological Wilderness, aesthetic	The Proposed Action will result in the temporary clearing of approximately 5.19 ha of native vegetation within the area identified as the LDTA and a Commonwealth Heritage Place. The Proposed Action is not expected to cause substantial change in to the landscape, wilderness and aesthetic values of the area. More specifically the Proposed Action is not expected to impact the natural biological and ecological values as a result of impacts to habitats, species composition or the decline or loss of functionally important species. Given the small scale of the proposed clearing footprint within the Commonwealth Heritage Place (5.19 ha), and the low impact and temporary nature of clearing (3.5 m wide access tracks), the proposed action will not result in an action that may cause a substantial change in the natural values. The Proposed Action is considered unlikely to result in one of more these values to be lost, degraded or damaged, notably altered, modified, obscured or diminished.

9. Limitations

Scope of services

This report ("the report") has been prepared by Strategen-JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen-JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen-JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen-JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen-JBS&G has also not attempted to determine whether any material matter has been omitted from the data. Strategen-JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen-JBS&G. The making of any assumption does not imply that Strategen-JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen-JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this Proposal and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

Strategen-JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by Strategen-JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

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Appendix A Strategen-JBS&G Raven 2D Seismic Survey Ecological Assessment

Energy Resources

Raven 2D Seismic Surveys Ecological Assessment

21 April 2020

JBS&G57624-126824 (Rev 0)

JBS&G Australia Pty Ltd T/A Strategen-JBS&G

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Appendices

1. Introduction

Energy Resources Limited (ERL), a subsidiary of Minerals Resources Limited (MRL), is proposing to undertake the Raven 2D onshore seismic acquisition survey in the Shire of Dandaragan in the mid-west region of Western Australia within Petroleum Exploration Permit EP 432 (the Project) (Figure 1.1).

This report presents the findings of flora, vegetation, and fauna surveys conducted within the Project Area to support approvals for the Project.

1.1 Background

The Project is proposed to be undertaken within an area of approximately 122.6 km^2 within EP 432 which is located in the Perth Basin (the Project Area). The Project Area is approximately 28 km southwest of Badgingarra and 25 km west of Dandaragan (Figure 1.1).

The Project comprises a total of 125 Lkm of 2D seismic lines and will require temporary disturbance (i.e. cutting and mulching) of up to 40 ha of native vegetation to create access tracks for the vibroseis trucks and light vehicles.

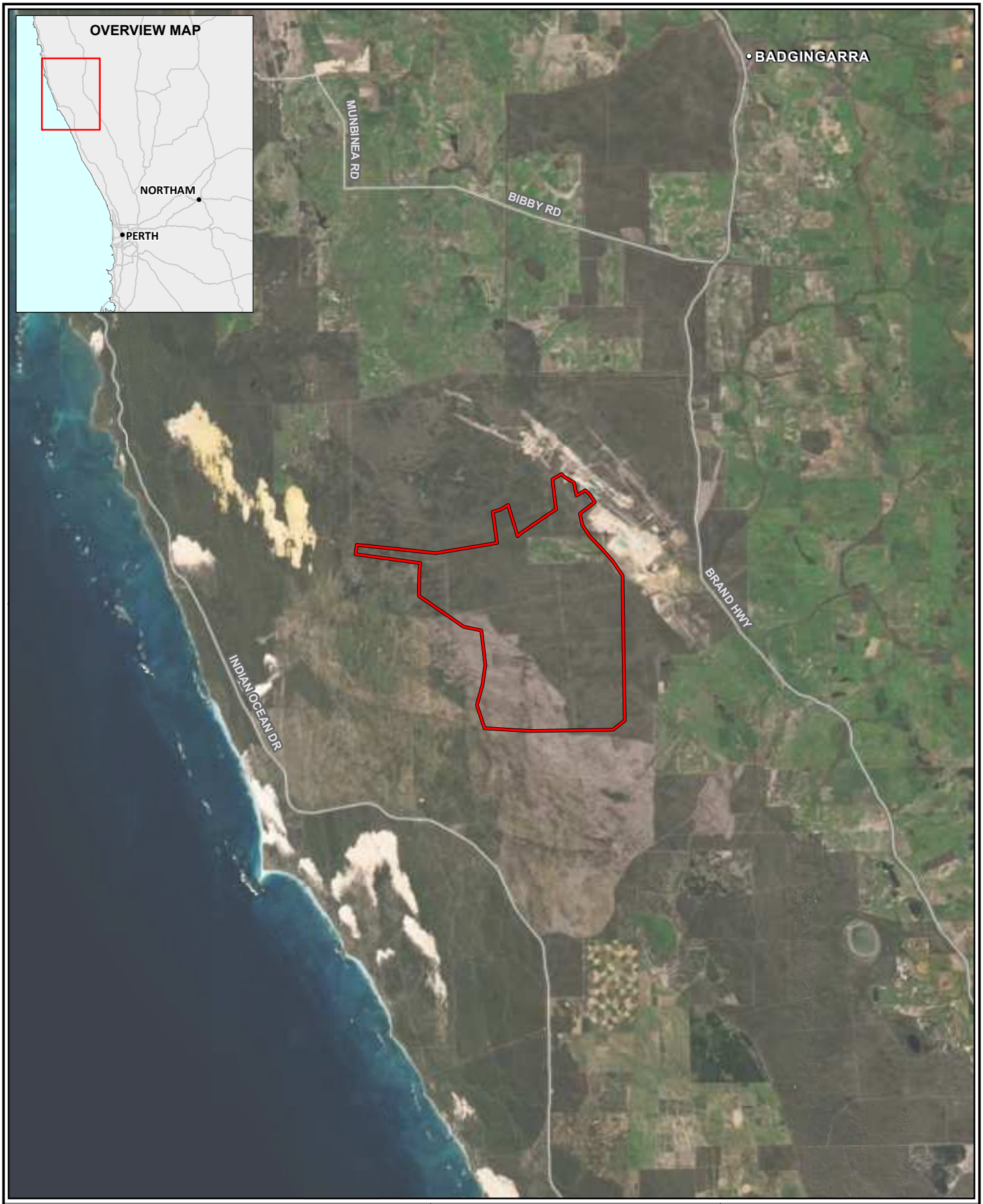
To determine the environmental values within the Project Area, Strategen-JBS&G were commissioned to undertake desktop and field assessments of the Project Area.

1.2 Scope

The scope of works was to undertake a desktop assessment and field assessment within the Project Area.

The objectives were to:

- complete a desktop review of available information
- undertake a reconnaissance field survey to review and update flora, vegetation and fauna surveys previously undertaken within the Project Area
- undertake a targeted flora survey along planned seismic lines that require vegetation clearing (Figure 1.3).
- undertake a targeted Black cockatoo habitat survey within the Project Area
- prepare an ecological survey report incorporating the results of the desktop and field-based assessments.



Legend:

- Project Area
- Major road

Scale 1:300,000 at A4

0 2.5 5
Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 57624

Client: Energy Resources Limited

Version: A | Date: 06-Mar-2020

Drawn By: cthatcher | Checked By: TS

REGIONAL LOCATION

FIGURE 1.1

strategen JBS&G

File Name: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_01_1_RegLocn.mxd
Image Reference: Energy Resources Limited; Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend:

- Project Area
- Minor road
- Tracks

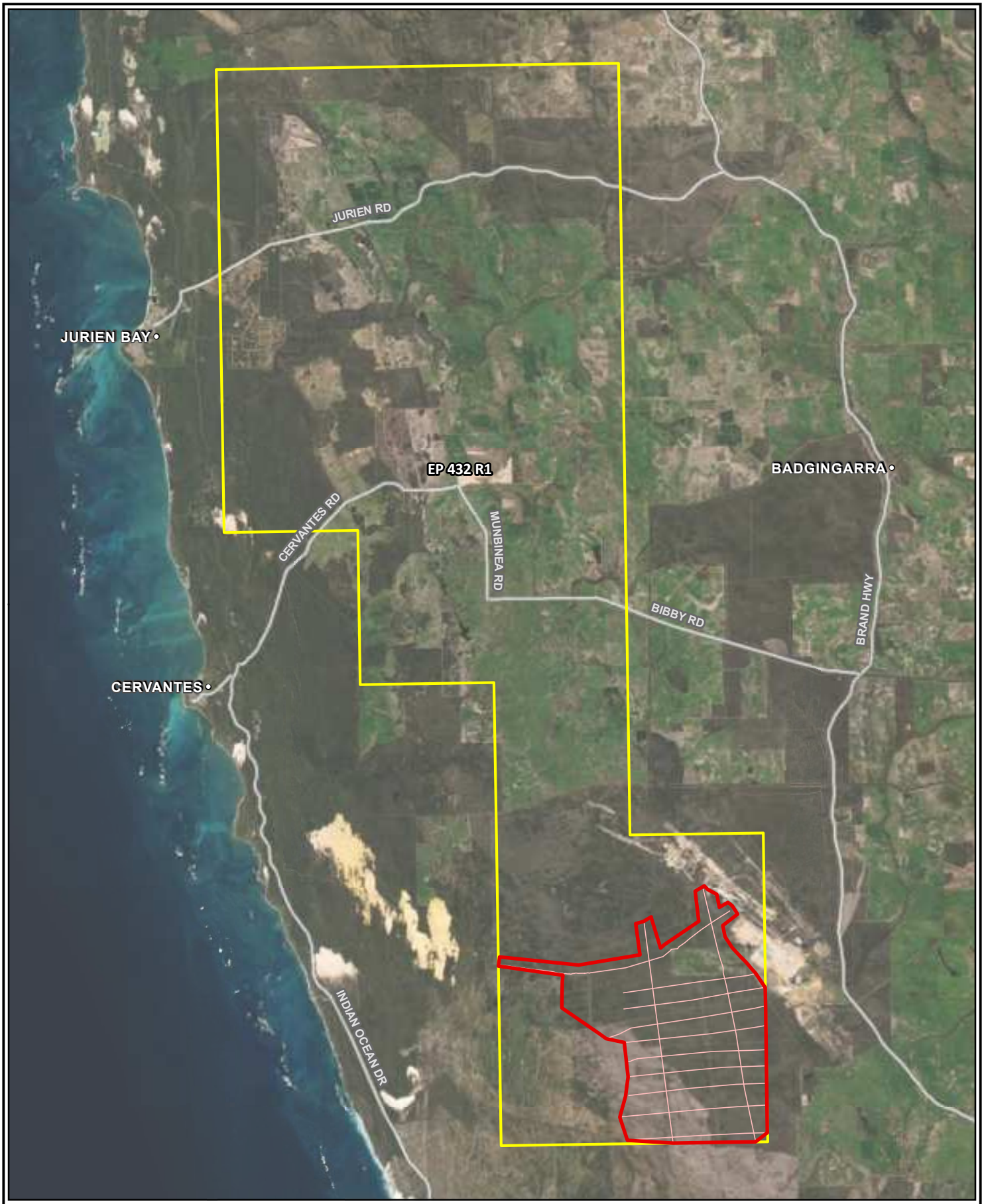
strategen JBS&G

0 2
Kilometers

PROJECT AREA

Job No: 57624		Scale 1:65,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 06-Mar-2020	**FIGURE: 1.2**

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_01_2_SurveyArea.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Raven project area
- Permit area
- Seismic lines
- Major road

Scale 1:300,000 at A4	0 2.5 5 Kilometres	
Coord. Sys. GDA 1994 MGA Zone 50		**RAVEN 2D SEISMIC LINES**
Job No: 57059		
Client: Energy Resources Limited		**FIGURE 1.3**
Version: A	Date: 20-Apr-2020	strategen JBS&G
Drawn By: cthatcher	Checked By: AL	

File Name: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\R01 Rev A\57059_0x_RavenSeismic.mxd
Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

2. Context

2.1 Legislative context

Flora and fauna in Western Australia are protected formally and informally by various legislative and non-legislative measures.

Relevant legislation comprises:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Australian Government
- *Biodiversity Conservation Act 2016* (BC Act) – State
- *Environmental Protection Act 1986* (EP Act) – State
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – State.

Non-legislative measures include:

- Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) Priority lists for flora, ecological communities and fauna
- Weeds of National Significance
- Recognition of locally significant populations by the DBCA.

A short description of each legislative measure is provided below. Other definitions, including species conservation categories, are provided in Appendix A.

2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act aims to protect matters of national environmental significance, which are detailed in Appendix A. Under the EPBC Act, the Commonwealth Department of Agriculture, Water and the Environment (DAWE) lists protected species and Threatened Ecological Communities (TECs) under criteria set out in the Act. Species are conservation significant if they are listed as Threatened (i.e. Critically Endangered, Endangered and Vulnerable) or Migratory.

Bird species protected as Migratory under the EPBC Act include those listed under international migratory bird agreements relating to the protection of birds which migrate between Australia and other countries, for which Australia has agreed. This includes the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Some marine fauna or terrestrial fauna that use marine habitats are listed as Marine under the EPBC Act. These species are only considered conservation significant when a proposed development occurs in a Commonwealth marine area (i.e. any Commonwealth Waters or Commonwealth Marine Protected Area). Outside of such areas, the EPBC Act does not consider these species to be matters of national environmental significance (MNES) so are not protected under the EPBC Act.

2.1.2 *Biodiversity Conservation Act 2016*

DBCA lists taxa (flora and fauna) under the provisions of the BC Act as protected and are classified according to their need for protection (see Appendix A). The BC Act makes it an offence to 'take' threatened species without an appropriate licence. There are financial penalties for contravening the BC Act.

2.1.3 *Environmental Protection Act 1986*

Threatened flora, fauna (and significant habitat necessary for the maintenance of indigenous fauna) and TECs are given special consideration in environmental impact assessments and have special

status as Environmentally Sensitive Areas (ESAs) under the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Clearing Regulations). Exemptions from the requirements to obtain a clearing permit do not apply in an ESA. There are also bioregions within which exemptions do not apply, these include:

- Avon Wheatbelt
- Esperance
- Geraldton Sandplains
- Jarrah Forest
- Mallee
- Swan Coastal Plain
- Warren
- Yalgoo (to the extent of the intensive land-use zone).

The Project Area is located within the Swan Coastal Plain bioregion.

2.1.4 *Biosecurity and Agriculture Management Act 2007*

The BAM Act provides for management and control of listed organisms, including introduced flora species (weeds). Species listed as declared pests under the BAM Act are classified under three categories:

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

Under the BAM Act, land managers are required to manage populations of declared pests as outlined under the relevant category.

3. Environmental setting

3.1.1 Soils and topography

The Project Area is located within the Swan Coastal Plain 2 (SWA02 –Swan Coastal Plain subregion) of Western Australia (al. 2002). The Swan Coastal Plain comprises five major geomorphologic systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson *et al*. 1994). Each major system is composed of further subdivisions in the form of detailed geomorphologic units (Churchward & McArthur 1980; Semeniuk 1990; Gibson *et al*. 1994). Beard (1990) describes the Swan Coastal Plain as a low-lying coastal plain, often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils.

Specifically, the Project Area is located within the Bassendean Dune landform unit. The Bassendean dune system formation is characterised by aeolian bedrock overlayed with siliceous sands (Smolinski & Scholz 1997; McPherson & Jones 2005).

3.1.2 Climate

The Midwest Region has a Mediterranean climate consisting of hot, dry summers and cool, wet winters. The nearest weather station which records both temperature and rainfall data is the Badgingarra (station 009037), approximately 32km from the Project Area. The average rainfall from 1965-2020 was 534.6 mm with the highest monthly rainfall occurring from May to September (Figure 3.1). The wettest year on record was 1963, with an annual rainfall of 785.2 mm, 607 mm of which fell during the May to August period (BOM 2020).

The average maximum temperatures range from 17.6°C in July to 34.7°C in January/February. The average minimum temperatures range from 7.1°C in August to 17.8°C in February.

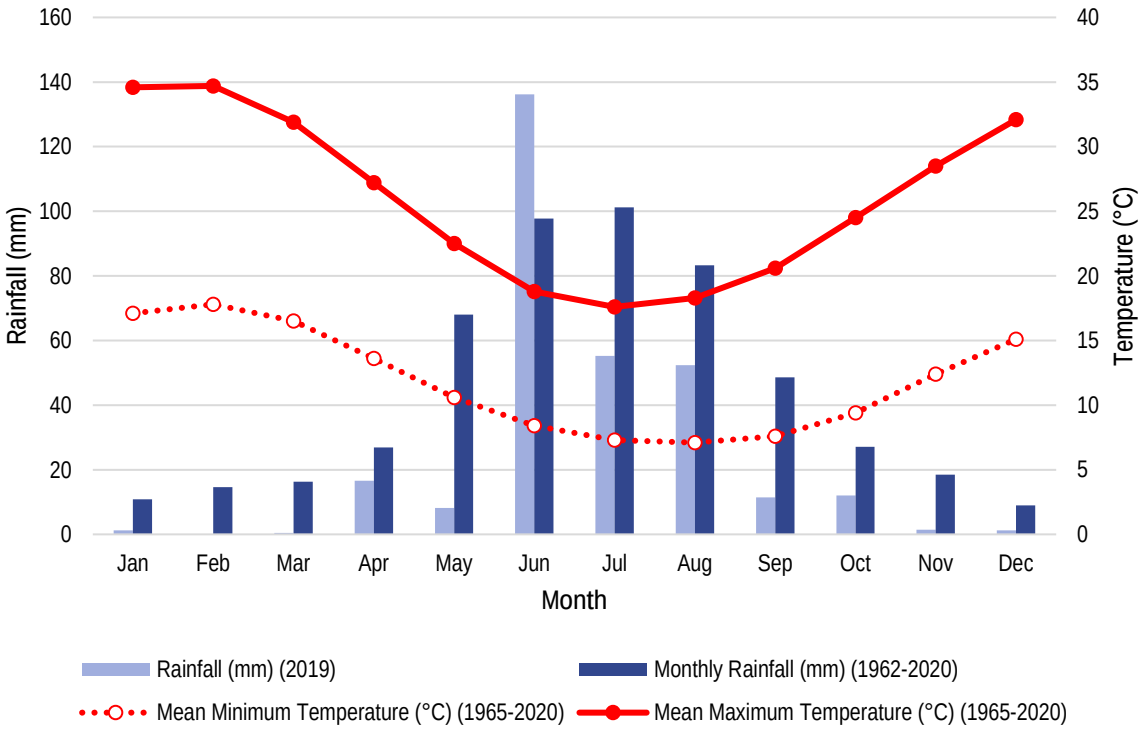


Figure 3.1: Monthly average rainfall and temperature at Badgingarra (Station 009037)

3.1.3 Hydrology

Within the Project Area, 135 mapped wetlands occur across a total area of 3477 ha. Wetland types within the Project Area include Creeks, Damplands, Floodplains, Palusplains, and Sumplands. These areas are shown in Figure 2.2.

3.1.4 Conservation areas

Two DBCA managed lands occur within the Project Area (Figure 3.2; Table 3.1).

Table 3.1: DBCA Managed lands within the Project Area

Type	Name	Identifier
Nature Reserve	Un-named Crown Land	R 40916

3.1.5 Aboriginal Heritage Sites

Eleven Aboriginal Heritage sites occur within, or are adjacent to, the Project Area (Table 3.2).

Table 3.2: Aboriginal Heritage Sites within the Project Area

Title	Identifier	Within Project Area (Y/N)?
Cooljarloo Well	4639	Y
Mullering Brook	4640	Y
Mududlu Myer	24662	Y
Yuccan Djooraly (Turtle Lake)	19735	Y
Dwert Djoorlay (Dog Hole)	19736	Y
Cooljarloo Swamp	20050	Y
Tombstone Rocks	20048	N
Coomado Swamp	20049	Y
Karong (Carnega)	28324	N
Kooyar	28325	Y

3.1.6 Land use

The primary land uses within the Swan Coastal Plain region are agriculture, conservation, Unallocated Crown Land and Crown Reserves, urban, rural residential, forestry and infrastructure. Within and surrounding the Project Area, historical land uses principally include agriculture, mining and conservation.

WONGONDERRAH NATURE RESERVE

WANAGARREN NATURE RESERVE

Legend

- Project Area

Legislated Lands and Waters (DBCA)
- National Park
- Nature Reserve
- Other Reserves

Geomorphic Wetlands (DBCA)
- Barlkarra
- Creek
- Dampland
- Floodplain
- Lake
- Palusplain
- River
- Sumpland

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0 2
Kilometres

WETLANDS AND CONSERVATION AREAS

Job No: 57624		Scale 1:80,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 06-Mar-2020

FIGURE: 3.2

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_02_2_ConsWetlands.mxd
Image Reference:SLIP Public Services Imagery 2020.

3.2 Flora and Vegetation desktop assessment

3.2.1 Regional vegetation

Beard (1990) Botanical Subdistrict

The Project Area occurs within the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

IBRA subregion

IBRA describes a system of 89 'biogeographic regions' (bioregions) and 419 subregions covering the entirety of the Australian continent (Department of the Environment and Energy, 2017). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The Project Area occurs within the Swan Coastal Plain 2 (SWA2) IBRA subregion which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

Vegetation system association and System 6 mapping

Vegetation occurring within the region was initially mapped at a broad scale (1: 1 000 000) by Beard during the 1970s. This dataset formed the basis of several regional mapping systems, including the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia) for Western Australia (DEE 2017), physiographic regions defined by Beard (1981), and System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980).

The Project Area comprises four Beard (1981) vegetation associations (Figure 3.3). Percentage remaining of each vegetation association is provided in Table 3.3 (GoWA 2019a). Heddle et.al. (1980) mapping does not extend to the Project Area.

Table 3.3: Beard (1981) vegetation associations within the Project Area

Vegetation Association	Description	Percent remaining in IBRA Region (%)
1026	Mosaic: Shrublands; *Acacia rostellifera, A. cyclops* (in the south) & *Melaleuca cardiophylla* (in the north) thicket / Shrublands; *Acacia lasiocarpa* & *Melaleuca acerosa* heath	93.84
1029	Shrublands; scrub-heath dryandra-calothamnus association with *Banksia prionotes* on limestone in the northern Swan Region	71.84
1030	Low woodland; *Banksia attenuata* & *B. menziesii*	63.81
1031	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath	19.30

Legend:

- Project Area

Pre-European vegetation (DPIRD)

- Bassendean_1030
- Bassendean_1031
- Guilderton_1026
- Guilderton_129
- Jurien_1029
- Jurien_125
- Le Sueur_1030
- Le Sueur_1031
- Le Sueur_7

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0 2
Kilometres

REGIONAL VEGETATION

Job No: 57624		Scale 1:100,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 06-Mar-2020

FIGURE: 3.3

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_02_3_RegVeg.mxd
Image Reference:SLIP Public Services Imagery 2020.

3.2.1.1 Flora and Vegetation

A number of previous surveys have been conducted within or adjacent to the Project Area. These are summarised in Table 3.4 below.

Table 3.4: Past flora and vegetation surveys and investigations

Description of survey and reference	Field work timing
Vegetation Survey – Vacant Crown Land, Cooljarloo (Mattiske 1996)	
Vegetation Survey – 27000 South Area, Cooljarloo (Mattiske 1997)	
Major Habitat Mapping – Cooljarloo Minesite North Mine Region, July 2002 (Western Botanical 2002)	July 2002
Mullering Onshore 3D Seismic Survey – Flora Vegetation and Dieback (*Phytophthora cinnamomi*) Survey (Woodman 2006a)	
Cooljarloo North (Falcon) Tenements, Flora, Vegetation and *Phytophthora cinnamomi* Assessment (Woodman 2006b)	
Tiwest Joint Venture – Cooljarloo West Phase 1 Drilling – Flora and Vegetation Assessment (Woodman 2007a)	
Falcon Mineral Sands Project: Flora and Vegetation, Local and Regional Conservation Significance (Woodman 2007b)	
Cooljarloo West Project – Flora and Vegetation Assessment (Woodman 2009a)	November 2008
Northern Operations – Cooljarloo Assessment of the Impacts of Mulch Harvesting on Floristic Composition of Native Vegetation (Woodman 2011)	
Cooljarloo West Drilling Program 2012 – Significant Flora Assessment (Woodman 2009b)	September –December 2009
Flora and Vegetation Survey of Exploration Access and Drill Lines in Cooljarloo West and Cooljarloo North West (Mattiske 2010)	September – December 2010
Tiwest 2011 Drill Program – *Phytophthora cinnamomi* Occurrence Assessment occurrence assessment (Glevan 2011)	October 2010
Cooljarloo West Mineral Sands Project – Regional Search for Restricted Wetland Communities (Woodman 2012)	February – March 2012
Targeted Flora Search of Additional Exploration Access Lines – Cooljarloo West (Astron 2012)	December 2012
Conservation Assessment of Threatened and Priorty Flora from the Cooljarloo Area	Woodman 2013
Cooljarloo West Titanium Minerals Project – Flora and Vegetation Assessment (Woodman 2014a)	September – November 2012 May 2013
Paracaleana dixonii review of conservation status and revised impact assessment (Woodman 2014b)	
Paracaleana dixonii Targeted Regional Surveys (Western Botanical 2014a)	December 2013, Jan 2014
Assessment of Conservation Significant Species, Cooljarloo (Western Botanical 2014b)	February 2014
Botanical Survey of 2015 Drill and Access Lines (Woodman 2015)	October 2015
Cooljarloo Survey Intensity Assessment (Astron 2015)	N/A
Cooljarloo West conservation significant flora risk assessment (Woodman 2015a)	N/A
Conservation significant flora survey and impact assessment, Tronox Cooljarloo West Project (Mattiske 2017)	July – December 2016

3.2.1.2 Fauna

Surveys and monitoring of terrestrial fauna have been conducted in the Cooljarloo area since 1986, including that conducted by Bamford (2015) and Bennelongia (2013a) in association with the Tronox Cooljarloo Mineral Sands Mine. Previous surveys have been conducted within or adjacent to the Project Area. These are summarised in Table 2.5 below.

Table 3.5: Past fauna surveys and investigations

Investigation	Scope
Cooljarloo West Development Envelope – Fauna Assessment (Bamford 2015)	Determine the fauna values within the Development Envelope and review any potential impacting processes. Data from surrounding areas collected since 1986 by Bamford Consulting Ecologists was utilised in this study.
Cooljarloo West Proposal: Short Range Endemic Fauna, Pilot and Targeted Surveys (Bennelongia 2013a)	Determine the extent of SRE communities occurring, or likely to occur within the vicinity of the Development Envelope. Identify any listed invertebrate species that may occur within the Development Envelope and to determine whether such species actually occur there. Evaluate the likelihood of threats to SRE and listed invertebrate species arising from mining within the Proposal.

3.2.2 Conservation significant flora

Based on data collected from previous flora surveys conducted, four (4) Threatened and 34 Priority flora species have been recorded within the Project Area:

- *Andersonia gracilis* (T)
- *Anigozanthos viridis* subsp. *terraspectans* (T)
- *Macarthuria keigheryi* (T)
- *Paracaleana dixonii* (T)
- *Grevillea thelemanniana* subsp. Cooljarloo (B.J. Keighery 28 B) (P1)
- *Chordifex reseminans* (P2)
- *Desmocladus microcarpus* (P2)
- *Isotropis cuneifolia* subsp. *glabra* (P2)
- *Lepyrodia curvescens* (P2)
- *Stylidium aceratum* (P2)
- *Thelymitra pulcherrima* (P2)
- *Allocasuarina grevilleoides* (P3)
- *Babingtonia urbana* (P3)
- *Banksia dallanneyi* subsp. *pollosta* (P3)
- *Beaufortia eriocephala* (P3)
- *Beyeria cinerea* subsp. *cinerea* (P3)
- *Conospermum scaposum* (P3)
- *Desmocladus biformis* (P3)
- *Desmocladus nodatus* (P3)
- *Eryngium pinnatifidum* subsp. Palustre (G.J. Keighery 13459) (P3)
- *Goodenia perryi* (P3)
- *Guichenotia alba* (P3)
- *Hakea longiflora* (P3)
- *Hensmania stoniella* (P3)
- *Hibbertia spicata* subsp. *leptotheca* (P3)
- *Hopkinsia anoectocolea* (P3)
- *Isopogon panduratus* subsp. *palustris* (P3)
- *Platysace ramosissima* (P3)
- *Schoenus pennisetis* (P3)
- *Stylidium hymenocraspedum* (P3)
- *Anigozanthos humilis* subsp. *chrysanthus* (P4)
- *Conostephium magnum* (P4)
- *Eucalyptus macrocarpa* subsp. *elachantha* (P4)
- *Grevillea saccata* (P4)
- *Lepidobolus densus* (P4)
- *Schoenus griffinianus* (P4)
- *Thelymitra apiculata* (P4)
- *Thysanotus glaucus* (P4)
- *Verticordia lindleyi* subsp. *lindleyi* (P4)

3.3 Fauna desktop assessment

3.3.1 Conservation significant fauna

Nine conservation significant fauna species were recorded from the Project Area (Table 3.6) during previous surveys undertaken by Bamford (2015). An additional 22 fauna species of conservation significance were identified as potentially occurring within the Project Area from database searches and literature reviews, but were not recorded Bamford (2015) (Table 3.7).

Table 3.6: Conservation significant fauna recorded in the Project Area

Fauna group	Species	Conservation status (EPBC Act)	Conservation status (State) Parks and Wildlife (2017) (previous 2013a)
Reptiles	Spotted Stone Gecko (*Diplodactylus polyophthalmus*)		Potentially of local significance
Birds	Rainbow Bee-eater (*Merops ornatus*)	Marine Listed migratory (JAMBA)	

	Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered	Endangered
	Rufous Fieldwren (*Calamanthus campestris montanellus*)		(previous P4)
	Crested Bellbird (*Oreoica gutturalis gutturalis*)		(previous P4)
	Southern Emu-wren (*Stipiturus malachurus*)		
Mammals	Brush Wallaby (*Macropus irma*)		P4
Insects	Graceful Sun Moth (*Synemon gratiosa*)		P4
Snails	*Bothriembryon perobesus*		P1 (previously P4)

Table 3.7: Conservation significant fauna potentially occurring but not recorded in the Project Area

Fauna group	Species	Conservation status (EPBC Act)	Conservation status (State) Parks and Wildlife (2013a)
Reptiles	Jewelled Ctenotus (*Ctenotus gemmula*)		P3
	Woma (*Aspidites ramsayi*)		P1
	South-West Carpet Python (*Morelia spilota imbricata*)		(previously P4)
	Black-striped Snake (*Neelaps calonotos*)		P3
Birds	Fork-tailed Swift (*Apus pacificus*)	Listed marine Listed migratory (CAMBA, JAMBA, ROKAMBA)	
	Peregrine Falcon (*Falco peregrinus*)		Specially protected
	Australian Bustard (*Ardeotis australis*)		(previously P4)
	Regent Parrot (*Polytelis anthopeplus*)		
	Western Ground Parrot (*Pezoporus flaviventris*)	Critically Endangered Listed migratory (JAMBA as *Pezoporus wallicus flaviventrus*)	Critically Endangered
Molluscs	*Westralunio carteri*	Vulnerable	(previously P4)
Insects	*Austroconops mcmillani*		P2
	Austromerope poultoni		P2
	Austrosaga spinifer		P3
	Hylaeus globuliferus		P3
	Leioproctus contrarius		P3
	Neopasiphae simplicior	Critically Endangered	Endangered
	Phasmodes jeeba		P2
	Psacadonotus seriatus		P1
	Throscodectes xederoides		P3
	Throscodectes xiphos		P1
	Trichosternus relictus		P1
Spiders	*Aganippe castellum*		P4

3.3.2 Fauna habitat

A broad range of habitats exist across the Project Area which were grouped into three Vegetation and Substrate Associations (VSAs) which support the fauna assemblages within the local area (Bamford 2015):

- VSA 1 Low Heath on flats
- VSA 2 Banksia Woodland on low dunes
- VSA 3 Riparian and Riverine Woodland.

3.3.3 Black cockatoo habitat

Carnaby's Black-Cockatoos, listed as Endangered under the EPBC Act, feed on the seeds, nuts and flowers, of a variety of native and introduced plant species and insect larvae (DEE 2019d). Food plants generally occur within proteaceous genera such as *Banksia*, *Hakea* and *Grevillea*, though are known to forage on eucalypt species in woodland areas. Carnaby's black cockatoos have also adapted to feeding on exotic species such as pines and cape lilac and weeds such as wild radish and wild geranium (DEE 2019d). Carnaby's black cockatoos usually breed between July and December in the hollows of live or dead eucalypts; primarily in Salmon Gum and Wandoo, but also within Jarrah, Marri and other eucalypt species (Johnstone 2011). Hollows are usually at least 2 m above ground, sometimes over 10 m and the depth of the hollow varies from 0.25 m to 6 m (DEE 2019d). Mapping of Carnaby's Black Cockatoo distribution (Johnstone and Kirkby undated) identifies the Project Area as occurring within the range of the species.

Bamford (2015) indicates that VSAs 1 and 2 area considered foraging habitat for Carnaby's Black-Cockatoos (approximately 11,211 ha, which represents 91.4% of the Project Area). Habitat identified within the Project Area is not confined to this area and suitable habitat for Carnaby's Cockatoo occurs throughout the region.

Bamford (2015) recorded no evidence of Carnaby's Cockatoos nesting and/or breeding and there are no suitable nesting sites within the Project Area. This species has been known to breed in the hollows of large trees outside the Project Area, specifically along Cataby Brook and in the upper catchment of Mullering Brook, approximately 5 km east.

4. Methods

4.1 Desktop assessment

Database searches were undertaken to generate an updated list of flora, fauna and Threatened and Priority Ecological Communities previously recorded within, and nearby the Project Area – with an emphasis on species and communities of conservation significance and introduced species (Table 4.1). Database searches were conducted within a 5-10 km buffer of the Project Area.

Table 4.1: Database searches conducted for the desktop assessment

Custodian	Database	Taxonomic group	Buffer
DBCA	NatureMap (*https://naturemap.dbca.wa.gov.au*)	Flora and Fauna	10km
DBCA	WA Herb (*https://florabase.dpaw.wa.gov.au/)*	Flora	5km
DBCA	TPFL (*https://catalogue.data.wa.gov.au/dataset/threatened-and-priority-flora)*	Flora	5km
DBCA	TFauna *https://catalogue.data.wa.gov.au/dataset/threatened-and-priority-fauna)*	Fauna	5km
DBCA	Communities (*https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/)*	Ecological Communities	5km
DAWE	PMST *(environment.gov.au/epbc/protected-matters-search-tool)*	Flora, Fauna and Communities	5km

Reports that document regional flora, vegetation and fauna within the surrounds of the Project Area were also reviewed prior to the field assessment.

The results as reported by Bamford (2015) were confirmed using updated database searches and conservation listings.

4.2 Field assessment

4.2.1 Targeted Flora

The field assessment was conducted by two ecologists from Strategen-JBS&G on 4 – 8 and 25 – 29 November 2019. The field assessment was conducted in accordance with guidelines provided in *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

Table 4.2: Personnel

Name	Role	Flora collection permit
Tristan Sleigh Senior Botanist	Planning, fieldwork, plant identification, data interpretation and report preparation	FB62000128
Hannah Sullivan Botanist	Planning, fieldwork, plant identification	n/a

Botanists walked mapped seismic lines with the aid of a GPS-enabled tablet which also included mapped known locations of Threatened and Priority Flora identified from database searches. Each line covered a 3-4 m distance either side of the seismic line (approximately 15 m transect width). For occurrences of taxa thought to be conservation significant, a GPS location and a count of the individuals present for a given area for the species, were recorded. The extent of the populations were also recorded to enable mapping of populations and to inform avoidance and mitigation strategies.

Prior to the field assessment, a list of conservation significant flora with the potential to occur within the Project Area was compiled. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey. A PDF document containing

photographs and descriptions of conservation significant flora was also stored on tablets used in the field, for quick reference to identification information.

The locations of any suspected conservation significant species were recorded on the tablets and in circumstances where identification was not certain, a specimen was collected to subsequently confirm its identity. Information on population size, surrounding vegetation, and soils was also collected at each point that a known or suspected conservation significant flora species was encountered, and a photograph taken in most circumstances.

Flora identification and nomenclature

All plant specimens collected during the field assessments were identified using appropriate reference material or through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

4.2.2 Vegetation assessment

During the surveys, vegetation mapping polygons and boundaries as mapped by Woodman (2015) and updated by Mattiske (2017) were compared with observations using vegetation descriptions with mapped vegetation types. Structure of vegetation potentially aligning with the Banksia Woodlands of the Swan Coastal Plain was also noted with condition rated where relevant.

The data collected was then used to update boundaries based on site observations and updated aerial imagery. Minor boundary changes were made for the following reasons:

- newly cleared areas
- higher resolution aerial imagery enabling some boundary changes
- boundary changes where field observations differed from mapping data.

4.3 Black cockatoo habitat assessment

The Project Area was inspected on 4 – 8 and 25 – 29 November 2019 by Strategen personnel with relevant experience as specified by the *EPBC Act Referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012).

4.4 Survey limitations and constraints

There are possible limitations and constraints that can impinge on the adequacy of vegetation, flora and fauna surveys. The field assessment has been evaluated against a range of potential limitations (Table 4.3). Based on this evaluation, the assessment has not been subject to limitations or constraints that have affected the thoroughness of the assessment and the conclusions reached.

Table 4.3: Flora and vegetation survey potential limitations and constraints

Potential Limitation	Impact on assessment	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint.**	The ecological survey has been undertaken in the Drummond Botanical Subdistrict on the Swan Coastal Plain which has been well studied and documented with ample literature available (Beard 1990). The Project Area has been extensively surveyed over the past 10 years with a comprehensive flora and vegetation report produced in 2013 and an update of vegetation mapping conducted in 2017. This enabled the ecological survey to be conducted with a high level of confidence.
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint.**	Number of species recorded, distance sampled and timing of the ecological survey (i.e. spring) were adequate for this level of survey.

Potential Limitation	Impact on assessment	Comment
Proportion of flora/fauna collected and identified (based on sampling, timing and intensity).	**Not a constraint.**	The proportion of flora surveyed was adequate..
Completeness and further work which might be needed (i.e. was the relevant Project area fully surveyed).	**Not a constraint.**	The information collected during the ecological survey was sufficient to assess the vegetation and black cockatoo habitat that was present during the time of the ecological survey.
Mapping reliability.	**Not a constraint.**	Species point data was collected using hand-held GPS units.
Timing, weather, season, cycle.	**Minor constraint.**	Flora and vegetation surveys are normally conducted following winter rainfall in the South-West Interzone Province, ideally during spring (EPA 2016). The field assessments were conducted in November(i.e. spring) in fine weather conditions. Winter rainfall prior to the ecological survey was less than the long-term average. This may have impacted the presence of annual species which presents a minor ecological survey constraint.
Disturbances (fire flood, accidental human intervention, etc.).	**Minor constraint.**	Minor disturbances were present. A fire across the north-western potion of the Project Area between 3 and 4 years ago may have impacted the presence of flora species.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint.**	The Project Area was traversed on foot.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint.**	The available resources were adequate to complete the ecological survey.
Access problems (i.e. ability to access Project area).	**Not a constraint.**	Existing tracks enabled adequate access to survey the vegetation and fauna within the Project Area. Where access was not available by car, the area was easily traversed on foot.
Experience levels (e.g. degree of expertise in species identification to taxon level).	**Not a constraint.**	The lead botanist has over 13 years' experience conducting flora and vegetation surveys within the bioregion.

5. Results

5.1 Flora and Vegetation

5.1.1 Desktop assessment

Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the Project Area was undertaken using NatureMap (Parks and Wildlife 2007-), the Western Australian Herbarium (Western Australian Herbarium 1998-), and the EPBC Protected Matters Search Tool (PMST) (DEE 2019a) (Appendix A). This data was used to update and append where necessary the data obtained from publicly available historical survey reports.

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or Priority flora. Where flora has been gazetted as Threatened flora under the BC Act, the taking of such flora without the written consent of the Minister is an offence. The BC Act defines "to take" flora as to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means. DBCA (2018a) contains the current list of Threatened flora in Western Australia.

Priority flora are considered to be species which are potentially under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. DBCA categorises Priority flora according to their conservation priority using five categories, P1 (highest conservation significance) to P4 (lowest conservation significance), to denote the conservation priority status of such species. Priority flora species are regularly reviewed and may have their priority status changed when more information on the species becomes available. Appendix A defines levels of Threatened and Priority flora (Western Australian Herbarium 1998-).

At the national level, the EPBC Act lists Threatened species as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Appendix A defines each of these categories of Threatened species. The EPBC Act prohibits an action that has or will have a significant impact on a listed Threatened species without approval from the Australian Government Minister for the Environment. The current EPBC Act list of Threatened flora may be found on the DEE (2019b) website.

The updated desktop assessment identified seven Threatened flora and 49 Priority flora species that have been recorded in the local area. Of these, based on general habitat requirements (Appendix C), four Threatened and 40 Priority flora species were considered to have potential to occur within the Project Area.

Threatened and Priority Ecological Communities

Based on location of the Project Area, comparison of community descriptions and assessment against diagnostic criteria (DCBA 2018, TSSC 2016, TSSC 2019), one TEC listed under the EPBC Act, and one community listed as a Priority Ecological Community (PEC) by DBCA, were considered to be potentially present within the Project Area:

- *Banksia* Woodlands of the Swan Coastal Plain TEC listed under EPBC Act and P3 PEC listed by DBCA)

5.1.2 Field survey

Conservation significant flora

Three Threatened flora species and 15 Priority flora species (Table 5.1; Figure 5.1) were recorded within the Project Area during the 2019 field assessment.

The taxon *Macarthuria keigheryi* was recorded in very large numbers in the north-western portion of the Project Area, in an section burned in a 2015-2016 fire. This taxa's regrowth is likely to be stimulated by fire, causing a flush of growth which will eventually senesce and then numbers will gradually reduce.

Table 5.1: Conservation significant flora identified in 2019

Taxon	Conservation Status	Number of individuals	Estimated impact from proposed clearing
Andersonia gracilis	T	1007	avoidable
Anigozanthos viridis subsp. *terraspectans*	T	25	avoidable
Macarthuria keigheryi	T	11500 (estimated)	2,990
Chordifex reseminans	P2	5000 (estimated)	1300
Isotropis cuneifolia subsp. *glabra*	P2	1	avoidable
Babingtonia urbana	P3	855	222
Banksia dallanneyi subsp. *pollosta*	P3	244	63
Conospermum scaposum	P3	955	248
Desmocladus nodatus	P3	1	avoidable
Guichenotia alba	P3	9	avoidable
Hakea longiflora	P3	1	avoidable
Isopogon panduratus subsp. *palustris*	P3	81	avoidable
Stylidium hymenocraspedum	P3	497	129
Verticordia huegelii var. *tridens*	P3	209	54
Anigozanthos humilis subsp. *chrysanthus*	P4	17	avoidable
Chordifex chaunocoleus	P4	6	avoidable
Conostephium magnum	P4	19	avoidable
Verticordia lindleyi subsp. *lindleyi*	P4	552	143

Project Area

Conservation significant flora

- Andersonia gracilis
- Anigozanthos humilis subsp. chrysanthus
- Anigozanthos viridis subsp. terraspectans
- Anigozanthos viridus subsp. terraspectans
- Babingtonia urbana
- Banksia dallanneyi subsp. pollosta
- Chordifex chaunocoleus
- Chordifex reseminans
- Conospermum scaposum
- Conostephium magnum
- Desmocladus nodatus
- Guichenotia alba
- Hakea longiflora
- Isopogon panduratus subsp. palustris
- Isotropis cuneifolia subsp. glabra
- Macarthuria keigheryi
- Stylidium hymenocraspedum
- Verticordia huegelii var. tridens
- Verticordia lindleyi subsp. lindleyi

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0 2 Kilometers

Job No: 57624		Scale 1:65,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 06-Mar-2020

CONSERVATION SIGNIFICANT FLORA RECORDED DURING 2019 SURVEYS

FIGURE: 5.1

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_04_1_ConSigFlora.mxd

Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

5.2 Flora and vegetation

5.2.1 Vegetation

Woodman (2014a) defined 18 vegetation types (VT) across the greater Cooljarloo West Study Area within which the Project Area is located, which was based on 370 10 x 10 m quadrats. Mapped boundaries of the vegetation communities across the greater Cooljarloo West Study Area were subsequently reviewed during field survey in 2016 by Mattiske Consulting which resulted in minor modifications (Mattiske 2017).

Thirteen native vegetation communities were defined and mapped within the Project Area based on Woodman (2015) listed in Table 5.2 and shown in Figure 5.2. Areas not classified as native vegetation included cleared areas and comprise 5.5% of the Project Area.

Table 5.2: Vegetation Types within the Project Area

Vegetation Type (VT)	Description	Area (ha)	% of Project Area
1	Low Open Heathland to Mid Closed Heathland of *Acacia lasiocarpa* var. *lasiocarpa*, *Banksia telmatiaea*, *Melaleuca seriata*, *Hakea obliqua* subsp. *parviflora*, *Regelia ciliata* and/or *Verticordia densiflora* var. *densiflora*, often with Mid Isolated Clumps of Shrubs to Mid Sparse Shrubland of *Melaleuca rhaphiophylla* on white grey to grey brown sand, sandy loam or sandy clay in broad damp depressions on flat to gently undulating plains	1,489.48	12.15
2	Mid Sparse Shrubland to Mid Closed Shrubland of *Melaleuca acutifolia*, *Melaleuca brevifolia*, *Melaleuca rhaphiophylla* and/or *Melaleuca viminea* subsp. *viminea* over Low Isolated Clumps of Shrubs to Low Shrubland of *Calothamnus hirsutus*, *Calothamnus sanguineus* and *Grevillea* ?*thelemanniana* subsp. Cooljarloo (B.J. Keighery 28 B) on grey to grey brown sand, sandy loam or sandy clay in broad damp to wet depressions and drainage lines on flat to gently undulating plains	215.79	1.76
3	Low Isolated Clumps of Shrubs of *Regelia ciliata* and *Kunzea glabrescens* or Mid Shrubland of *Verticordia densiflora* subsp. *densiflora* over Low Isolated Clumps of Forbs of **Hypochaeris glabra* and *Trachymene pilosa* on white grey sandy clay or grey brown sand on the periphery of claypans	3.46	0.03
5	Low Heathland to Mid Closed Heathland of *Banksia telmatiaea*, *Hakea obliqua* subsp. *parviflora*, *Melaleuca seriata* and/or *Regelia ciliata* on white grey to grey brown sand, sandy loam, sandy clay or clay loam in broad damp depressions on flat to gently undulating plains	358.45	2.92
6	Low Isolated Clumps of Trees to Low Woodland of *Banksia attenuata*, *Banksia menziesii* and/or *Banksia ilicifolia* over Low Sparse Shrubland to Mid Closed Shrubland of *Adenanthos cygnorum* subsp. *cygnorum*, *Banksia telmatiaea*, *Beaufortia squarrosa*, *Hypocalymma angustifolium*, *Jacksonia nutans* and/or Melaleuca seriata over Low Isolated Clumps of Sedges to *Melaleuca seriata* Mid Sedgeland of *Anarthria laevis* and/or Low Isolated Clumps of Rushes of *Chordifex sinuosus* on white grey to grey brown sand in damp depressions	84.47	0.69
7	Low Sparse Heathland to Low Closed Heathland of *Allocasuarina* spp., *Calothamnus quadrifidus*, *Calothamnus sanguineus*, *Hakea incrassata*, *Hakea lissocarpha*, *Hibbertia crassifolia* and/or *Melaleuca seriata* over Low Isolated Clumps of Sedges to Mid Sparse Sedgeland of *Mesomelaena pseudostygia* and *Schoenus clandestinus* on white grey to grey sand or white grey sandy loam to yellow brown clay loam with lateritic surface stones in broad dry depressions or gently undulating plains	114.65	0.93
8	Mid Open Shrubland to Mid Shrubland of *Banksia leptophylla*, *Banksia sessilis* var. *cygnorum* and *Hakea trifurcata* over Low Open Shrubland to Low Shrubland of *Bossiaea eriocarpa*, *Calothamnus quadrifidus* subsp. *quadrifidus*, *Grevillea preissii* subsp. *preissii*, *Hibbertia racemosa*, *Melaleuca systena* and *Scholtzia leptantha* on yellow grey sand to yellow brown sandy loam on ridges and dunes with limestone outcropping	35.20	0.29
9a	Mid Open Shrubland to Tall Closed Shrubland of *Melaleuca teretifolia*, *Melaleuca rhaphiophylla* and *Melaleuca viminea* subsp. *viminea*, occasionally with Mid Shrubs of *Melaleuca lateritia* and Low to Tall Sedges and Rushes of *Baumea juncea*, *Chorizandra enodis*, *Leptocarpus coangustatus* and *Schoenus subfascicularis* on	178.76	1.46

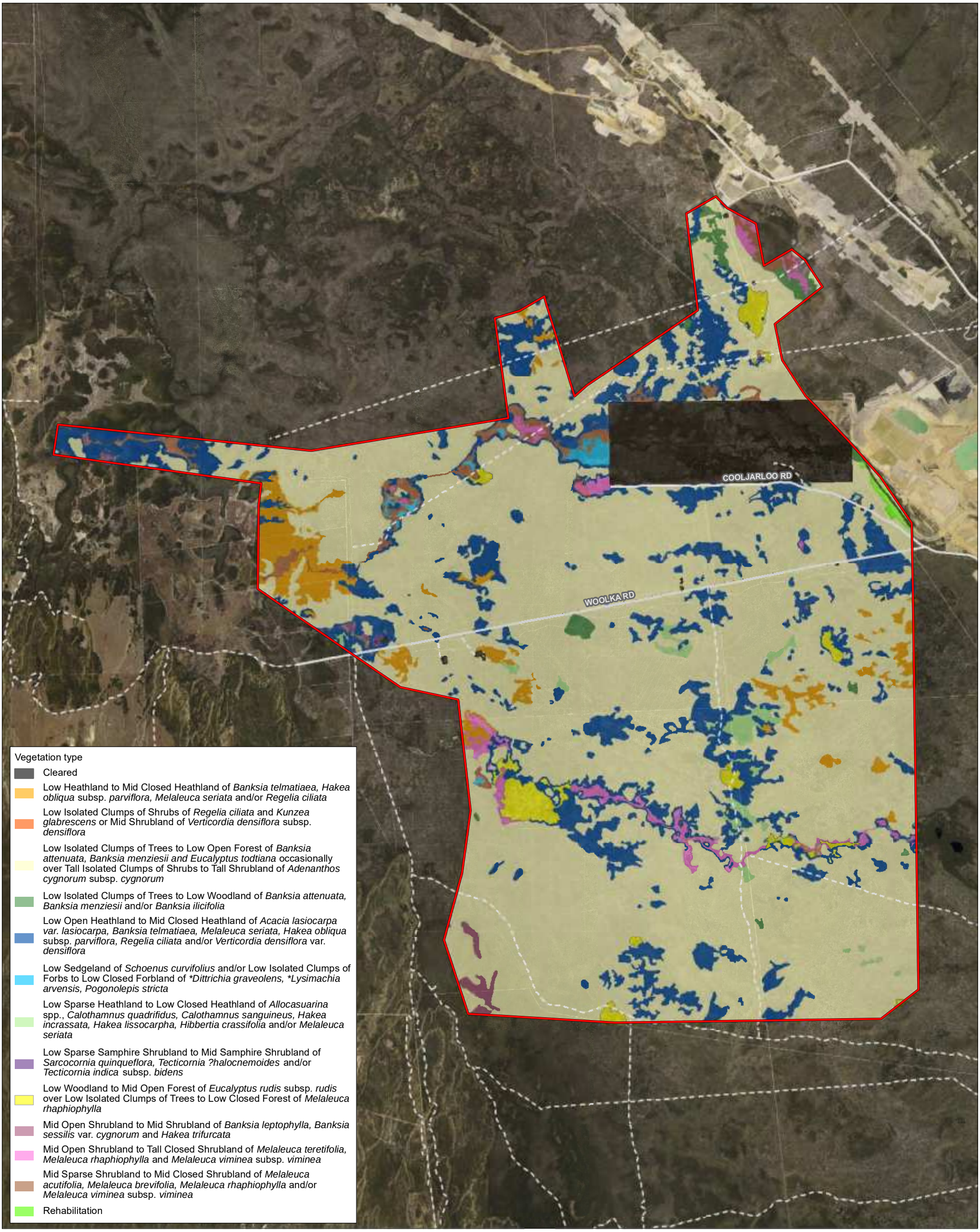
Vegetation Type (VT)	Description	Area (ha)	% of Project Area
	grey to grey brown sandy loam or clay loam in broad shallow basins, wet flats and drainage lines		
9b	Low Woodland to Mid Open Forest of *Eucalyptus rudis* subsp. *rudis* over Low Isolated Clumps of Trees to Low Closed Forest of *Melaleuca rhaphiophylla*, often with Tall Sparse Shrubland to Tall Shrubland of *Acacia saligna* subsp. *lindleyi*, over Low Isolated Clumps of Forbs to Low Closed Forbland of **Galium murale*, **Hypochaeris glabra*, **Lysimachia arvensis* and *Trachymene pilosa* on grey to grey black sand, sandy loam, sandy clay or clayey sand in wetlands, broad shallow basins/depressions and drainage lines	178.94	1.46
13	Low Sparse Samphire Shrubland to Mid Samphire Shrubland of *Salicornia quinqueflora*, *Tecticornia* ?*halocnemoides* and/or *Tecticornia indica* subsp. *bidens* over Low Isolated Clumps of Shrubs to Low Open Shrubland of *Frankenia pauciflora* and/or *Lawrencia squamata* over Low Isolated Clumps of Forbs to Low Forbland of *Angianthus micropodioides*, *Angianthus pygmaeus* or *Angianthus preissianus*, **Hypochaeris glabra*, **Lysimachia arvensis*, **Polypogon monspeliensis* and/or **Vulpia bromoides* on white grey to grey brown sandy clay to clay on saline flats	10.19	0.08
16	Low Sedgeland of *Schoenus curvifolius* and/or Low Isolated Clumps of Forbs to Low Closed Forbland of **Dittrichia graveolens*, **Lysimachia arvensis*, *Pogonolepis stricta*, **Parentucellia viscosa*, *Brachyscome bellidioides*, *Calandrinia* sp. Kenwick (G.J. Keighery 10905), *Goodenia pulchella* subsp. Coastal Plain A (M. Hislop 634) and *Wurmbea* sp. on grey to grey brown sandy clay loam on non-saline flats	41.04	0.33
17	Low Isolated Clumps of Trees to Low Open Forest of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* over Mid Isolated Clumps of Shrubs to Mid Shrubland of *Adenanthos cygnorum* subsp. *cygnorum*, *Eremaea pauciflora*, *Jacksonia floribunda*, *Jacksonia nutans*, *Stirlingia latifolia* and *Xanthorrhoea preissii* over Low Isolated Clumps of Shrubs to Low Shrubland of *Bossiaea eriocarpa*, *Dasypogon obliquifolius*, *Eremaea asterocarpa* subsp. *asterocarpa*, *Eremaea pauciflora*, *Hibbertia crassifolia*, *Hibbertia hypericoides*, *Jacksonia nutans*, *Melaleuca clavifolia*, *Patersonia occidentalis* var. ?*occidentalis* and *Petrophile linearis* over Low Isolated Clumps of Sedges to Mid Open Sedgeland of *Mesomelaena pseudostygia* on white or grey sand on undulating plains and low dunes	5,777.11	47.11
18	Low Isolated Clumps of Trees to Low Open Forest of *Banksia attenuata* and *Banksia menziesii* over Mid Isolated Clumps of Shrubs to Mid Shrubland of *Allocasuarina humilis*, *Conospermum stoechadis* subsp. *stoechadis*, *Eremaea pauciflora*, *Hakea costata* and/or *Xanthorrhoea preissii* over Low Isolated Clumps of Shrubs to Low Closed Shrubland of *Bossiaea eriocarpa*, *Calothamnus sanguineus*, *Dasypogon obliquifolius*, *Eremaea pauciflora*, *Hibbertia hypericoides*, *Jacksonia nutans* and/or *Melaleuca clavifolia* over Low Isolated Clumps of Sedges to Mid Open Sedgeland of *Mesomelaena pseudostygia* on grey to yellow grey sand on undulating plains and low dunes or white grey to grey brown sand, sandy loam or sandy clay loam on simple slopes, open depressions or flats within undulating plains	3,080.98	25.13
C	Cleared Land	674.86	5.50
R	Rehabilitation Area	18.38	0.15
	Total	12,261.75	

*= introduced

Vegetation Condition

The majority of vegetation within the Project Area and surrounds is intact and has not been subjected to any significant disturbance (Woodman 2014a). Disturbance is usually related to historical access lines for exploration drilling and seismic surveys, firebreaks and vehicle tracks.

As such, vegetation condition within the Project Area is predominantly in Excellent condition (EPA 2016). Freehold farmland and existing roads (Woolka and Cooljarloo Roads), together with introduction of vehicles, machinery material from external areas are the primary existing sources of weed propagules.



Legend:

- Project Area
- Minor road
- Tracks

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0 2 Kilometers

Job No: 57624		Scale 1:65,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 13-Mar-2020

VEGETATION TYPES MAPPED WITHIN THE PROJECT AREA

FIGURE: 5.2

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R02_Rev_A\57624_02_4_VegTypes.mxd

Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

5.2.1.1 Threatened and Priority Ecological Communities

From the results of the field assessment, one TEC (and one PEC) occurs within the Project Area:

- Banksia Woodlands of the Swan Coastal Plain (TEC and P3 PEC).

Banksia Woodlands of the Swan Coastal Plain

An analysis of the quadrat data was undertaken to determine the extent of the Banksia Woodlands of the Swan Coastal Plain TEC (Table 5.3). The determination of patches was made using the key diagnostic criteria as per the Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016).

Vegetation within VT6, VT17 and VT18 met the key diagnostic criteria for the Banksia Woodlands of the Swan Coastal Plain ecological community. This represents a total area within the Project Area of 8,942.6 ha across one patch. This patch is not fully confined to the Project Area, with vegetation adjacent being considered part of the patch. Average vegetation condition within the patch ranged from Good to Very Good-Excellent.

Areas mapped as Banksia Woodlands of the Swan Coastal Plain TEC are also considered to represent the State level community Banksia Woodlands of the Swan Coastal Plain PEC. This listing is not subject to condition criteria.

Table 5.3: Banksia woodlands of the Swan Coastal Plain – assessment against key diagnostic criteria (TSSC 2016)

Key diagnostic criteria (TSSC 2016)	Patch
	1
Assessment sites	Multiple
Area within Project Area	8,942.6 ha
Location: Occurs in the Swan Coastal Plain or Jarrah Forest IBRA bioregions.	YES
Soils and landform: Occurs on: • well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands • sandy colluviums and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau • transitional substrates and sandflats.	YES - sandy colluviums and aeolian sands
Structure: Low woodland to forest with: • 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 below • 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.	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species
Composition: Contains at least one of the following species: • Banksia attenuata • Banksia menziesii • Banksia prionotes • Banksia ilicifolia.	YES – contains *Banksia attenuata*
Condition (Keighery 1994): 'Pristine': no minimum patch size; 'Excellent': 0.5 ha; 'Very Good': 1 ha 'Good': 2 ha.	Good to Excellent

Legend

Project Area

Banksia woodlands of the Swan Coastal Plain TEC/PEC

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Kilometers

BANKSIA WOODLAND MAPPED WITHIN THE PROJECT AREA

Job No: 57624		Scale 1:65,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 13-Mar-2020	**FIGURE: 5.3**

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Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

5.3 Fauna

5.3.1 Desktop Assessment

Results of the databases searches identified a total of 25 conservation significant vertebrate species (including Priority species) were identified during the desktop review of the database searches (Appendix B). These were comprised of one reptile, 17 birds, and seven mammals.

Database errors and anomalies

It is important to note that the EPBC PMST is not entirely based on point records, but also on broader information, including bioclimatic distribution models. Consequently, the results of the EPBC PMST are in some cases less accurate, particularly at a local scale (e.g. the Malleefowl [*Leiopa ocellata*]). As a result, the EPBC PMST can include species that do not occur in the Project Area because, for example, there is no habitat available or they are now known to be locally extinct. These species have therefore been omitted from any further discussion. In addition, when the DBCA threatened fauna database results return three or less records and the records are more than 30 years old, these species are also omitted from further discussion.

In addition, many fauna are not distributed evenly across the landscape, are more abundant in some places than others, and consequently more detectable (Currie 2007). Furthermore, some small, common ground-dwelling reptile and mammal species tend to be habitat specific, and many bird species can occur as regular migrants, occasional visitors or vagrants. Therefore, all these species have been excluded from any further discussion.

Waterbirds

Wetland avifauna such as wading birds, including Plovers, Sandpipers and Stilts inhabit estuaries, mudflats, saltmarshes, sandflats and beaches, with shallow water edges, where they feed on invertebrates such as worms, molluscs, insects and crustaceans (Garnett *et al.* 2011) and these habitats for these species are not present in the Project area. A number of seabirds including Shearwaters, Petrels and Albatross were also recorded. These species spend most of their time far offshore (Slater *et al.* 2009, Garnett *et. al*. 2011) therefore, these species have been omitted from any further discussion.

Now regionally extinct

A number of species in the database searches were also known to be historical records of species now locally or regionally extinct. These species have therefore been omitted from any further discussion.

5.3.2 Conservation Significant Fauna

A total of nine (9) conservation significant species retrieved from the database searches are considered to potentially occur in the Project Area. Of these, three (3) species were recorded by Bamford (2015) (Table 5.4).

Table 5.4: Conservation significant fauna potentially occurring in the Project Area

Fauna group	Species	Conservation status (EPBC Act)	Conservation status (BC Act/ DBCA 2019)	Occurrence within Project Area
Reptiles	Jewelled Ctenotus (*Ctenotus gemmula*)		P3	Potential to occur based on presence of habitat
	Woma (*Aspidites ramsayi*)		P1	Potential to occur based on presence of habitat
	Black-striped Snake (*Neelaps calonotos*)		P3	Potential to occur based on presence of habitat
Birds	Rainbow Bee-eater (*Merops ornatus*)	Marine		Recorded (Bamford 2015)
	Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered	Endangered	Recorded (Bamford 2015)
	Fork-tailed Swift (*Apus pacificus*)	Listed migratory (CAMBA, JAMBA, ROKAMBA)		Potential to occur based on presence of habitat
	Peregrine Falcon (*Falco peregrinus*)		OS	Potential to occur based on presence of habitat
	Western Ground Parrot (*Pezoporus flaviventris*)	Critically Endangered Listed migratory (JAMBA as *Pezoporus wallicus flaviventrus*)	Critically Endangered	Potential to occur based on presence of habitat
Mammals	Brush Wallaby (*Macropus irma*)		P4	Recorded (Bamford 2015)

CR = Listed as Critically Endangered under the EBPC Act and BC Act, EN = Listed as Endangered under the EBPC Act and BC Act, VU = Listed as Vulnerable under the EBPC Act and BC Act, Mi = Listed as Migratory under the EBPC Act, Ma = Listed as Marine under the EBPC Act, OS = Other specially protected fauna under the BC Act , and P = Listed as Priority by the DBCA.

5.3.3 Black cockatoo habitat assessment

5.3.3.1 Foraging Habitat

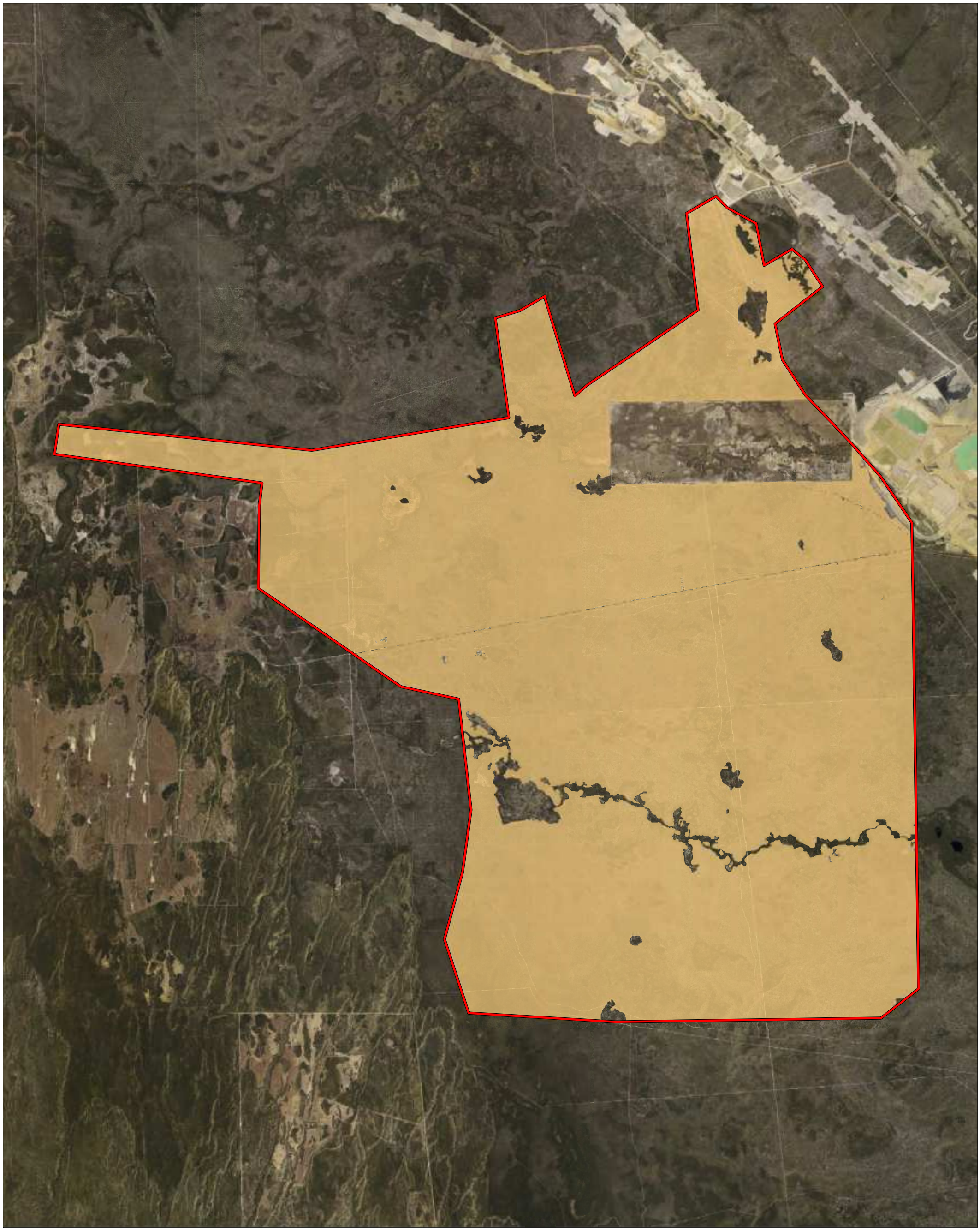
There was approximately 11,211 ha of foraging habitat recorded within the Project Area (Figure 5.4). Foraging species primarily consist of *Banksia attenuata*. Mapping was based on that conducted by Bamford (2015).

The Project Area ranges between moderate quality (VSA1) and good quality (VSA2)with regard to Black Cockatoo foraging habitat quality. Habitat foraging quality of each VSA was determined using the scale described in Table 5.5.

Table 5.5: Definitions 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, mid-storey 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 (i.e. canopy and mid-storey).
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 (i.e. canopy and mid-storey).
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 (i.e. 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 (i.e. canopy).
Nil	Cleared areas - no suitable vegetation present.

-



Legend

- Project Area
- Black cockatoo foraging habitat

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Kilometers

BLACK COCKATOO FORAGING HABITAT

Job No: 57624		Scale 1:65,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: TS	Version: A	Date: 13-Mar-2020	**FIGURE: 5.4**

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Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

6. Discussion

6.1 Flora

Three (3) Threatened and 15 Priority flora were recorded during the ecological survey which was conducted within all vegetation with the potential to be impacted. While habitat to support other conservation significant species was present, the potential impact areas and therefore targeted field assessment areas, represent less than 4% of the Project Area.

The taxon *Macarthuria keigheryi* was recorded in high densities in the north-western portion of the Project area, in an area which was burned in the 2015-2016 fire. Avoidance of impacts to this species within the previously burnt area is unlikely to be possible given the large area they are likely to cover. Based on current proposed clearing footprint, approximately 2,990 individuals will be directly impacted. This is approximately 26% of the recorded number. However, the population of this species extends further that the areas surveyed. Based on this, the proportion of the population proposed to be impacted will be less than 26%.

The two other threatened flora species recorded, *Andersonia gracilis*, and *Anigozanthos viridis* subsp. *terraspectans*, occur in lower densities and disturbance to these species should be able to be avoided by deviating planned seismic lines around known populations.

Of the 15 Priority flora species recorded, avoidance of impacts to eight species (*Isotropis cuneifolia* subsp. *glabra, Desmocladus nodatus, Guichenotia alba, Hakea longiflora, Isopogon panduratus* subsp. *palustris, Anigozanthos humilis subsp. chrysanthus, Chordifex chaunocoleus, Conostephium* magnum) is likely possible by deviating planned seismic lines around known populations. These populations are low in numbers and their extent was mapped during the field assessment. The remaining seven species (*Chordifex reseminans, Babingtonia urbana, Banksia dallanneyi* subsp. *pollosta, Conospermum scaposum, Stylidium hymenocraspedum, Verticordia huegelii* var. *tridens, Verticordia lindleyi* subsp. *lindleyi*) occurred in large densities and total extents were unable to be mapped. While impacts to these species are unlikely to be avoidable, their large population size and small area of impact on each population mean any impacts on the local populations of these species are unlikely to be significant.

6.2 Vegetation

Thirteen native vegetation communities were defined and mapped within the Project Area based on Woodman (2015). Areas not classified as native vegetation included cleared areas and covered 5.5% of the Project Area. Minor boundary changes were made for the following reasons:

- newly cleared areas
- higher resolution aerial imagery enabling some boundary changes
- boundary changes where field observations differed from mapping data.

No edits to entire polygons were made based on field observations.

Based on a 3.5 metre wide clearing footprint, initial clearing estimates for each vegetation type are shown in Table 6.1.

Table 6.1: Vegetation clearing per vegetation types

Vegetation Type	Area (ha)
1	5.13
2	0.47
5	0.69
6	0.51
7	0.31
8	0.18
9a	0.57
9b	1.08

17	20.20
18	10.15
Cleared Areas	0.04
Total	**39.32**

The most dominant vegetation type within the Project Area was VT17 with 47% of the Project Area represented by this vegetation type. Within VT17 there is 20.2 ha of native vegetation proposed to be cleared.

One TEC, also listed as a PEC, was identified to occur within the Project Area.

The TEC "Banksia woodlands of the Swan Coastal Plain" was identified in the desktop assessment and confirmed as occurring within the Project area. This TEC is listed as Endangered under the EPBC Act and as a P3 PEC at the state level. An assessment of vegetation data, against published diagnostic criteria determined vegetation mapped as VT6, VT17 and VT18 represents the TEC. This vegetation is present in one contiguous patch meeting the diagnostic criteria over an area within the Project Area of 8942.6 ha. Average vegetation condition ranged from Good to Excellent. This TEC extends beyond the Project Area in large areas of contiguous vegetation. Based on a 3.5 metre wide clearing footprint, initial clearing estimates for the Banksia woodland TEC is 30.86 ha.

6.3 Fauna

Within the Project Area, 11,211 ha of Black Cockatoo foraging habitat was mapped. The highest quality habitat was present in areas of Banksia woodland (VSA2) where multiple species used for foraging were present in two or more strata. This vegetation is widespread locally. Based on a 3.5 metre wide clearing footprint, initial clearing estimates for Black cockatoo foraging habitat is 37.6 ha.

The desktop fauna assessment identified nine conservation significant species as having potential to occur within the Project Area. Of these, three have been recorded within the Project Area (Carnaby's cockatoo, Rainbow bee-eater, Brush Wallaby). Given the low proposed impact to the Project Area (0.34%) impacts to conservation significant fauna are unlikely to be significant.

7. Conclusion

The key results and outcomes of the flora and vegetation survey and desktop fauna and targeted Black cockatoo survey were:

- thirteen native vegetation types were mapped within the Project Area.
- one TEC and one PEC was recorded and mapped within the Project Area:
  - Banksia woodland of the Swan Coastal Plain (TEC and PEC).
- three Threatened and 15 Priority flora species were recorded within the proposed clearing area.
- 11,211 ha of Black cockatoo foraging habitat was mapped within the Project Area.

8. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

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Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, Strategen-JBS&G reserves the right to review the report in the context of the additional information.

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Appendix A Conservation significant flora and ecological community definitions

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] 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.

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.*

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

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.

CR **Critically endangered species**

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.

EN **Endangered species**

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.

VU **Vulnerable species**

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.

EX Extinct species

Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

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.

MI Migratory species

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*.

CD Species of special conservation interest (conservation dependent fauna)

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*.

OS Other specially protected species

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*.

P Priority species

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

1 Priority 1: 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.

2 Priority 2: 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.

3 Priority 3: 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.

4 Priority 4: 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.

[1] The definition of flora includes algae, fungi and lichens
[2]Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Definition of Threatened Ecological Communities -EPBC Act

Critically endangered

An ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).

Endangered

An ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).

Vulnerable

An ecological community is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).

Appendix B Desktop assessment results

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

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

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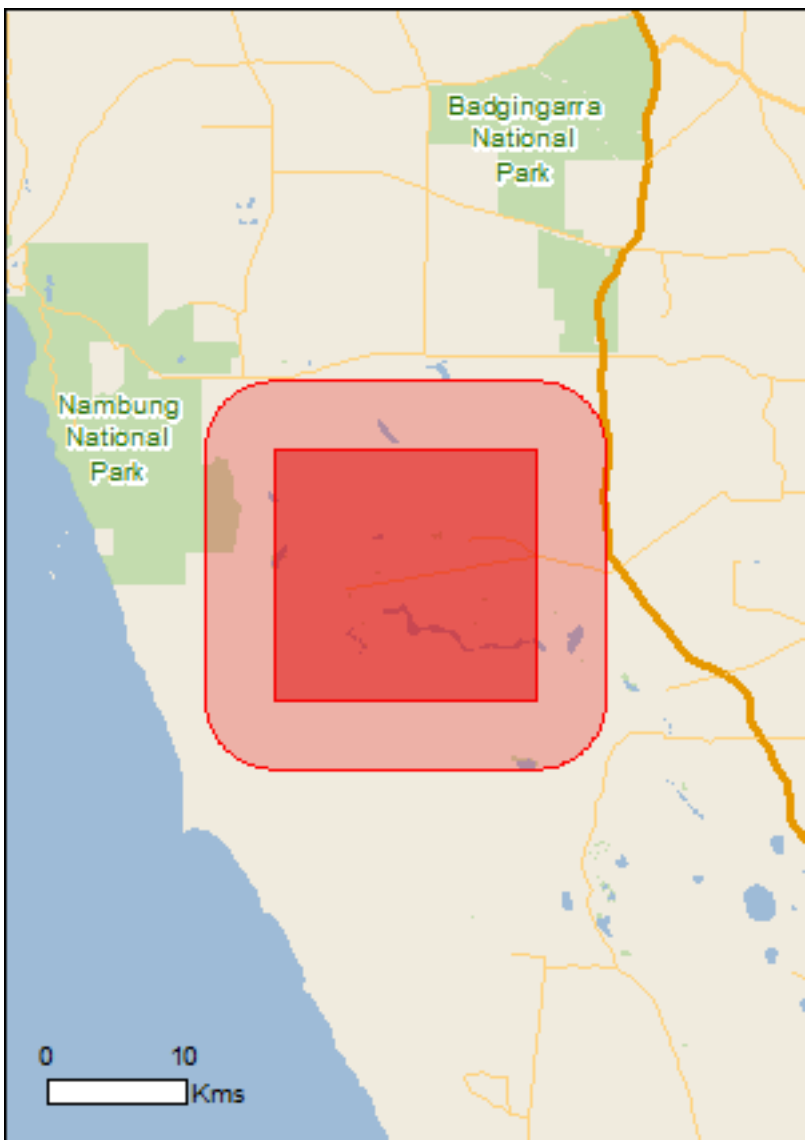

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
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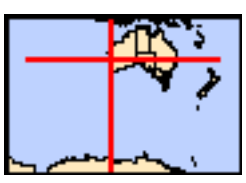

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	27
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	1
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	14
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

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

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat may occur within area
Plants		

Name	Status	Type of Presence
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat known to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat may occur within area
Eucalyptus absita Badgingarra Box [24260]	Endangered	Species or species habitat may occur within area
Eucalyptus impensa Eneabba Mallee [56711]	Endangered	Species or species habitat may occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat likely to occur within area
Grevillea batrachioides Mt Lesueur Grevillea [21735]	Endangered	Species or species habitat may occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Hakea megalosperma Lesueur Hakea [10505]	Vulnerable	Species or species habitat may occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat may occur within area
Leucopogon obtectus Hidden Beard-heath [19614]	Endangered	Species or species habitat may occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Paracaleana dixonii Sandplain Duck Orchid [86882]	Endangered	Species or species habitat may occur within area
Ptychosema pusillum Dwarf Pea [11268]	Vulnerable	Species or species habitat may occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Lancelin Defence Training Area	WA	Listed place

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Nambung	WA
Unnamed WA40916	WA
Unnamed WA41986	WA
Wanagarren	WA
Wongonderrah	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species

Name	Status	Type of Presence
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		habitat may occur within area Species or species habitat may occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Lancelin Defence Training Area	WA

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-30.61 115.249,-30.61 115.42,-30.75 115.42,-30.75 115.249,-30.61 115.249

Acknowledgements

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

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

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

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

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Appendix C Conservation significant flora likelihood assessment

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Acacia benthamii FABACEAE	Not listed	P2	Shrub, ca 1 m high. Fl. yellow, Aug to Sep. Sand. Typically on limestone breakaways.	Unlikely due to absence of preferred habitat.	Unlikely.
Allocasuarina grevilleoides CASUARINACEAE	Not listed	P3	Dioecious, lignotuberous shrub, 0.15-0.4 m high. Sand over laterite, gravel.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Andersonia gracilis ERICACEAE	Endangered	Threatened	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple, Sep to Nov. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Recorded in Project area.	Recorded in Project area.
Angianthus micropodioides ASTERACEAE	Not listed	P3	Erect or decumbent annual, herb, 0.03-0.15 m high. Fl. yellow-white, Nov to Dec or Jan to Feb. Saline sandy soils. River edges, saline depressions, claypans.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Anigozanthos humilis subsp. Badgingarra (S.D. Hopper 7114) HAEMODORACEAE	Not listed	P2	Erect, hirsute rhizomatous, herb, to 0.9 m high. Grey-white sand, rich brown sandy loam, sandy clay, alluvial soils. Low plains, river-banks, winter-wet swamps.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Anigozanthos humilis subsp. *chrysanthus* HAEMODORACEAE	Not listed	P4	Rhizomatous, perennial, herb, 0.2-0.4(-0.8) m high. Fl. yellow, Jul to Oct. Grey or yellow sand. Leaves flat, 50-170 mm long, 3-10 mm wide; bristles or hairs on the leaf margin present. Flowers in July, August, September or October.	Recorded in Project area.	Recorded in Project area.
Anigozanthos viridis subsp. *terraspectans* HAEMODORACEAE	Vulnerable	Threatened	Rhizomatous, perennial, herb, 0.05-0.2 m high. Fl. green/yellow-green, Aug to Sep. Grey sand, clay loam. Winter-wet depressions.	Recorded in Project area.	Recorded in Project area.
Arnocrinum gracillimum HEMEROCALLIDACEAE	Not listed	P3	Rhizomatous, perennial, herb, 0.2-0.4 m high. Fl. purple, Oct to Nov. White, grey, yellow or lateritic sand.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Babingtonia delicata MYRTACEAE	Not listed	P1	Shrub 0.3–0.85 m high, with erect slender stems and antrorse to widely spreading leaves that are sometimes densely clustered. The habitat is of sandy soils close to wetlands, described as seasonally wet and low-lying. Flowers recorded in November.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Babingtonia urbana MYRTACEAE	Not listed	P3	Shrub 0.4–0.7 m high, with erect slender stems and antrorse to widely spreading leaves. Associated with wetlands.	Recorded in Project area.	Recorded in Project area.
Banksia dallanneyi subsp. *pollosta* PROTEACEAE	Not listed	P3	Prostrate, lignotuberous shrub. Fl. yellow-brown, Aug to Sep. Grey/yellow sand. Flats, lateritic rises.	Recorded in Project area.	Recorded in Project area.

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Beaufortia bicolor MYRTACEAE	Not listed	P3	Dense shrub, 0.3-1 m high. Fl. red & yellow & orange, Nov to Dec. White sand over laterite. Sandplains.	Unlikely due to absence of preferred habitat.	Unlikely.
Beaufortia eriocephala MYRTACEAE	Not listed	P3	Erect, compact shrub, 0.3-0.6 m high. Fl. red, Sep to Nov. Lateritic sandy soils. Slopes.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Beyeria cinerea subsp. *cinerea* EUPHORBIACEAE	Not listed	P3	Flowers have been collected in July and from September to November, fruits from September to November. Occurs in coastal heath and shrubland communities on sandy soils over limestone.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Beyeria gardneri EUPHORBIACEAE	Not listed	P3	Shrub, 0.25-0.5 m high. Fl. yellow, Aug to Sep. Yellow sand.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Boronia tenuis RUTACEAE	Not listed	P4	Procumbent or erect & slender shrub, 0.1-0.5 m high. Fl. blue/pink-white, Aug to Nov. Laterite, stony soils, granite.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Byblis gigantea BYBLIDACEAE	Not listed	P3	Small, branched perennial, herb (or sub-shrub), to 0.45 m high. Fl. pink-purple/white, Sep to Dec or Jan. Sandy-peat swamps. Seasonally wet areas.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Caladenia denticulata subsp. *albicans* ORCHIDACEAE	Not listed	P1	Flowers August–early September. Occurs in moist, calcareous sand under Eucalyptus camaldulensis and Acacia species. Associated orchids include *Caladenia longicauda* subsp. *borealis*, *C. hirta* subsp. *rosea*, *C. latifolia* and *Prasophyllum calcicola*.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Calectasia palustris DASYPOGONACEAE	Not listed	P2	Stilt-rooted herb (undershrub), stems to 0.7 m high. Fl. blue, Jul to Oct. White or grey sand. Seasonally inundated swamplands.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Chordifex chaunocoleus RESTIONACEAE	Not listed	P4	Rhizomatous, erect perennial, herb, 0.15-0.5 m high. Fl. brown, Sep. Grey, siliceous or peaty sand, well to poorly drained. Drainage lines, depressions.	Recorded in Project area.	Recorded in Project area.
Chordifex reseminans RESTIONACEAE	Not listed	P2	Rhizomatous, erect, tufted, dioecious herb, 0.6-0.9 m high. Fl. Mar to May. Dry sand. Heath.	Recorded in Project area.	Recorded in Project area.
Comesperma rhadinocarpum POLYGALACEAE	Not listed	P3	Perennial, herb. Fl. blue, Oct to Nov. Sandy soils.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Conospermum scaposum PROTEACEAE	Not listed	P3	Erect shrub, 0.2-0.45(-0.75) m high. Fl. blue, Oct to Dec or Jan to Feb. White-grey sand, sandy clay. Low swampy areas, road verges.	Recorded in Project area.	Recorded in Project area.

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Conostephium magnum ERICACEAE	Not listed	P4	Erect, compact, many-stemmed shrub, to 2 m high. Fl. pink-purple, Jul to Sep. White-grey sands sometimes associated with laterite gravels. Sand dunes, swampland, disturbed roadside, drainage channels, open woodland.	Recorded in Project area.	Recorded in Project area.
Desmocladus biformis RESTIONACEAE	Not listed	P3	Rhizomatous, densely tufted perennial, herb (sedge-like), 0.1-0.2 m high. Fl. Sep to Oct. Sand, sandy clay, lateritic soils. Dry sites.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Desmocladus elongatus RESTIONACEAE	Not listed	P4	Rhizomatous, perennial, herb (sedge-like), 0.25-0.5 m high. Fl. Aug to Dec. White or grey sand. Dry kwongan.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Desmocladus nodatus RESTIONACEAE	Not listed	P3	Rhizomatous, dioecious. Male and female inflorescences similar. Fruit indehiscent (nut).	Recorded in Project area.	Recorded in Project area.
Drosera leioblastus DROSERACEAE	Not listed	P1	Fibrous-rooted perennial, herb, to 0.02 m high, to 0.015 m wide. Fl. white, Sep to Dec. White sandy soils.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Drosera leucostigma DROSERACEAE	Not listed	P1	Fibrous-rooted, rosetted perennial, herb, to 0.05 m high. Fl. white, Nov to Dec or Jan. Sandy soils. Margins of wet depressions.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Drosera prophylla DROSERACEAE	Not listed	P3	Perennial herb growing between 0.1-0.3 m high. Flowers are white in Jun to Jul. Laterite-silica sand soils.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Eremophila glabra subsp. *chlorella* SCROPHULARIACEAE	Endangered	Threatened	Prostrate & spreading or sprawling shrub, 0.2-1 m high. Fl. green-yellow, Jul to Nov. Sandy clay. Winter-wet depressions.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459) APIACEAE	Not listed	P3	No description available.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Eucalyptus abdita MYRTACEAE	Not listed	P2	(Mallee) or shrub, 2-3 m high, bark smooth, grey. Laterite, sandy clay with gravel over laterite. Slopes, breakaways.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Eucalyptus macrocarpa subsp. *elachantha* MYRTACEAE	Not listed	P4	(Spreading or sprawling mallee), 0.8-4 m high, bark smooth, grey over salmon pink. Fl. red-pink, Aug to Sep or Nov to Dec. White or grey sand over laterite. Hillslopes, ridges, sandplains.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Eucalyptus pendens MYRTACEAE	Not listed	P4	(Slender, pendulous mallee), 2-5 m high, bark smooth. Fl. white, Aug to Nov. White or grey sand with lateritic gravel. Hillsides, breakaways, sandplains.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Grevillea saccata PROTEACEAE	Not listed	P4	Diffuse scrambling or trailing shrub, 0.25-0.5 m high, 1-2 m wide. Fl. red, Apr or Jun to Nov. Yellow or brown sand, often with lateritic gravel.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Grevillea sp. Cooljarloo (B.J. Keighery 28 B) PROTEACEAE	Not listed	P1	Spreading lignotuberous shrub to 1.5 m on winter-wet sandy soils.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Grevillea synapheae subsp. *minyulo* PROTEACEAE	Not listed	P1	Spreading to sprawling, lignotuberous shrub, 0.2-0.5 m high. Fl. white-cream-yellow, Aug to Sep. Gravel, laterite.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Grevillea thelemanniana PROTEACEAE	Critically Endangered	Threatened	Spreading, lignotuberous shrub, 0.3-1.5 m high. Fl. pink-red, May to Nov. Sand, sandy clay. Winter-wet low-lying flats.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Grevillea thyrsoides subsp. *thyrsoides* PROTEACEAE	Not listed	P3	Spreading or procumbent shrub, 0.3-0.7 m high, up to 1.5 m wide. Fl. red-pink, Feb or Aug to Sep. Sand or sandy lateritic gravel.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Guichenotia alba MALVACEAE	Not listed	P3	Slender, lax, few-branched shrub, 0.1-0.45 m high. Fl. white, Jul to Aug. Sandy & gravelly soils. Low-lying flats, depressions.	Recorded in Project area.	Recorded in Project area.
Hakea longiflora PROTEACEAE	Not listed	P3	Erect, pungent shrub, 0.6-0.75 m high. Fl. yellow, Jun to Sep. White sand, loam, gravel, laterite. Breakaways.	Recorded in Project area.	Recorded in Project area.
Hensmania stoniella HEMEROCALLIDACEAE	Not listed	P3	Tufted, stilt-rooted perennial, herb, 0.1-0.2 m high. Fl. yellow-cream-white, Sep to Nov. White, grey or lateritic sand, often winter-wet.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Hibbertia helianthemoides DILLENIACEAE	Not listed	P4	Spreading to erect, low or prostrate shrub, to 0.3 m high. Fl. yellow, Jul or Sep to Oct. Clayey sand over sandstone or loam over quartzite. Hills and scree slopes.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Hibbertia leptotheca DILLENIACEAE	Not listed	P3	Low-growing, erect to spreading shrub to 50 cm high with distinctive glossy foliage. Leaves linear, 0.8–30 mm long with margins inrolled with undersurface densely and finely hairy. Flowers on short stalks, somewhat pendulous Flowers July-October. Occurs on coastal limestone and secondary dunes.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Hopkinsia anoectocolea ANARTHRIACEAE	Not listed	P3	Rhizomatous, tufted perennial, herb, 0.5-1 m high, to 1 m in diameter. Fl. brown, Sep to Dec. White or grey sand, often saline. Winter-wet depressions, floodplains, salt lakes.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Hypocalymma serrulatum MYRTACEAE	Not listed	P2	Erect shrub, 0.45-1.7 m high. Fl. white-pink, Apr to May. Grey or white sand. Along drainage lines.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Hypocalymma tetrapterum MYRTACEAE	Not listed	P3	Shrub, 0.4-0.9 m high. Fl. white, Aug. Grey sand, loam, lateritic gravel. Riverbanks, breakaways.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Hypolaena robusta RESTIONACEAE	Not listed	P4	Dioecious rhizomatous, perennial, herb, ca 0.5 m high. Fl. Sep to Oct. White sand. Sandplains.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Isopogon drummondii Jacques PROTEACEAE	Not listed	P3	Shrubs, 0.5-1 m high; branchlets hairy, with curled hairs. Leaves alternate, 15-35 mm long, 1.5-2 mm wide, glabrous. Flowers in February, March, April, May or June.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Isopogon panduratus subsp. palustris PROTEACEAE	Not listed	P3	Shrubs; branchlets glabrous. Leaves alternate, 45-90 mm mm long, 7-10 mm mm wide, glabrous; lamina flat, clearly widest above the middle, entire, apex acute. Inflorescences pink. Flowers in January, August, September, October or November.	Recorded in Project area.	Recorded in Project area.
Isotropis cuneifolia subsp. *glabra* FABACEAE	Not listed	P2	Prostrate to ascending, spreading perennial, herb or shrub, 0.05-0.15 m high. Fl. yellow/orange & red, Sep. Sand, clay loam. Winter-wet flats.	Recorded in Project area.	Recorded in Project area.
Jacksonia anthoclada FABACEAE	Not listed	P3	Erect shrub, 1.5-2.5 m high. Fl. yellow & red, Apr. White or grey sand. Sandplains.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Jacksonia carduacea FABACEAE	Not listed	P3	Bushy shrub, 0.2-0.5 m high. Fl. yellow & red, Aug to Dec. Grey sand, sandy clay.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Lepidobolus quadratus RESTIONACEAE	Not listed	P3	Rhizomatous, caespitose perennial, herb (sedge-like), 0.15-0.3 m high. Fl. brown/red, Aug to Sep. Lateritic gravel, grey/white sand. Dry kwongan.	Possible.	Unlikely. Not recorded during targeted survey.
Lepyrodia curvescens RESTIONACEAE	Not listed	P2	Dioecious, shortly creeping, tufted rhizomatous, herb, 0.24-0.4 m high, rhizomes on surface or to 1 cm deep. Fl. Sep to Nov. Sand, laterite. Seasonally inundated swampland.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Leucopogon foliosus ERICACEAE	Not listed	P3	Low, spreading shrubs to c. 40 cm high and 40 cm wide, usually single-stemmed at ground level from an apparently fire-sensitive rootstock but occasionally multi-stemmed and potentially with some fire tolerance. Usually occurs on lateritic uplands in shallow gravelly soils over laterite and in association with low, species-rich heath.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Leucopogon sp. Badgingarra (R. Davis 421) ERICACEAE	Not listed	P2	Open, erect shrub, 0.7-1 m high. Fl. white, Dec. Grey sand, dry white sand. Hills, plains.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Leucopogon sp. Yanchep (M. Hislop 1986) ERICACEAE	Not listed	P3	Erect shrub, 0.15-1 m high, to 0.6 m wide. Fl. white/pink, Apr to Jun or Sep. Light grey-yellow sand, brown loam, limestone, laterite, granite. Coastal plain, breakaways, valley slopes, low hills.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Lyginia excelsa ANARTHRIACEAE	Not listed	P1	Dioecious rhizomatous, erect, tufted herb, 0.6-1.5 m high, rhizomes on surface. Fl. Mar to Nov. Sand. Dry heath & Banksia woodland.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Macarthuria keigheryi MACARTHURIACEAE	Endangered	Threatened	Erect or spreading perennial, herb or shrub, 0.2-0.4 m high, 0.3-0.6 m wide. Fl. Sep to Dec or Feb to Mar. White or grey sand.	Recorded in Project area.	Recorded in Project area.
Meionectes tenuifolia HALORAGACEAE	Not listed	P3	No description available.	Possible.	Unlikely. Not recorded during targeted survey.
Myriophyllum muelleri HALORAGACEAE	Not listed	P1	Slender, aquatic annual, herb, stems to 0.6 m long. Fl. red. Lagoons.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Paracaleana dixonii ORCHIDACEAE	Endangered	Threatened	Tuberous, perennial, herb, 0.09-0.2 m high. Fl. yellow-brown, Oct to Dec or Jan. Grey sand over granite.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Persoonia filiformis PROTEACEAE	Not listed	P3	Erect, spreading, lignotuberous shrub, 0.07-0.4 m high. Fl. yellow, Nov to Dec. Yellow or white sand over laterite.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Persoonia rudis PROTEACEAE	Not listed	P3	Erect, often spreading shrub, 0.2-1 m high. Fl. yellow, Sep to Dec or Jan. White, grey or yellow sand, often over laterite. Shrubs, 0.5-1 m high. Flowers in January, September, October, November or December.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Phlebocarya pilosissima subsp. *pilosissima* HAEMODORACEAE	Not listed	P3	Shortly rhizomatous, compactly tufted perennial, grass-like or herb, 0.15-0.4 m high. Fl. cream-white, Aug to Oct. White or grey sand, lateritic gravel.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Platysace ramosissima APIACEAE	Not listed	P3	Perennial, herb, to 0.3 m high. Fl. white-cream, Oct to Nov. Sandy soils.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Ptychosema pusillum FABACEAE	Vulnerable	Threatened	Perennial, herb, mostly 0.05-0.1 m high. Fl. red & brown & yellow, Aug to Oct. Sand. Rises.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Schoenus badius CYPERACEAE	Not listed	P2	Slender annual, grass-like or herb (sedge), 0.05-0.12 m high. Fl. brown-green, Sep to Oct. Grey sand. Moist areas.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Schoenus griffinianus CYPERACEAE	Not listed	P4	Small, tufted perennial, grass-like or herb (sedge), to 0.1 m high. Fl. Sep to Oct. White sand.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Schoenus natans CYPERACEAE	Not listed	P4	Aquatic annual, grass-like or herb (sedge), 0.3 m high. Fl. brown, Oct. Winter-wet depressions.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Schoenus pennisetis CYPERACEAE	Not listed	P3	Tufted annual, grass-like or herb (sedge), 0.05-0.15 m high. Fl. purple-black, Aug to Sep. Grey or peaty sand, sandy clay. Swamps, winter-wet depressions.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Stenanthemum sublineare RHAMNACEAE	Not listed	P2	Erect shrub, to 0.1 m high. Fl. green, Oct to Dec. Littered white sand. Coastal plain.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Stylidium aceratum STYLIDACEAE	Not listed	P3	Fibrous rooted annual, herb, 0.05-0.09 m high, leaves spathulate. Fl. pink/white, Oct to Nov. Sandy soils. Swamp heathland.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Stylidium aeonioides STYLIDACEAE	Not listed	P4	Rosetted perennial, herb, 0.05-0.4 m high, Leaves adpressed to soil, oblanceolate, 0.7-3 cm long, 1.5-5 mm wide, apex subacute, margin hyaline, glabrous. Scape glabrous. Inflorescence paniculate. Fl. cream-yellow, Sep to Nov. Sandy clay loam over laterite. Hillsides and breakaways. Low heath, open woodland.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Stylidium hymenocraspedum STYLIDACEAE	Not listed	P3	Rosetted perennial, herb, 0.27-0.7 m high, Leaves adpressed to soil, spathulate, 1.5-7 cm long, 6-13 mm wide, apex subacute, margin hyaline, glabrous. Scape mostly glabrous, sparingly glandular near bract and pedicel axils. Inflorescence racemose. Fl. yellow, Sep to Oct. Sand over laterite. Hillslopes. Heath, Banksia and Eucalyptus low open woodland.	Recorded in Project area.	Recorded in Project area.
Stylidium longitubum STYLIDACEAE	Not listed	P4	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Stylidium maritimum STYLIDACEAE	Not listed	P3	Caespitose perennial, herb, 0.3-0.7 m high, Leaves tufted, linear to narrowly oblanceolate, 10-40 cm long, 1-5.5 mm wide, apex acute to mucronate, margin involute, glabrous. Membraneous scale leaves present at base of mature leaves. Scape glandular throughout. Inflorescence paniculate. Fl. white/purple, Sep to Nov. Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Stylidium tinkeri STYLIDACEAE	Not listed	P1	Erect annual, herb, 0.03-0.07 m high. Fl. white & pink, Oct. Grey sandy soil. Seasonal wetlands.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur within the Project area (pre-field survey)	Potential to occur within proposed clearing area (post-field survey)
	EPBC Act	BC Act			
Stylidium torticarpum STYLIDACEAE	Not listed	P3	Caespitose perennial, herb, 0.12-0.27 m high, Leaves tufted, broadly linear, (2-) 5-13 cm long, 0.6-1.5 mm wide, apex mucronate, margin hyaline and serrulate, glabrous. Scape glandular throughout. Inflorescence paniculate. Capsule twisted. Fl. pink, Sep to Nov. Sandy clay and clay loam over laterite. Adjacent to creeklines, depressions, and beneath breakaways. Heath or mallee shrubland.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Tetratheca angulata TREMANDRACEAE	Not listed	P3	Lax to erect, slender shrub (subshrub), 0.2-0.3 m high. Sandy to gravelly laterite soils. Low hill crests, breakaways with massive laterite boulders.	Unlikely due to absence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Thelymitra apiculata ORCHIDACEAE	Not listed	P4	Tuberous, perennial, herb, 0.2-0.35 m high. Fl. purple & yellow, May to Jul. Grey sand, lateritic gravel.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Thelymitra pulcherrima ORCHIDACEAE	Not listed	P2	Tuberous, perennial, herb, to 0.15 m high. Gravel.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Thelymitra stellata ORCHIDACEAE	Endangered	Threatened	Tuberous, perennial, herb, 0.15-0.25 m high. Fl. yellow & brown, Oct to Nov. Sand, gravel, lateritic loam.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Thysanotus glaucus ORCHIDACEAE	Not listed	P4	Caespitose, glaucous perennial, herb, 0.1-0.2 m high. Fl. purple, Oct to Dec or Jan to Mar. White, grey or yellow sand, sandy gravel.	Possible, previously recorded in Project area.	Unlikely. Not recorded during targeted survey.
Verticordia amphigia MYRTACEAE	Not listed	P3	Shrub, 0.6-1.3 m high. Fl. yellow, Oct to Nov. Sandy loam, clay & rocky loam. Winter-wet depressions.	Possible due to presence of preferred habitat.	Unlikely. Not recorded during targeted survey.
Verticordia huegelii var. *tridens* MYRTACEAE	Not listed	P3	Shrub, 0.15-0.6 m high. Fl. green-yellow/red, Sep to Nov. Sandy or gravelly loam. Winter-wet areas, low hills.	Recorded in Project area.	Recorded in Project area.
Verticordia lindleyi subsp. *lindleyi* MYRTACEAE	Not listed	P4	Erect shrub, 0.2-0.75 m high. Fl. pink, May or Nov to Dec or Jan. Sand, sandy clay. Winter-wet depressions.	Recorded in Project area.	Recorded in Project area.

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